Contractual approach to optimising risk sharing: A quantitative study of the multidimensional nature of risk in private provision of road infrastructure.

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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-13-08
TITLE:	**Contractual approach to optimising risk sharing: A quantitative study of the multidimensional nature of risk in private provision of road infrastructure.**

ABSTRACT: In 2009 and 2010, we conducted an international survey to identify the extent to which risk-sharing in tollroad projects procured under the public-private-partnership (PPP) method and the structures of PPP concession contracts lead to the value for money outcome.

The survey was conducted using an advanced computer-aided personal instrument technique within which the stated choice methodology was deployed to capture the risk perceptions of contracting parties. Information drawn from the project experience of 101 respondents over 32 countries was used to test the impact of contractual conditions and external institutional variables on their risk preferences, and hence, their choice behaviour in relation to the PPP procurement.

The empirical findings affirmed a number of significant relationships that involve the risk preferences of contracting parties: choice of procurement method, contractual conditions, institutional environment, clarity of government's strategic objectives, property rights, and the way in which risks are shared among contracting parties. We conclude that risk-sharing can be optimised through more equitable risk allocation, better handling of public misperception about the scheme and misperceived social risks associated with ownership transfer, undertaking reforms at the institutional level to make the environment more conducive to PPP investments, and selecting a reputable private partner for a sustainable partnership.

KEY WORDS: *Public private partnerships, risk preference, risk sharing, toll road, incomplete contract theory, transaction cost economics.*

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DATE: April 2013

1.   Introduction

Public-Private-Partnerships (PPPs)[1] are a public procurement policy that argues in support of greater value for money through optimal risk-sharing, by aligning incentives among parties who are profoundly different in terms of interests, objectives and risk preferences.

The PPP concept differs from other forms of private provision of assets, such as contracting out and privatisation, in relation to the dimensions of risks and rewards sharing and greater private involvement in the finance arrangements (Hodge, 2005). The relationships within a PPP are established by a concession contract that enables a commercial organisation to design, build, finance and operate an asset for an agreed period, hence they are known as DBFOs[2,3]. The principal rationale for PPPs is that they facilitate the transfer of risk to the party that has the greatest capacity to manage that risk (Partnerships Victoria, 2000; HM Treasury, 2006; NSW Treasury, 2012).

The subject of interest in this study is PPP tollroads, which traditionally involve the transfer of demand risk to the private sector. The focus is on the structure of PPP road concession contracts, which defines the risk allocation strategy, impacting on contracting parties' risk preferences.

> *Research Question 1 (RQ1):*
> *What are the risk preferences of stakeholders engaging in PPP tollroad projects?*

The second area of investigation is to examine how the defined risk preferences would influence stakeholders' choice of contract between PPPs and other alternatives.

> *Research Question 2 (RQ2):*
> *To what extent do stakeholders' risk preferences influence their choice of procurement method?*

In recognising the limitations of contract incompleteness (Grossman and Hart, 1986), we are further motivated to investigate determinants of risk preferences and contract choice, at the contract level and beyond the contract level.

> *Research Question 3 (RQ3):*
> *How are risk preferences and choice of procurement method affected by factors at contract, policy and institutional levels?*

The first question will be explored using discrete choice models to analyse data collected by a computer-aided-personal-instrument (CAPI) survey. The survey includes a stated-choice (SC) experiment that gathers data on international stakeholders' perceptions of risk associated with alternative packages of attributes that define the dimensions of PPP risk, and questions to elicit revealed preference (RP) data on the stakeholders' experience of risk allocation in past tollroad concessions. The candidate attributes revealed in the in-depth interview study (Chung *et al*., 2010) are used in the choice experiment. With the derived risk indices that measure stakeholders' risk preferences, we estimate a number of ordered logit models to investigate RQ2. We call on different theoretical constructs in the contracting paradigm, namely incomplete contract theory (ICT) and transaction cost economics (TCE) to examine RQ3 and suggest ways to better risk-sharing outcomes.

This study contributes to the literature in several ways. The first contribution is the quantification of stakeholders' risk preferences through the calculus of a PPP risk index (PPPRI). Many empirical studies of contracting assume that the risk preferences of the contracting parties are given (e.g., Allen and Lueck,

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[1] PPPs are also termed Privately Financed Projects (PFPs) in the NSW Government procurement policy (NSW Treasury, 2006). The early generation of the British equivalent is the Private Finance Initiative (PFI). In this study, the terms PPPs and PFPs are interchangeable, while PFIs refer specifically to projects undertaken in the UK.

[2] The use of terminology varies between countries. In the UK, a DBFO project in transport involves the transfer of ownership at the end of the concession period (Glaister *et al.*, 2000), while the similar arrangement in Australia is termed BOOT (Debande, 2002 p. 380).

[3] There are many different types of PPPs, see for example Broadbent and Laughlin (1999) for a review of different organisational structures of PPPs. This study only examined the DBFO type.

1999; Martimort and Pouyet, 2008; Chen and Chiu, 2010), or use self-reported measures (e.g., Gaynor and Gertler, 1995; Jin and Doloi, 2008), which may lead to conclusions that are potentially biased. This study empirically derives a set of risk indices to measure the risk preferences of key stakeholders who have been actively engaging in PPP tollroads. The derived risk indices have made it possible to draw an objective and unbiased conclusion. Although the indices are derived from data that are primarily concerned with PPP tollroad concessions, the process of derivation can be readily applied to other areas of risk management.

If risk preferences are correspondent to risk premium charge by the market, our evidence on RQ2 sheds light on ways to structure a PPP contract if the principal wishes to drive the premium down.

A further contribution is the examination of the PPP procurement method through the body of work on contracting. Premised on a number of propositions established in the contracting literature, our aim is to evaluate how effectively does the contractual approach of PPPs facilitate the realisation of value for money (VFM). Through the lens of contract, we are able to gain an insight into the extent to which risk allocation that accommodates different preferences for risk can foster interests and goals congruent to the realisation of policy objectives. The analytics from the behavioural data at microscope level support the position that PPPs can deliver VFM. Using data simulation that creates various combinations of risk allocation to vary the levels of the derived risk index of PPPs, we suggest possible ways to improve risk-sharing outcomes.

In the next section, we introduce the method of deriving the risk index to guide the collection of behaviour data. Section 3 develops a research framework through the lens of contract, and proposes a number of testing propositions. In Section 4, we set out the data collection method and provide a descriptive overview of the data from the choice experiment and other questions in the overall CAPI survey. The descriptive analysis focuses on the contrast between the perceptions of risk of public sector respondents versus private sector respondents. The analysis reveals that the underlying motivation of the PPP procurement policy is, as argued by pundits, essentially to establish a financing mechanism for government road authorities around the world to fulfil their obligations of providing their constituents with public road space. This observation holds true at the country level as well as at the global level. Section 5 reports the results of hypothesis testing. Section 6 reflects on the limitations of the contracting paradigm in analysing risk-sharing behaviour in PPPs, and presents a discussion of the contributions, policy implications and limitations of the present research.

2. Quantitative instrument to measure risk preferences

We draw on the Hensher Service Quality Index (HSQI) empirical framework (Hensher and Prioni, 2002; Hensher *et al.*, 2003) as a way to establish a set of risk indices relevant to PPP roads as measures of contracting parties' risk preferences. The HSQI represents a set of quantitative performance indicators used 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 in order to identify the strength of positive and negative sources of overall satisfaction.

To fulfil this objective, stated-choice (SC) methods were used in the original study (Hensher and Prioni, 2002), whereby a sample group of passengers was asked to choose their most preferred package from a number of alternative packages of service levels based on their attributes. 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, as reference levels must be identified in order to apply the weights, revealed preference (RP) data of the perceptions of passengers relative to the levels of each attribute as experienced in a current trip were obtained and then multiplied by the relevant weight. Summing these calculations across all attributes produced the service quality index for each sampled passenger.

To implement the HSQI framework, we designed a series of SC experiments to obtain behaviour data on respondents' perception of risk associated with alternative packages of attributes that define the dimensions of PPP risk, in order to define a set of quantitative risk attributes pertinent to PPP roads.

We follow the existing literature (Monteiro, 2010, p. 263) to define risk as:

> *An event that may or may not occur and can lead to failure to satisfy project requirements ... and is being considered as having an upside and a downside: a party facing risk suffers from negative events, but may also benefit from positive events. In this way, the party will have higher incentives for putting effort into preventing negative outcomes.*

Risk comprises the expected value of a trade-off outcome associated with downside risk (the likelihood of an outcome reaching a disaster level), upside gain (the likelihood of an outcome reaching an optimistic level), and risk neutrality (the likelihood of an outcome reaching the expected level) (Lafontaine and Bhattacharyya, 1995). In the seminal paper by March and Shapira (1987), risk preference is subject to a decision-maker's ability to control the odds, is conditional upon their experience in the underlying investment, their knowledge and skills in pooling resources to mitigate downside outcomes and in trading off one risk with another, and their informational advantage. The considerations of trade-off are framed by attention factors that considerably affect action. Risk-averse individuals tend to pay greater attention to the dangers of downside risk, hence displaying a propensity for risk-avoidance; risk-seeking individuals have a predilection for opportunities for upside gain and thus exhibit risk-prone behaviour; and risk-neutral individuals favour certainty over variability, with a strong reaction to risk neutrality.

In the experiment design, we adopted the nine key risk attributes pertaining to PPP roads 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. Each risk is further divided into three attribute levels: downside risk, risk neutrality and upside gain. The definition of each risk attribute is provided in Appendix A.

Construction of the empirical risk index entails using parameter estimates obtained from a choice model, using data gathered from the SC experiment to condition the role of reference levels representing the attribute risk levels perceived by stakeholder experience in real PPP settings. We used the latent class model (LCM) to obtain estimates of the parameters. The LCM is preferred over the standard multinomial logit model because of the increased behavioural richness of the model in accommodating heterogeneity of stakeholder preferences for specific levels of risk (given the likely outcome associated with the full attribute package). LCM models also avoid the controversial implications of arbitrarily selecting specific continuous distribution for each parameter that is required in mixed (or random parameter) logit models, and they are also starting to accumulate evidence of improved goodness-of-fit over all alternative discrete choice model forms (Greene and Hensher, 2003). The risk index of interest is given in Equation (1).

$$PPPRI_n = \sum_{k=1}^{K} \beta_{njk} \cdot x_{njk} \tag{1}$$

(PPPRI=risk index; n=decision maker, j=investment alternative, k=attribute weight)

Given the reported reference levels from respondents' prior experience in terms of risk borne in PPP road projects, i.e., x_k in Equation (1), we multiply the x_k by the betas (parameter estimates) and sum them across all risk attributes to produce the risk index as the measure of each respondent's risk preference. A respondent is risk-averse if the outcome of Equation (1) is negative; a respondent is risk-seeking if the outcome is positive; and a respondent is risk-neutral if the outcome is zero.

3. Research framework

We use the contracting perspective to investigate RQ3. In the contracting literature, two approaches have come to dominate the analysis of contracts: incomplete contract theory (ICT) and transaction cost economics (TCE). They are distinguished by differences in their underlying assumptions, in their emphasis on different motives to contract, and different functions of contract. We develop a number of hypotheses under the premises of ICT and TCE to understand the power of contract and factors beyond the contract level in determining the degree of risk preferences and stakeholders' contract choice.

3.1 Incomplete contract theory

ICT points out that in anticipation of large transaction costs involved in writing a comprehensive contract and the rigidity of court enforcement of written contract terms, parties to a relationship will prefer to settle for a contract that is incomplete (Klein, 1996). Under the conditions of low describability of transactions *ex ante* and uncertainty due to the absence of complete information on future states, the theory focuses on incentive designs that induce *ex ante* investments. Property rights are at the centre of the analysis – they empower the owner with a bundle of *ex post* decision rights: (a) ability to act on uncontracted-for provisions and therefore have greater incentive to invest *ex ante* (Grossman and Hart, 1986); (b) protection against *ex post* expropriation on investments (Laffont and Tirole, 1991); and (c) residual rights to insider information (Schmidt, 1996).[4] The behavioural assumptions regard contracting parties as rational without constraint, whereas the rationality of an outside arbiter (the judge) is irremediably bounded – a premise that necessitates the relevance of *ex ante* asset ownership (Hart, 1990). Credible commitments, reputation and trustworthiness of contracting parties play little role in ICT because of the judicial imperfection that believes that contract variables are observable but not verifiable (Hart, 2002).

The enhanced incentive that comes with the property rights suggests that the structure of a PPP contract, which bundles asset construction and service provision under one ownership, strengthens incentives for risk-taking. The literature has demonstrated that in projects where the risk of unclear project objectives prevailed, ownership shielded the contractor from this risk, as it resulted from poorly defined objectives by the responsible government authority (Dewatripont and Legros, 2005).

On the basis of this literature, we predict that private sector agents are risk-averse[5] to unclear project objectives (H1a). Because ownership empowers the agent with the freedom of adopting measures to manage uncontracted-for events, we argue that the PPP contract with the embedded ownership entitlement would be preferred by the agent over other alternatives (H1b). From the principal's standpoint, the enhanced value of clearly defined project objectives, as highlighted in Bajari and Tadelis (2001), reinforces the benefit of cost savings to the public sector procurer carried through from the *ex ante* competitive tendering, which leads us to predict that public sector authorities are averse to unclear project objectives (H1c).

> H1a   *Unclear project objectives will increase private sector agents' risk aversion.*
>
> H1b   *The higher the risk of unclear project objectives, the more preferred is the PPP method by private sector agents.*
>
> H1c   *Unclear project objectives will increase public sector authorities' risk aversion.*

Property rights are supposed to entitle the proprietor to the freedom of making decisions on how much they charge users for using their asset. PPP tollroads, however, often preclude this privilege as toll pricing is politically sensitive, and therefore heavily regulated. ICT would argue that both the agent and the principal should be in favour of the relaxation of this condition, because such freedom would incentivise the agent to exert more performance effort from which the principal would equally benefit.

> H2a: *Private sector agents are in favour of the option of having the freedom to set toll pricing, i.e., the freedom will reduce private sector agents' risk aversion.*
>
> H2b: *Public sector authorities are in favour of the option of granting the private sector agents the freedom to set toll pricing, i.e., the granting of the right will reduce public sector authorities' risk aversion.*

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[4] Laffont and Tirole (1991) magnify the trade-off between efficiency and asset expropriation when the regulated firm has an information advantage. Its extended model (Schmidt, 1996) considers regulation with asymmetric information. Both models are integral to the theory of property rights and incomplete contracts. The analysis on PPPs however, is most extensively based on Laffont and Tirole's proposition, which features symmetric information with contract incompleteness and uncertainty.

[5] Following agency theory (Jensen and Meckling, 1976), we assume agents are risk-averse. We will confirm this after deriving the PPPRI in a later section.

We have argued in Chung *et al.* (2010) that governments were often seen to use private ownership to shield themselves from risks related to politically sensitive matters, such as direct exposure to conflicts arising from the workforce. Theoretically, the concessionaire would be able to exercise full flexibility, as if they were the owner, to deal with labour productivity issues (H3a). The perception however, would have the adverse effect on the principal, as it would mar the public acceptance of any PPP project and the public image of government (H3b).

> H3a: *The public perception that ownership transfer is seen to transfer ownership-related risk arising from workforce dispute will increase the risk aversion of private sector agents.*
>
> H3b: *The public perception that ownership transfer is seen to transfer ownership-related risk arising from workforce dispute will increase the risk aversion of public sector authorities.*

3.2 *Transaction cost economics*

While ICT emphasis is on *ex ante* incentive alignment and distribution of residual surplus through the allocation of decision rights, TCE seeks to craft *ex post* governance structures to align with the differential attributes of transactions (Williamson, 1979). TCE explains why exchange partners value reputational effects, multilateral dependence, mutual credible commitments and self-enforcing agreements.

Three governance structures exist within the TCE regime: the two polar opposites – markets and hierarchies (firms), and an intermediate hybrid mode (contracts). Each is described in terms of different levels of governance attributes, i.e., incentive intensity, administrative control and contract laws regime (Williamson, 2006). The hybrid mode, which includes various forms of long-term contracting of high levels of asset specificity (Williamson, 1985; 1991), fosters autonomous and cooperative adaptations; risk-sharing is a central motivation to organise transactions under this form (Ménard, 2004).

The effectiveness of governance mechanisms largely relies on the institutional environment within which transactions are organised. Williamson proposed the shift parameter framework, where the institutional environment is treated as a set of parameters, "… changes in which elicit shifts in the comparative cost of governance" (1991, p. 287), which may change the optimal governance form for a given set of transactions.

Within the PPP framework there are different procurement methods (Soliño and Gago de Santos, 2010) that are characterised by the surrounding institutional environment. These observations are in line with Williamson's shift parameter framework (Williamson, 1991), which suggest that institutional factors can influence the choice of PPP methods.

> H4: *Institutional factors will significantly influence the choice of procurement methods by all parties, i.e., PPPs versus other methods.*

Due to its long duration, a PPP contract is inevitably confronted by many uncertainties. For example: demand uncertainty, such as the use of the facility by private vehicles, generates financial concern for the private operator; technology uncertainty, which includes tolling technology, generates operational difficulty for the operator and creates network integration problems for the road authority[6]; and uncertainty of the institutional environment will have a fundamental influence on the choice of method of organising transactions for all parties involved (Oxley, 1999).

If we make allowances for variable risk preferences existing in the TCE framework[7] as proposed by Chiles and McMackin (1996), we argue that the greater the uncertainty an economic actor confronts, the more risk-averse they become. Uncertainty can be minimised, and risk aversion can be reduced by transacting in a stable institutional environment and by clearly articulating contractual conditions.

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[6] The integrated electronic tolling for Melbourne CityLink encountered serious technical problems that caused a lengthy delay in its opening.

[7] Williamson maintains the behavioural assumption of risk neutrality to place emphasis on governance structures, which may go unnoticed when the risk preferences of transactors are made the focus of attention (Williamson, 1985, p. 388-390).

H5a: Contractual conditions and institutional variables will significantly affect the risk preferences of contracting parties.

If sovereign risk measures the stability of the transaction environment, it is expected that private sector agents' risk aversion is positively associated with sovereign risk:

H5b: Sovereign risk will significantly increase the risk aversion of private sector agents.

The characteristic of asset specificity associated with PPP transactions, i.e., there is a near nil possibility of relocating a transport infrastructure other than designated in the contract, exposes governments to lock-in and hold-up situations. Lock-ins occur where the obligation of being responsible for significant financial compensation to the concessionaire once the asset is built may deter the public sector procurer from seeking service supply elsewhere (Williamson, 1979, p. 251). Hold-ups occur when unanticipated events place the contractual relationship outside the self-enforcing range (Klein, 1996). In hold-up situations, governments are exposed to deceptive acts by the concessionaire, who may withhold crucial inputs or pose threats to terminate the contract in order to obtain benefits that governments hoped to derive from the investment. Mitigations to problems of this kind include self-enforcing safeguards, such as credible commitment, reputation and trust; these traits have yielded lower transaction costs over an indefinite time horizon compared with repeated short-term legal contracts (Dyer, 1997).

If economising transaction cost over the long-term is an important consideration to market participants, we expect:

H6:   Private sector agents who are actively engaging in PPP contracts value their reputation effect.

In an extended model of TCE, Chiles and McMackin (1996) predict that interdependence exists between the choice of governance structure and risk preferences of transactors with respect to the underlying transaction. Their prediction implies that risk preferences are contextually dependent on the structure of contract. The flow-on implication on a risk-sharing contract is that:

H7:   Risk preferences are significantly affected by how risks are shared.

3.3   Summary

The foregoing discussion on the contracting literature has shown that each of the two strands offers a unique insight into contracting problems, while sharing complementary perspectives. Beyond the common ground on behavioural attributes of economic actors, each strand formulates its theoretical constructs based on its respective unit of analysis. ICT establishes a number of propositions to account for attributes related to incomplete contract; its unit of analysis is contract. TCE introduces asset specificity and extends the factors of investigation to institutional variables; its unit of analysis is transaction. The two strands are interconnected by the added attributes: ICT explores the likelihood of risk-sharing outcomes through the assignment of residual rights; and TCE searches for the optimal governance structure suitable for the dimensions of the underlying transaction. In the survey design, we will formulate a number of questions to seek stakeholders' views on the factors identified in this section; these factors will then be tested against the PPPRI and stakeholders' choice of contract in order to answer RQ3.

4.   Survey design and data description

We designed a computer-assisted personal-instrument (CAPI) survey as the data collection instrument. The CAPI includes a SC experiment with five hypothetical scenarios, and a number of additional screens that seek information on the respondent's experience with PPPs as well as their subjective views on the key drivers of risk. 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; (3) questions related to the attribute processing strategies (APSs) enacted by respondents within each choice situation; (4) RP questions surveying respondents' prior experience to determine the reference level for the derivation of the risk index; (5) attitudinal questions intended to obtain respondents' opinions of the adequacy of risk allocation in PPP tollroad projects and their preference for the PPP procurement method; and (6) questions intended to evaluate the extent to which

other institutional and contractual conditions impact on respondents' decisions to enter into a PPP contract.

In the following sections, we will describe in detail the design as well as analyse the empirical data collected for each part.

Part 1: Socio-demographic covariates of respondents and other contextual effects

The design

This is the first of the six sections of the CAPI survey. We solicited respondents from the mailing list of the Institute of Transport and Logistics Studies at the University of Sydney based on the criteria that they must have had direct input in the decision-making process of entering into a PPP road contract. Additional subjects were recruited through referrals by respondents.

After the pilot study with eight respondents, it was clear that the conciseness of the experiment required a detailed explanation to ensure a consistent understanding of the experiment across all respondents. Therefore, a decision was made to adopt the CAPI approach to complete the collection process. Semi-structured interviews were set up for the subsequent 93 respondents. Interviews lasted on average 100 minutes. Most meetings were face-to-face, some were through Skype, and two were by telephone; all were undertaken by the first author.

At the beginning of the survey, respondents 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 provided in the survey. These 10-15 minute initial conversations benefit the research in a number of ways: (a) they help make sense of the perspectives of the respondents, and the information is then reflected in the first screen of the survey – About You and the Projects You Have Been Involved In (Figure 1); (b) the information unveiled in the conversation determined the role the respondents would play in the experiments; and (c) they provided points for cross-referencing with survey data when information was missing or unclear.

Data descriptions

One hundred and one people participated in the survey, of whom 41 represented the public sector and 60 the private sector. A list of respondents is included in Appendix B. The international significance of this study is enhanced by the coverage and diversity of the experience and knowledge of respondents who took part in the survey. Their experience in PPP years (projects) ranged from 1 to 46 years (1 to 120 projects), and brought to this study project experience in 6 geographic regions covering 32 countries. The diversity of their backgrounds has strengthened the study's global significance: there are 24 different roles represented, from primary decision maker to consultant, from 14 different organisations, including steering committees and commercial banks.

Figure 1: Details of respondents and projects of involvement

The distributions in Figure 2 and Figure 3 show that the participating cohort represents a good spread across roles and organisations.
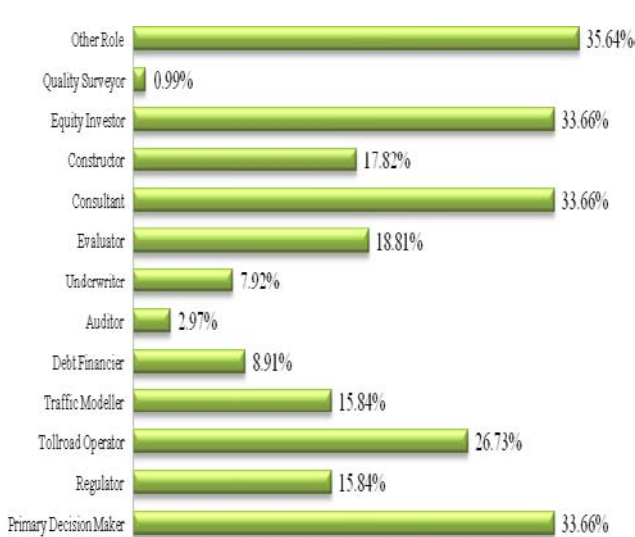
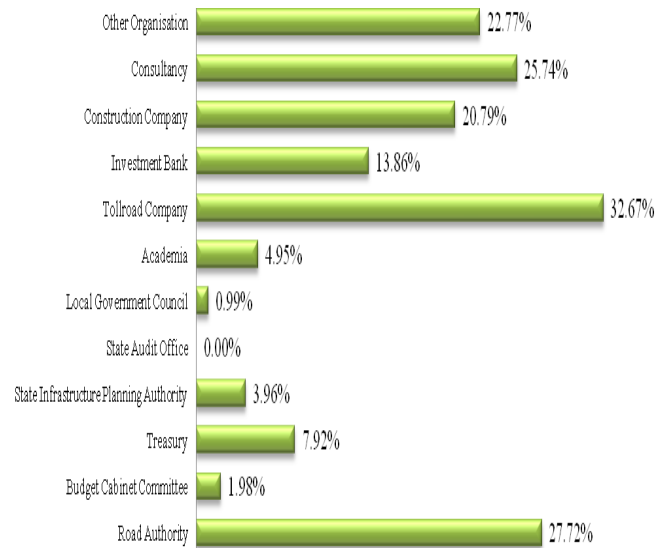

Figure 2: Distribution of roles - 101 respondents

Figure 3: Distribution of organisations - 101 respondents

Public sector respondents

Among the 41 public sector respondents (PUBLIC), 68 per cent worked in public road authorities with a sizeable proportion has a regulator background (39 per cent). Two PUBLIC indicated they were acting as debt financier – public authorities in some countries (like Spain) and some international organisations (like the European Bank and Asian Development Bank) would lend to tollroad companies at a lower-than-market interest rate in order to facilitate project delivery.

Often, governments create steering committees to oversee a major project. These committees appoint auditors and evaluators to assure procurement procedures are adhered to. Before being submitted to the Budget Cabinet Committee (or equivalent) for final approval, such governance assurance requires PPP contracts to be audited by a party that is independent from all contractual parties.

Other roles of PUBLIC include internal financial adviser of a road authority, policy adviser of a government PPPs unit, PPP liaison officer responsible for exchanging knowledge between European countries, commercial lawyers acting on behalf of the public sector procurer, financial adviser to government and technical adviser to government.

Private sector respondents

Among the 60 private sector respondents (PRIVATE), 93 per cent have first-hand knowledge in bidding for PPP tollroads. A large proportion of the construction companies and almost half the investment banks occupy multiple roles (e.g., primary decision maker, equity investor, tollroad company). Investment banks are also active in assuming financial responsibilities – 18 per cent take on the roles of debt financier and underwriter (Figure 4).

Construction companies and investment banks have cumulative expertise in building infrastructure projects, financial power to shoulder the expensive bidding costs, and the financial strength to sustain these mega investments. Most bidding consortia are led by one of these two players (or both).[8]

If successful, they will subsequently incorporate into a tollroad company (the special purpose vehicle or the SPV) to manage the construction, as well as operate and maintain the facility. They will also have a good proportion of equity stake in the project in order to entice financial interest from the market. Most debt financiers, in particular in the aftermath of the global financial crisis (GFC), require the sponsor to bear a considerable share of equity risk.

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[8] Different arms of the same construction group will form different consortium to partner with other interested parties to bid for a project. This strategy will increase the group's chance of winning.
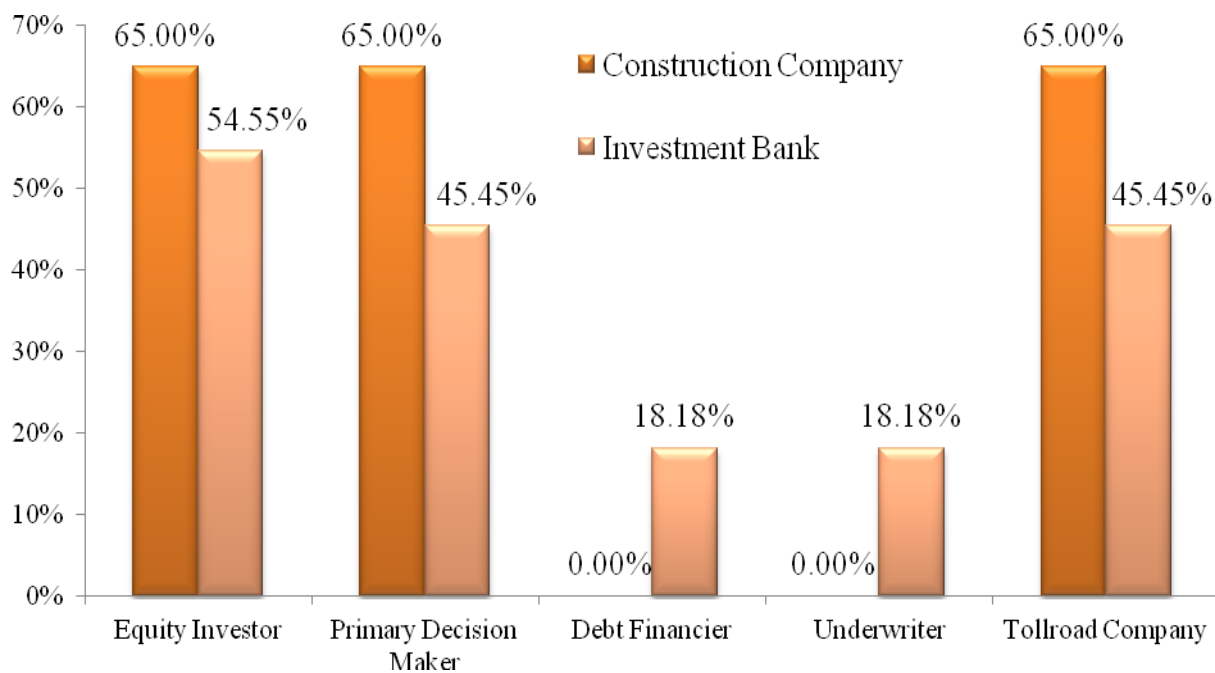
Figure 4: Stake in PPP tollroads - construction company vs. investment bank

In PPP road projects, bidding costs for any private proponent can be well over three per cent of the project's capital value (Dudkin and Välilä, 2005). Theses transaction costs constitute an obvious hurdle for new entrants, with the potential impact of undermining the disciplining power of *ex ante* competition. Evidence from the UK suggests that prohibitive transaction costs do indeed deter competition (NAO, 2007).

A number of respondents complained that high transaction costs result in PPP roads being predominantly the market for construction companies and investment banks[9]:

> R_a: High cost of bidding for PPP projects makes it untenable for new players to enter the market.

Some respondents argued that costs were inflated by governments' procurement processes:

> R_b: Tendering costs are too expensive... financial close documentations are far too rigid.
> R_c: Governments will need to be open to processes that reduce upfront bid costs (and associated agency costs on the bidding consortia) and progress to a negotiated style of outcome as has been seen in the US. This can be done effectively to achieve the same commercial, political and financial outcomes for all parties but will reduce the upfront bidding costs. Reducing the upfront bidding costs will also attract offshore D&C [design and construction] contractors and other investors who see the bid costs as a real barrier to entering the [country's] market.
> R_d: Project implementation must consider streamlining procurement processes to reduce time and cost for all parties.

There are many success stories of PPP tollroads being built and operated by construction company-led consortia. However, Australia has recently seen a number of high profile projects experiencing severe financial difficulties. These failures are considered inevitable by several respondents, for the reason of the short-term approach taken by some of these consortia:

> R_e: PPPs procured with consortia dominated by [construction companies] (most of those procured in the past) can suffer from a short-term perspective.
> R_f: Constructors and short-term financial sponsors have too much influence over long-term contractual matters to the detriment of the project's viability.
> R_g: [The resultant] PPPs create a tension between the need to create a winning bid scenario and the most likely ongoing operating conditions.

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[9] The quotations are provided by respondents in the comment section of the survey.

Other roles and organisations of PRIVATE include financial adviser, legal adviser, general counsel of a tollroad company, bond issuer of an investment bank, investment fund manager (acting mainly as equity sponsor), operations and maintenance contractor, engineering adviser and commercial bank (acting mainly as debt financier).

Some respondents had been independent directors of investment banks, where their role was to exert prudential governance to ensure the bank did not undertake aggressive investment decisions. The effectiveness of this governance measure was weakened at the time when there was an abundant supply of private capital, as noted by one respondent:

R_h: *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.*

Comparison of experience: PUBLIC versus PRIVATE

Compared to PUBLIC, PRIVATE seem to be much more experienced in dealing with PPP projects (Figure 5). On average, project experience in any PPP is 30 per cent (20 vs. 14) higher for PRIVATE, with project experience specific to PPP tollroads double (50 per cent) for PRIVATE (12 vs. 6). However, this should not be interpreted as the private sector being better at the bargaining table, because the difference in number of years of experience is marginal (PRIVATE are only 15 per cent, i.e., 13 vs. 11, more experienced in any type of PPP and 18 per cent, i.e., 11 vs. 9, more experienced in PPP tollroads).
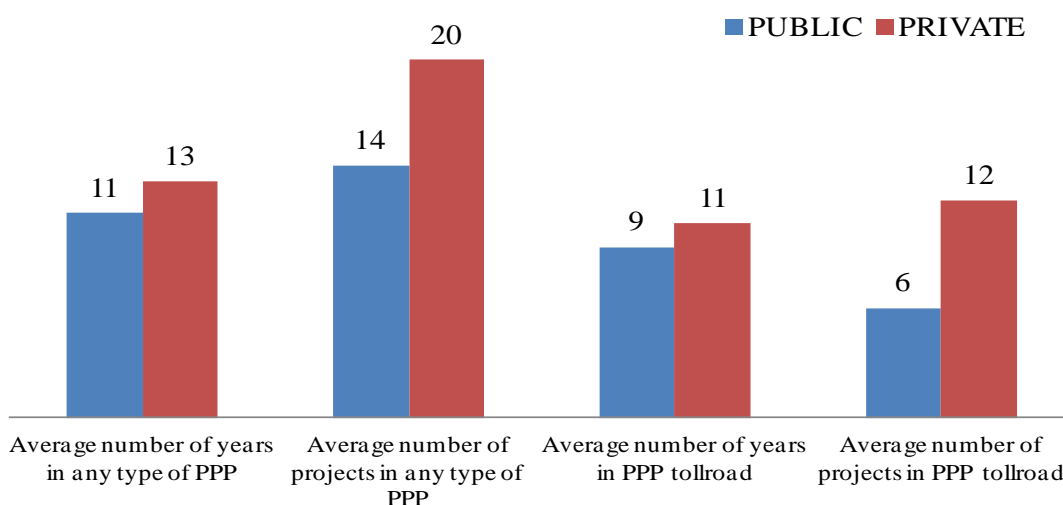

Figure 5: Overall experience in PPPs – PUBLIC vs. PRIVATE

Involvement in tollroad projects

Respondents were asked to list the three most recent projects they had been involved in: 83 listed three, while 18 had experience in two or fewer projects. Of these 18 respondents, nine had experience in one project; these are summarised in Table 1.

As shown in Table 1, the locations of projects are diverse, covering six geographic regions and 32 countries. This shows that the PPP is an important and popular procurement method of road infrastructure across the world. Nevertheless, a couple of respondents qualified this finding in light of experience encountered in developing economies:

R_i: *For developing countries, PPPs are difficult to procure, [their] under-developed legal framework [presents] higher risk.*

R_j: *In developing economies they [PPPs] provide facility for a government to implement infrastructure projects which they might not otherwise be able to afford - through increased participation of private sector investment. However ability to pay in these instances is problematic and government subsidy may be required.*

These comments support our propositions established in Section 5: i) sovereign risk is a concern to the private sector, and this is particularly so in developing countries; and ii) PPPs are in essence a financing instrument.

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

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

Eight types of PPP tollroads are identified by all respondents (Figure 6). Motorways top the list (40.22 per cent), followed by tunnel (29.71 per cent), and multiple (18.84 per cent)[10] . The nature of project experience is divided into four categories (Figure 7): new infrastructure (63.77 per cent), existing infrastructure (32.61 per cent)[11], other (2.17 per cent)[12], and missing link (1.45 per cent). The spike in new infrastructure confirms that a large share of roads would not have been available for motorists if private finance were not sought.

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[10] This group includes motorway, tunnel and bridge.

[11] Includes upgrade, widening, extension, refinancing and acquisition of an existing infrastructure.

[12] Includes upgrading a segment of existing infrastructure plus adding a portion of new infrastructure.
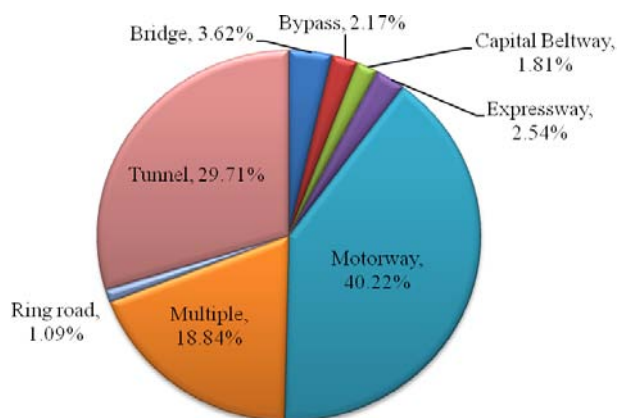
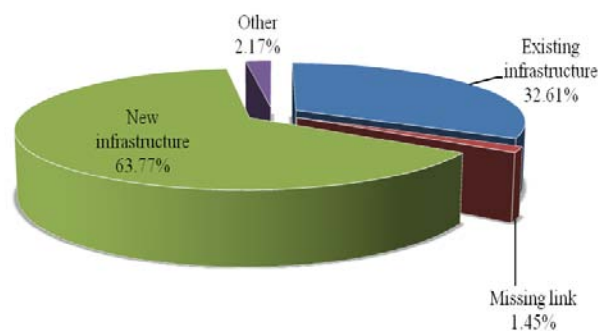*Figure 6: Involvement in Types of PPP Tollroads*

Figure 7: Involvement in the nature of PPP tollroads

Figure 8 illustrates the tolling schemes that respondents have been involved in. A little less than half of project experience (46.38 per cent) applies to fixed tolls, among which are three in South Africa that charge a fixed toll with a discounting regime; one in Australia and another in South Korea that both are paid by a fixed toll and revenue guarantee; one in Canada that is charged to natural gas companies only; and one in Belgium where the pricing level change is subject to return on private capital. This is followed by 23.91 per cent of project experience charging distance-based tolls, 9.06 per cent charging an availability payment, and 8.70 per cent charging distance plus time-based variable tolls, these projects being located in Canada and Russia.
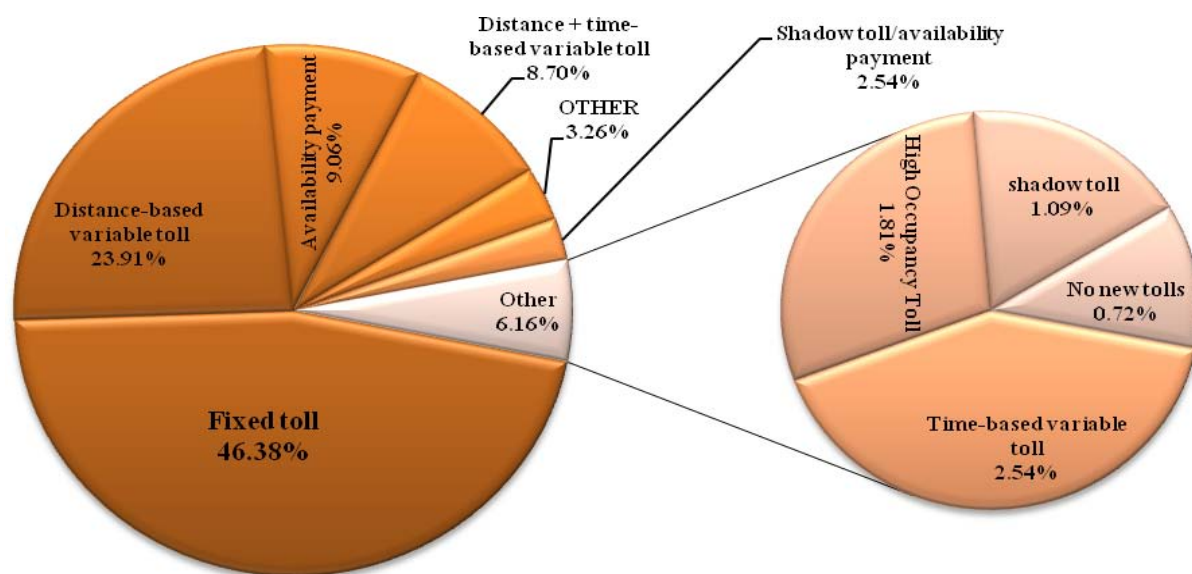

Figure 8: Involvement in tolling schemes

Only one project (located in the US) applies the HOT (mentioned by five respondents). The 'No new tolls' category accounts for two refinancing projects. The 'Other' category includes two projects in Canada that charge an availability payment plus a fixed toll; one in Hungary that started with a distance-based variable toll but changed to an availability payment in 2003; one in Canada that uses an availability payment plus 16 per cent of shadow tolls; and one in the US that applies a distance-based variable toll as well as a fixed toll. Only three projects apply shadow tolls, one each in Canada, Portugal[13] and Spain, accounting for 1.09 per cent of total project experience. The combination of shadow and availability

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[13] Portugal is one of the pioneers that embarked on a shadow tollroad program on an aggressive scale; it proved unsustainable as the government found the program difficult to budget for and unaffordable, and it was unable to pay for the usage of these roads.

payment regimes (2.54 per cent) is only seen in the UK. Time-based variable toll represents 2.54 per cent of total project experience, over half of which (57 per cent) are in Spain.

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 the purpose of allocative efficiency in managing road space. However, this is not the failure of the PPP scheme per se, but rather the outcome of political intent to bypass fiscal constraint.

A retired director of a road authority succinctly pinpointed the problem:

R_k: *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 other respondents:

R_l: *Design, Build, Operate & Maintain [method] 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.*

R_m: *[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.*

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

Some respondents commented further on the myopic view of politics that may have compromised the social benefits of PPPs:

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

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

Most PUBLIC 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. The contract for the first PPP tollroad in Toronto, Canada (Motorway 407) did not provide for the regulation of toll escalation. Within their legal rights, the private operator increased the toll price a number of times. The price hikes were seen as maximising private profit at the expense of the public purse. The high volume of traffic on Motorway 407 created mounting pressure on government because it meant a bad deal for public users. The government later attempted to stop the toll escalation, but lost the law suit to the private operator. Cognisant of the 407's poor publicity, some PUBLIC, especially those in Canada, have shown a high level of averseness to projects that would yield financial gains to the private operator.

Many governments impose strong clauses in contracts to limit the private operator's capacity to set and vary toll prices. Figure 9 shows that only 13 per cent of project experience to some extent applies the pricing structure (e.g., time variable, HOT) that is linked to traffic demand management, compared to an 87 per cent share of other tolling schemes.
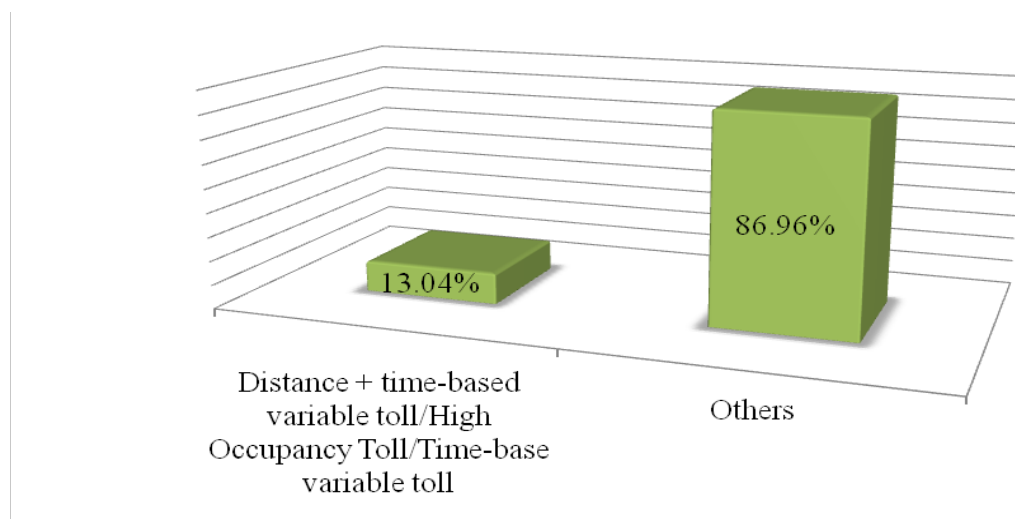
Figure 9: Tolling scheme – traffic management vs. others

The lack of consistency in tolling schemes has caused unintended consequences for society and for infrastructure planning, as one of the PUBLIC commented:

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

The power of pricing mechanisms is often overlooked (strategically in some cases). Consequences of toll pricing regulation are only narrowly considered at the project level. One respondent noted:

> R_r: *Spain recently in 2007 passed a legislation that the annual escalation of toll prices can only be up to 85 per cent of the inflation index. Because the government believed that the life-cycle benefit of operating the tollroad should be incorporated in the reduced toll price. I think this is a controversial issue.*

Among the countries that embrace time-related variable tolling, Canada and Spain each account for 33.33 per cent; followed by France, Mexico, Russia and the US, each accounting for 8.33 per cent (Figure 10). A few governments are fond of the idea of using a tolling structure to manage roads, albeit not for the same purpose. Some government officials candidly maintained that the tolling scheme should be aligned with the project objective. A tolling scheme can help remove budget uncertainty. Greenfield projects where traffic demand is unknown should be funded by an availability fee, whereas brownfield projects where there is an established traffic pattern can be paid by shadow tolls. Different tolling schemes should be applied to roads that make up the integrated transport network: a real toll is charged on segments where government wants to ensure a smooth flow of traffic, while shadow and availability tolls are used on segments where patronage should be encouraged.
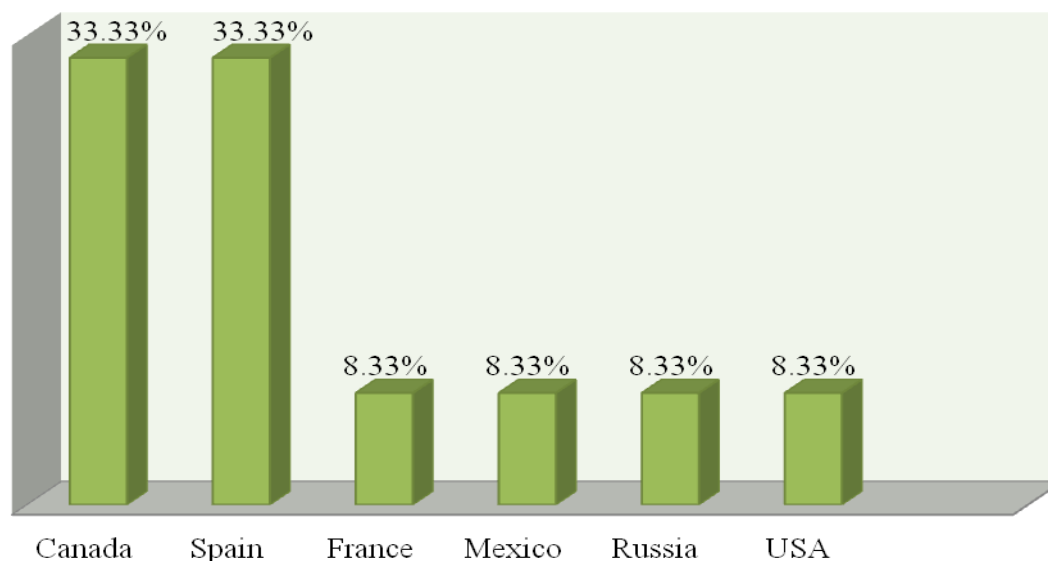
Figure 10: Countries using toll pricing for traffic demand management

The Dutch government is exploring the financial advantage of PPPs while maintaining an independent tolling scheme to manage driving behaviour; as described by one of the road authority officials:

> R_s: *PPP is now promoted by the government, but without the private tolling part. We will pay the concessionaires on availability of the road. A national electronic tolling system is expected in about 2014 on all roads both public and private: the revenues will be for the public sector ([to manage] demand). There is no direct link between the tolls and revenues to the private operator. The so tolled revenues will go to the treasury therefore reduce tax on new vehicles and vehicle ownership. [This is] a new way to manage traffic demand, by implementing time-based variable tolls and making more expensive to drive a vehicle than owning a vehicle.*

Summary

The experience of the respondents presents a fair picture of the current state of PPP tollroads around the world. It highlights a number of current practices, such as the players in a bidding consortium, the institutional environment underlying the PPP transaction (developed versus developing countries), restrictions imposed in the contract regarding toll pricing, and the application of the availability payment model, to name just a few.

We will draw on this experience to make sense of our hypothesis testing in Section 5.

Part 2: The stated choice experiment

The design

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. For example, in the Instructions screen in Figure 11, a labelled experiment will have Sydney Harbour Tunnel instead of Contract A, and Melbourne CityLink instead of Contract B.
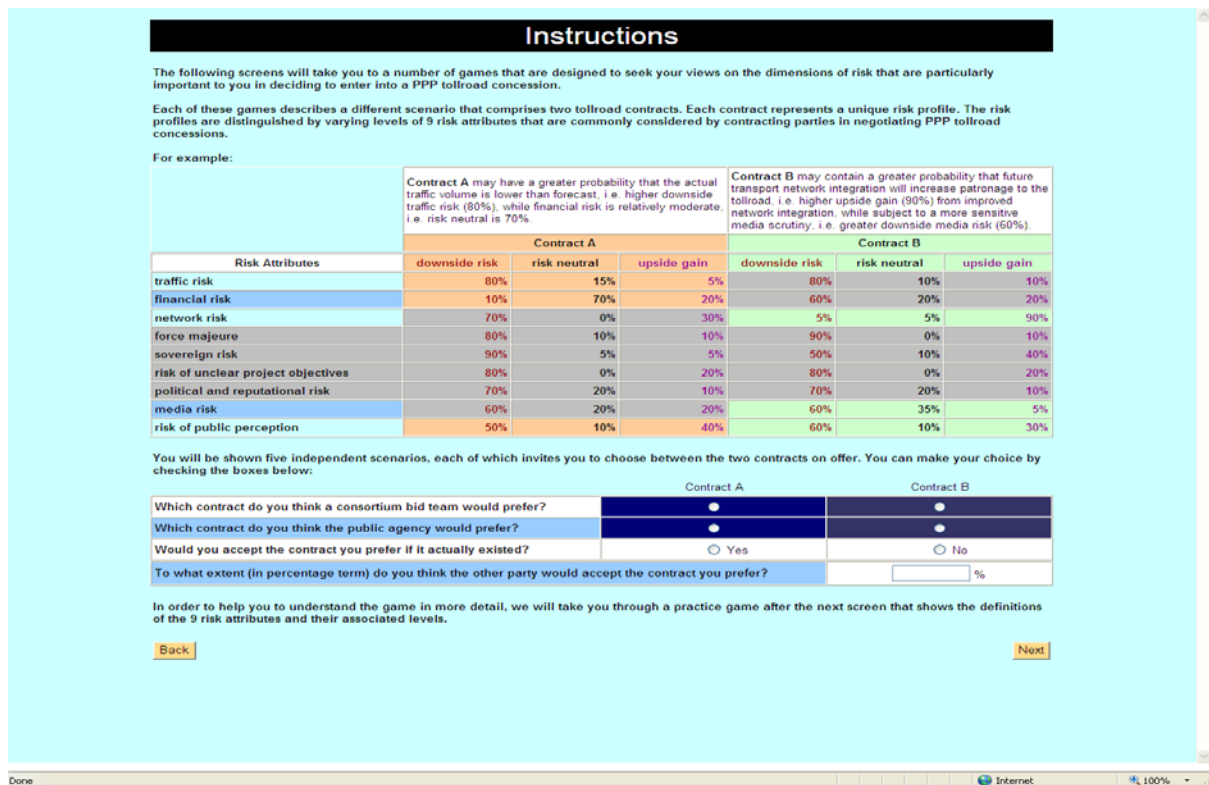
Figure 11: Stated choice experiment – instructions screen

The decision to use an unlabelled experiment rather than a labelled one 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, this may invite unintended perceptions that respondents might 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). This may include assumptions based either on direct experience or second-hand information as proxies for these additional attributes (Hensher *et al.*, 2005a, 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 in Chung *et al*. (2010), so that respondents can understand and relate to the attributes in a realistic way. 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 more or less meets 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 100 for each risk). Choice situations were assigned by a block column so that no contract would 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.

Descriptive data of contract choice

With background information collected from Part 1, we were able to understand each respondent's most recent experience or the area that they were most experienced in. Before commencing the experiment, respondents were briefed that they were going to assess five choice situations based only on hypothetical scenarios that had been designed to mimic the risk profile of PPP tollroad contracts. Each respondent was specifically instructed to exercise their judgement based upon their prior experience and their ability to manage the risks associated with the alternatives. Stated differently, the project risks are presented as the

level of downside, upside and neutrality in the experiment; whether they are acceptable to the decision maker is dependent on the attitude the decision maker formed from their prior experience with respect to their ability to manage and (or) trade-off these project risks, taking into account cooperative efforts of all those contracting.

In each of the five choice situations, respondents were asked to consider contract A and contract B and, based on each contract's risk profile, indicate which contract they thought a private consortia would prefer ('1st row' in Figure 12) and the contract they believe a public agency would prefer ('2nd row' in Figure 12). In more than half (57 per cent or 290 cases) of the 505 choice situations, respondents believed that both parties would prefer the same contract. Of these, a vast majority of 57 per cent (165 cases) of respondents are PRIVATE. It suggests that PRIVATE are more confident about reaching an agreement with the road authority. Such confidence may have accumulated from their exposure to more projects and a greater number of countries.

In Figure 12, PRIVATE's choice in the '1st row' and PUBLIC's choice in the '2nd row' are used to obtain parameter estimates (beta in Equation 1) under the LCM model form for each attribute for the PRIVATE and PUBLIC respectively.

After choosing their preferred contract, respondents were asked whether they would accept that contract if it actually existed ('3rd row' in Figure 12). In 54 per cent of 505 cases, respondents indicated they would accept the preferred contract; 60 per cent of respondents came from the private sector. It is evident that most PUBLIC favour inaction over action. This status quo bias implies that when making decisions about whether or not to enter into a procurement contract, PUBLIC are highly loss-averse, preferring avoidance of risks (Kahneman *et al.*, 1991; Tversky and Kahneman, 1991). This may be due to the pressures of accountability, which increase the status quo bias and other manifestations of loss aversion (Tetlock and Boettger, 1994).
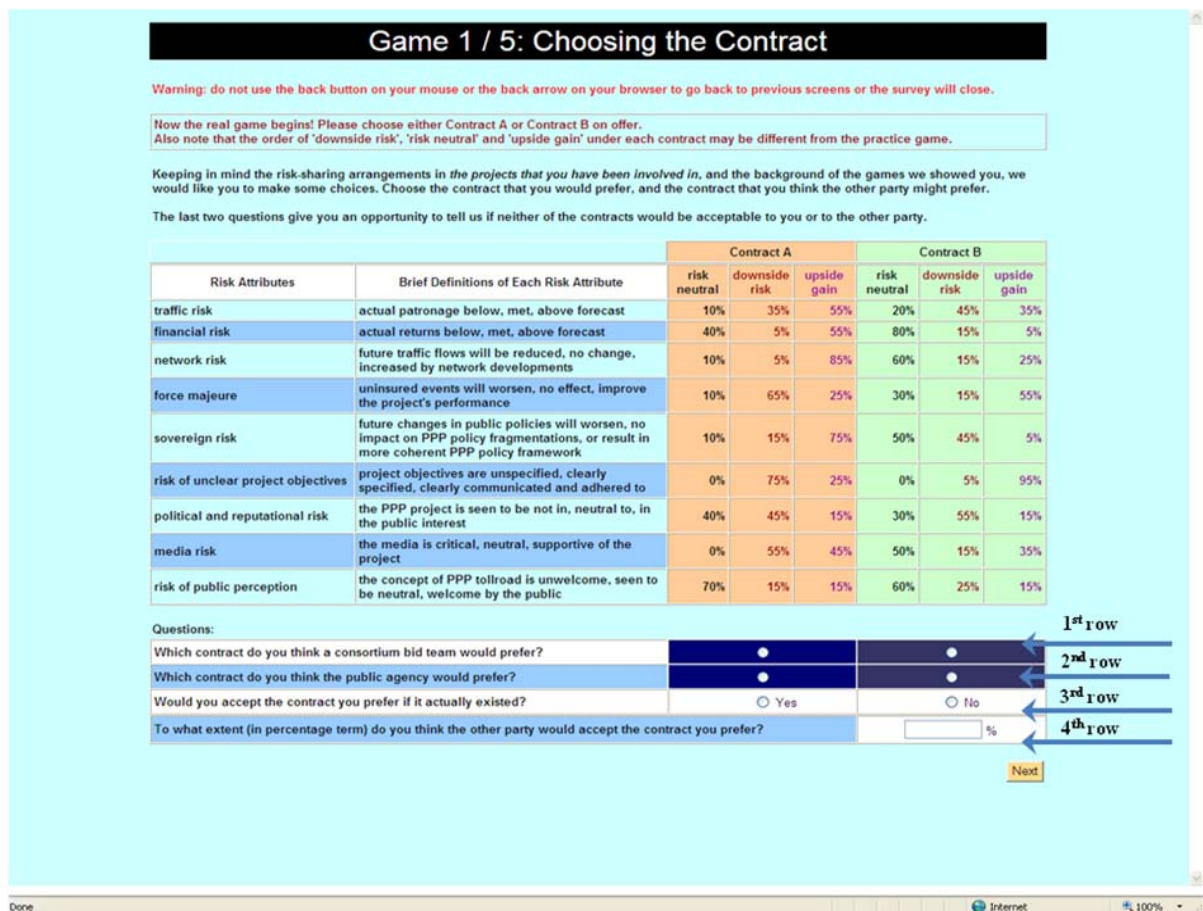

Figure 12: The stated choice experiment – contract choice

Figure 13[14] shows that consultants would most likely accept the preferred contract if it existed, closely followed by stakeholders from tollroad companies. Interest in tollroads from construction companies remains strong, while interest from pension funds has overtaken that of investment banks. Investment banks are the least likely to accept the preferred contract, even though in the past they had a highly active role in the field. This dramatic change in appetite toward tollroads may be related to the failure of a number of high-profile tollroads worldwide. Each of these failed projects involved a large proportion of stake from investment banks. One such experience has resulted in the restructure of an Australian-based international tollroad company that was backed by an investment bank. Subsequently, the new entity now only manages the existing tollroad assets, and no longer engages in acquiring new tollroads.

In terms of respondents' appetite for tollroads, consultants – who have the highest incidence of accepting the preferred contract if it existed – are the most aggressive in their investment decisions. This is within expectations given that consultants do not bear any project risks. One consultant informed the first author that they were typically paid a set fee by the bidding consortium regardless of the outcome of the bid, or a percentage of the project cost if the consortium won the project. The latter may have fuelled a strong desire to take aggressive measures, including optimism bias in traffic forecasts (GHD, 2011).
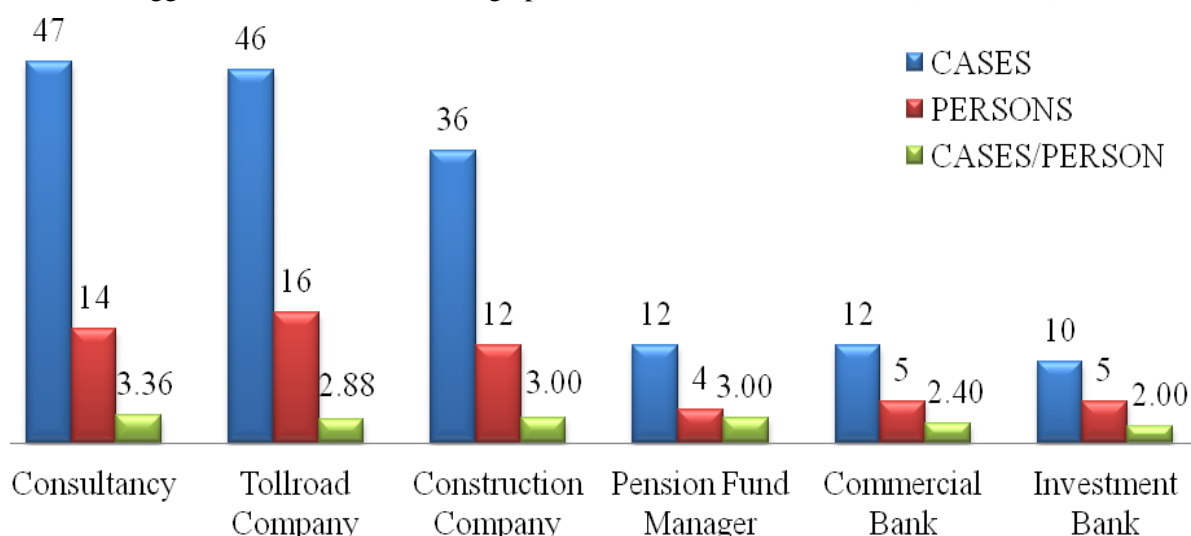

Figure 13: Would accept the contract if it existed – PRIVATE

Construction companies and pension fund managers are slightly behind consultants in their respective incidence of accepting the preferred contract if it existed. Winning a project will generate construction revenues for constructors, many of whom do not tend to hold the asset for the long term; therefore, tollroads are fairly safe investments for these players. This observation leads us to expect that the leader of the bidding consortium may be less risk-averse compared with the other members of the consortium bid team. We will test this in the empirical section. Pension funds prefer PPPs because these projects have a maturity similar to the fund's liabilities; moreover, PPP projects are the only component of public infrastructure that offer asset ownership to private capital.

In Table 2, the average extent to which individual respondents consider that the other party in the scheme would accept the contract that they prefer ('4th row' in Figure 12) is shown to be 55.28 per cent. The average of PUBLIC (55.50 per cent) is very close to that of the PRIVATE (55.13 per cent). However, PRIVATE (66.67 per cent) are more likely to believe that the public sector party would definitely accept the contract they prefer. That shows that the PRIVATE are more optimistic in terms of reaching a deal with public authorities. Interview data confirm that many PRIVATE consider that they are willing to take on any risks as long as they will be adequately compensated for. This information reaffirms the positive relationship between risk preferences and risk premium.

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[14] Multiplications of roles and organisations have been removed from the numbers reported in Figure 13. Each category has been examined carefully by cross-referencing to notes taken during the survey and conversations recorded, to determine the primary role/organisation of the respondent for the survey purpose.

If risk preferences are indeed contextually dependent, as predicted by TCE and March and Shapira (1987), our investigations of avenues in which one's risk preference can be modified – and hence the correspondent level of risk premium – will offer new means by which PPPs can enhance VFM.

Part 3: Attribute processing strategies of respondents

The design

Decision-making processes are sensitive to the complexity of the decision-making context (Simon, 1986). With 54 cells in a single-choice situation (two contracts by nine risks by three attributes), we suspected that respondents would not consider all risk attribute levels when choosing the preferred contract.

When confronted with complexity, individuals will adopt decision-making strategies to simplify the process, including focusing on a limited number of attributes that are of paramount importance to them. In some cases, individuals were found to ignore specific attributes as a coping strategy to process information in order to deal with the perceived complexity of a SC experiment (Hensher *et al.*, 2005b). In other scenarios, individuals were observed to ignore unimportant attributes as part of their appraisal of the relevance of the information available (Hensher, 2004; Hensher, 2006).

Table 2: Extent that the other party would accept the contract I prefer

	ALL %	**PUBLIC %**	**% of choosing min/max**	**PRIVATE %**	**% of choosing min/max**
Average	55.28	55.50		55.13	
Median	60.00	60.00		52.50	
Mode	50.00	50.00		50.00	
Std. Deviation	26.34	26.01		26.59	
Minimum	0.00	0.00	33.33	0.00	66.67
Maximum	100.00	100.00	33.33	100.00	66.67

To accommodate individual heterogeneity in the processing of choice experiments, we included in the survey two methods that elicit respondents' attribute processing strategies (APSs). The first method involves supplementary self-stated response questions on whether particular attributes were ignored. This method will minimise the risk of over-simplifying the SC design because some respondents may require all the information to make meaningful choices and some may require information that may be irrelevant to others (Hensher *et al.*, 2007; Puckett and Hensher, 2008) – this is highly possible in our study because it is about understanding the choice of decision makers from diverse backgrounds. Further, this method acknowledges that varying APSs may be enacted not only across decision makers, but also across choice situations faced by a given decision maker.

Figure 14 shows an example of the supplementary APS screens. In such screens, which are shown immediately after each choice situation and contain attribute levels that are identical to the choice scenario, respondents are asked to click on the attributes that they ignored during the experiment (the upper panel in Figure 14). An attribute could be ignored within some alternatives but not within others, hence the APS task involved respondents indicating which attributes were ignored for each alternative (it could be a particular level of an attribute they were ignoring). Another issue to take into account, given the interest in the risk perceptions of two vastly different cohorts, involved asking each respondent to click on the attributes that they thought the other party would ignore when making their decision (see the lower panel of Figure 14).

The second method involved the inclusion of an opt-out or null alternative (Rose and Hess, 2009; Hensher, 2010) – an additional response question was added to each of the choice scenario screens: "*Would you accept the contract you prefer if it actually existed?*" (see Figure 12). This gave respondents a choice to not choose any of the contracts on offer.
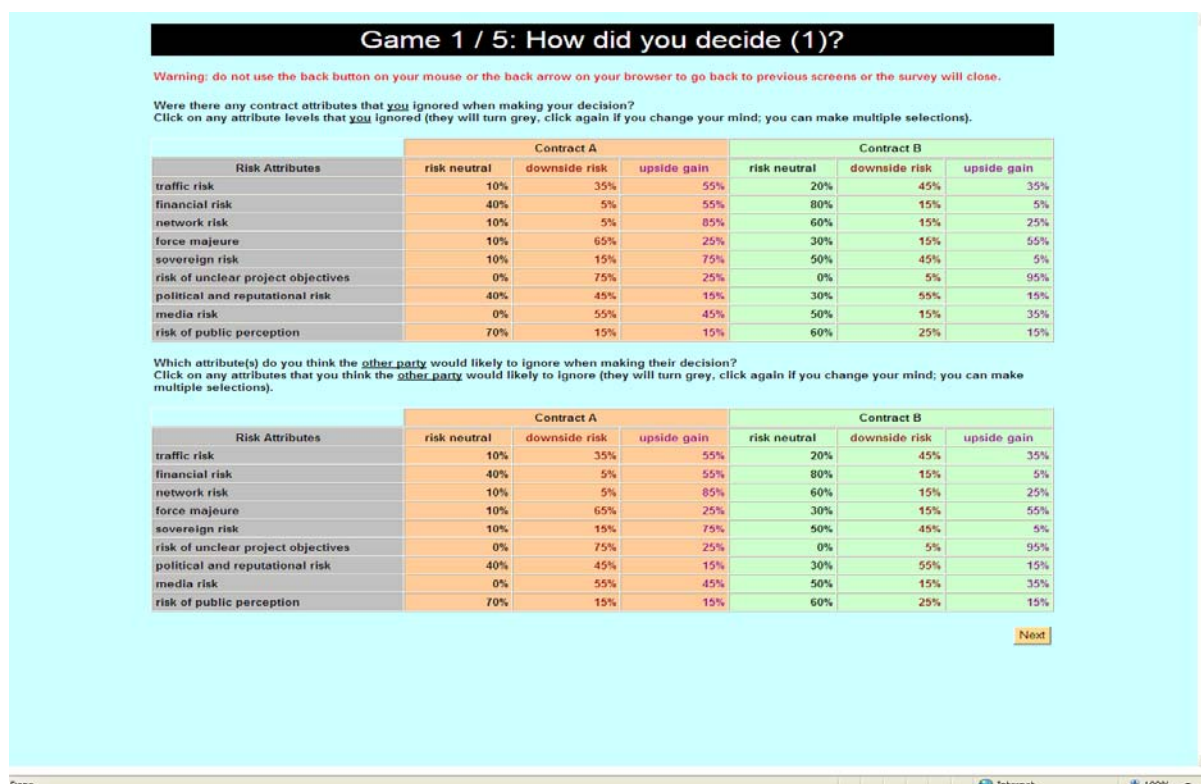
Game 1 / 5: How did you decide (1)?

Warning: do not use the back button on your mouse or the back arrow on your browser to go back to previous screens or the survey will close.

Were there any contract attributes that <u>you</u> ignored when making your decision?
Click on any attribute levels that <u>you</u> ignored (they will turn grey, click again if you change your mind; you can make multiple selections).

Risk Attributes	Contract A			Contract B		
	risk neutral	downside risk	upside gain	risk neutral	downside risk	upside gain
traffic risk	10%	35%	55%	20%	45%	35%
financial risk	40%	5%	55%	80%	15%	5%
network risk	10%	5%	85%	60%	15%	25%
force majeure	10%	65%	25%	30%	15%	55%
sovereign risk	10%	15%	75%	50%	45%	5%
risk of unclear project objectives	0%	75%	25%	0%	5%	95%
political and reputational risk	40%	45%	15%	30%	55%	15%
media risk	0%	55%	45%	50%	15%	35%
risk of public perception	70%	15%	15%	60%	25%	15%

Which attribute(s) do you think the <u>other party</u> would likely to ignore when making their decision?
Click on any attributes that you think the <u>other party</u> would likely to ignore (they will turn grey, click again if you change your mind; you can make multiple selections).

Risk Attributes	Contract A			Contract B		
	risk neutral	downside risk	upside gain	risk neutral	downside risk	upside gain
traffic risk	10%	35%	55%	20%	45%	35%
financial risk	40%	5%	55%	80%	15%	5%
network risk	10%	5%	85%	60%	15%	25%
force majeure	10%	65%	25%	30%	15%	55%
sovereign risk	10%	15%	75%	50%	45%	5%
risk of unclear project objectives	0%	75%	25%	0%	5%	95%
political and reputational risk	40%	45%	15%	30%	55%	15%
media risk	0%	55%	45%	50%	15%	35%
risk of public perception	70%	15%	15%	60%	25%	15%

Next

Done   Internet   100%

Figure 14: Stated choice experiment - attribute processing screen

Descriptive data of APSs

In each supplementary APS screen, respondents selected the attribute levels that they ignored ('ignored by self') when making decisions on the contract choice based on the hypothetical scenario immediately before the APS screen, as well as the attribute levels they thought that the other party would ignore ('ignored by other'). In giving reasons why an attribute was ignored, statements provided by respondents indicate that various APSs were used to select the preferred choice. The most common reasons are:

- the risk hardly materialises, e.g., *force majeure* (upside)
- the risk has been transferred out
- the risk exists regardless, e.g., public perception
- the risk is beyond their control, e.g., political risk (mainly with politicians, not with public sector authorities or private consortium)
- the risk is too trivial to be of concern, e.g., 5 per cent
- the risk levels are identical in both contract

The statistics shows that in 19 per cent of cases, of which 56 per cent are from PUBLIC, respondents stated that they considered all attribute levels in their decision making. Again, this result confirms that PUBLIC are (slightly) more cautious in committing to long-term contracts. Unlike the private operator, who can sell their right to manage the tollroad facility, the public sector's options to make alternative use of the facility are constrained by the specificity of the asset. It seems that the public sector is more likely to be confronted with lock-in problems.

In stating their own attribute non-attendance (ANA) (Figure 15), both cohorts exhibited the same levels of attention (indicated by the numbers inside the columns) to traffic (9 for both sectors), financial (8 for both sectors) and network (7 for both sectors) risks. The fact that respondents from both sectors gave the same levels of attention to these three risks refutes what is often construed: that the public sector does not care about the economic benefits of a project because many of the related risks are transferred out. Interview data confirm that the economics of all projects had been carefully evaluated by the responsible public

authorities before tenders were put to the market. Most PUBLIC maintained that only projects that have the potential to self-sustain economically – an important criterion to minimise budget uncertainty – would be considered for the PPP procurement method.
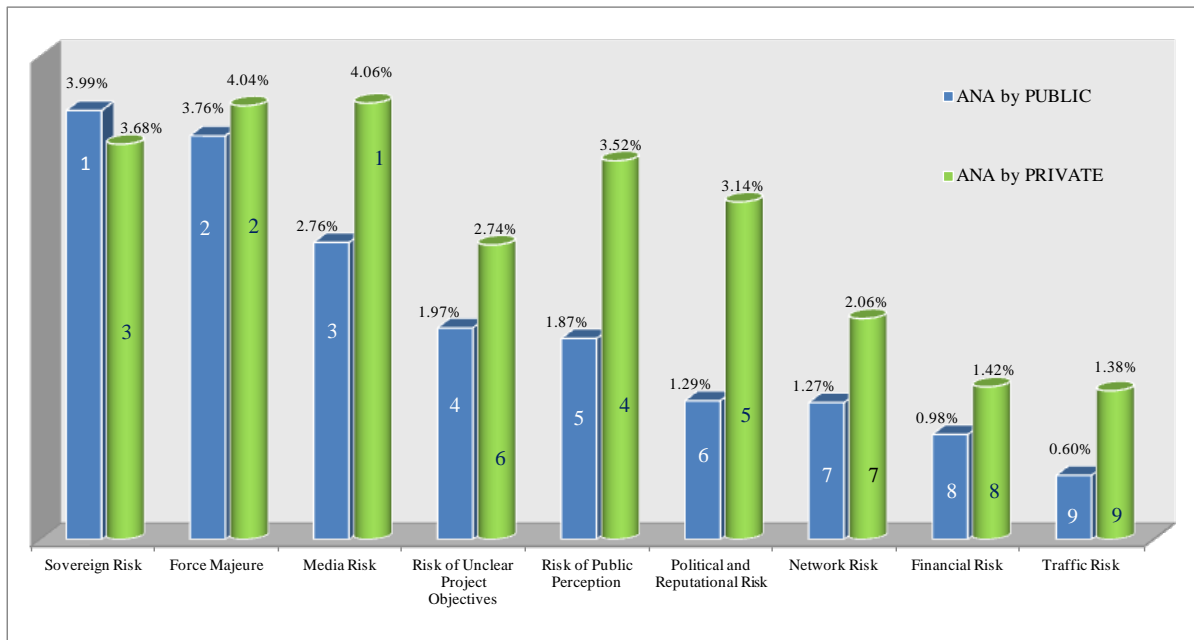

Figure 15: ANA by self – PUBLIC vs. PRIVATE

There are discernable misalignments in levels of attention given to sovereign risk and media risk. Most PUBLIC who have only worked for one government did not consider sovereignty a risk (ANA of almost 4 per cent). But sovereign risk is the matter of most concern for PRIVATE; many maintained that they would not invest in a politically unstable environment. The reason that this strong averseness to sovereign risk is not clearly shown in the data is because 97 per cent of PRIVATE insisted that they only invested in countries where there is a well-developed legal system to ensure their contracts with the state will be honoured. From time to time, media coverage places government under public scrutiny, which has a powerful influence on a citizen's voting preference (ANA is 2.76), whereas the extent of media coverage on the private sector is not as strong, and it is the most ignored risk by PRIVATE (ANA is 4.06 per cent).

As illustrated in Figure 16 and Figure 17, there exists, unfortunately, noticeable disparity in perceptions of ANA by the other party. The degree of misunderstanding by PRIVATE with respect to PUBLIC's preference is much larger than its counterpart – up to five times for traffic risk (i.e., 3.24 per cent vs. 0.6 per cent in Figure 16).

PRIVATE believed that PUBLIC would care most about social risks, such as risk of public perception, political and reputational risk and media risk. But contrary to PRIVATE's perception, PUBLIC paid as much attention to project-specific risks as their private counterparts. Respondents from road authorities impressed upon us that their risk analysis was steered by the objective of assuring certainty in budget and project delivery. Consequently, all projects that are placed in the market must have undergone in-house feasibility analysis to ensure that they are economically attractive to private investment; thus, before a procurement method decision is made, their primary focus is on project risks.
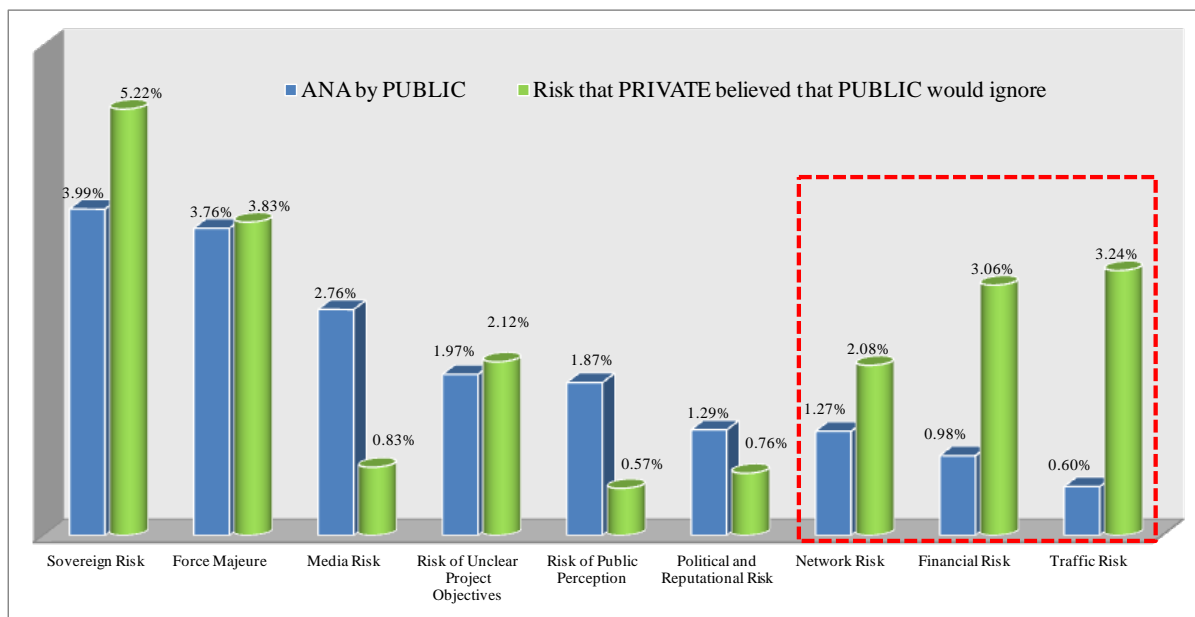
Figure 16: ANA by PUBLIC – by self vs. by PRIVATE
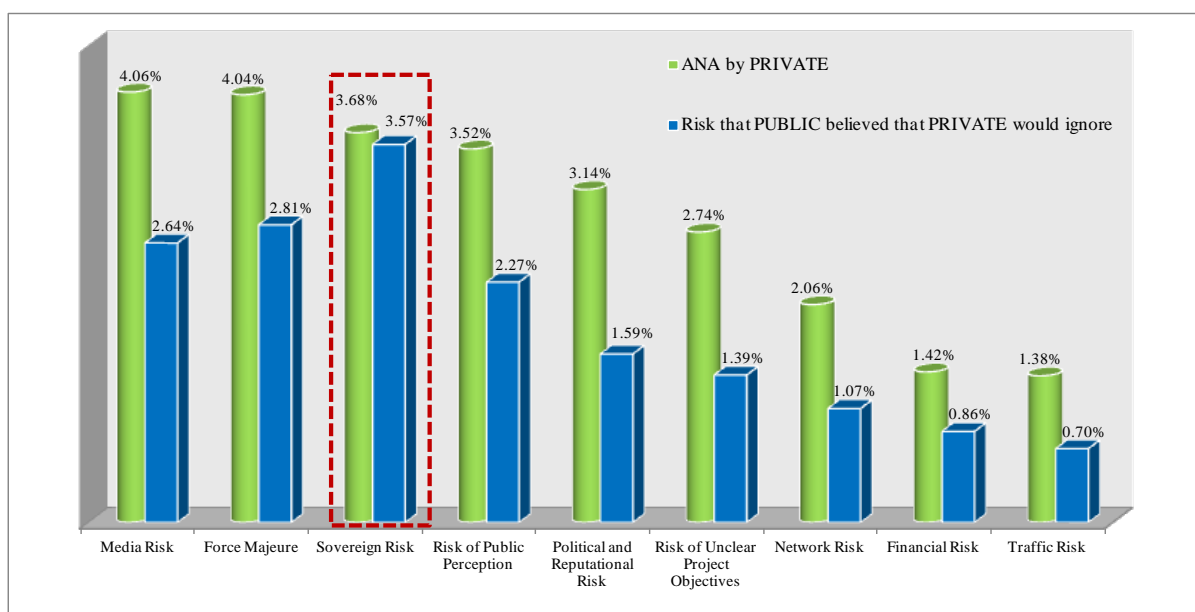
Figure 17: ANA by PRIVATE – by self vs. by PUBLIC

Figure 17 shows that PUBLIC misunderstood the importance of sovereign risk to the private sector – it was ranked by PUBLIC the least-attended risk. The 3.57 per cent in the blue column associated with sovereign risk is the highest among the percentages associated with other blue columns. Interview data have confirmed that many PUBLIC have strong confidence that their jurisdiction offers a safe and stable PPP environment for private investment.

Descriptive data of level of focus

After identifying the ANA, respondents were asked to further rank the levels of risk that they foucused on (the screen is provided in Figure 18; 3=most focus, 1=least focus); this was repeated for each choice situation. Overall, the evidence suggests that although respondents from different sectors share a similar averseness to downside risk, there are large differences in the distribution of attention to risk levels by each sector.

Figure 18: Level of focus

In the 'ALL' category illustrated in Figure 19, downside risk draws the greatest amount of attention (focus level=3, 24.95 per cent); upside gain tops the ranking in focus level=2 (15.05 per cent); and risk-neutral takes out the highest proportion in the least-focused category (focus level=1, 18.15 per cent). The evidence suggests that all respondents are concerned with the variability in risk distribution, while a project with fairly stable risk distribution as indicated by its risk-neutrality causes the least concern to respondents.

Among a quarter (24.95 per cent) of respondents who devoted their focus to downside risk (most focus=3), a majority (64.29 per cent) is from the private sector. The smallest difference in the distribution of attention level is found in 'least focused on downside risk' (55.56 per cent vs. 44.44 per cent) and 'most focused on upside gain' (55.42 per cent vs. 44.58 per cent). Only 2.38 per cent of respondents did not care about downside risk as much (least focus=1). Although there is an almost equal proportion of PUBLIC and PRIVATE (55.42 per cent and 44.58 per cent) ranking this category as the highest level (upside gain: 3), their reasons of focus are quite the opposite.

PUBLIC feared that too much financial upside gain in the project will draw poor publicity, because there have been cases in which the public perceived the government as handing over a money-making project to profit-making private operator. As for Motorway 407 in Toronto, public opinion considers that the project should be retained in public hands and procured via traditional methods rather than a PPP.

On the other hand, PRIVATE believed that a project's upside gain is the risk premium that rewards the private sector for taking on project risks. An alternative explanation is that some private consortia believe that upside gains are a good selling point to raise project finance; it is particularly appealing to equity investors (such belief has at times translated into optimism bias), and our data support this.
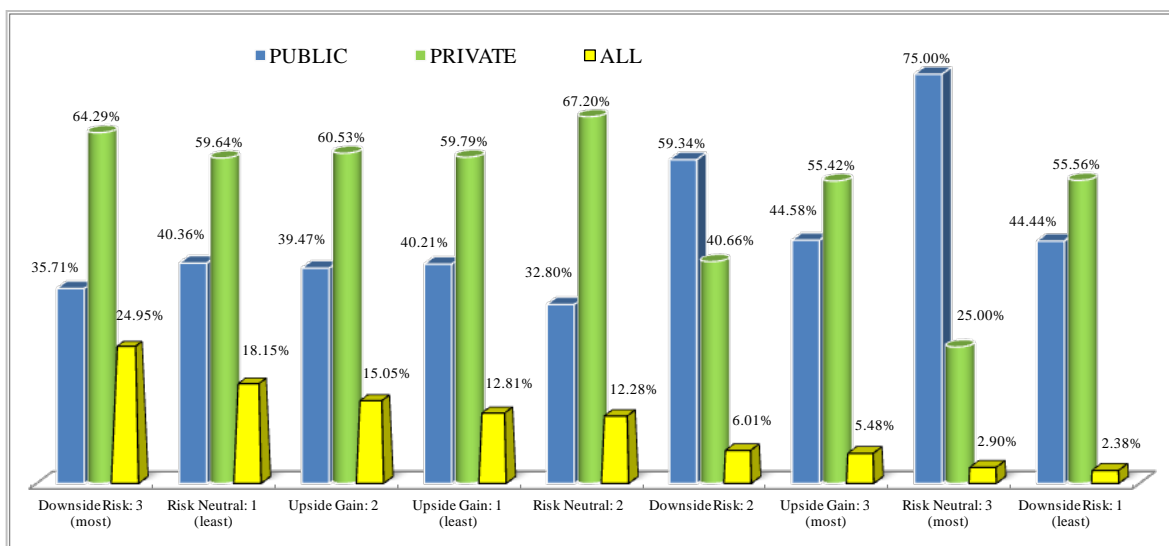
Figure 19: Ranking of focus level – distributions of PUBLIC, PRIVATE and ALL

Many respondents commented that construction companies and investment banks displayed a risk-seeking tendency in their evaluation of PPP tollroads. If this perception were true, then our data should show that these companies would focus most on the upside gain, but this is not reflected in our data. According to Figure 20, consultants are more likely to be risk seekers; this is consistent with our interpretation of Figure 13.
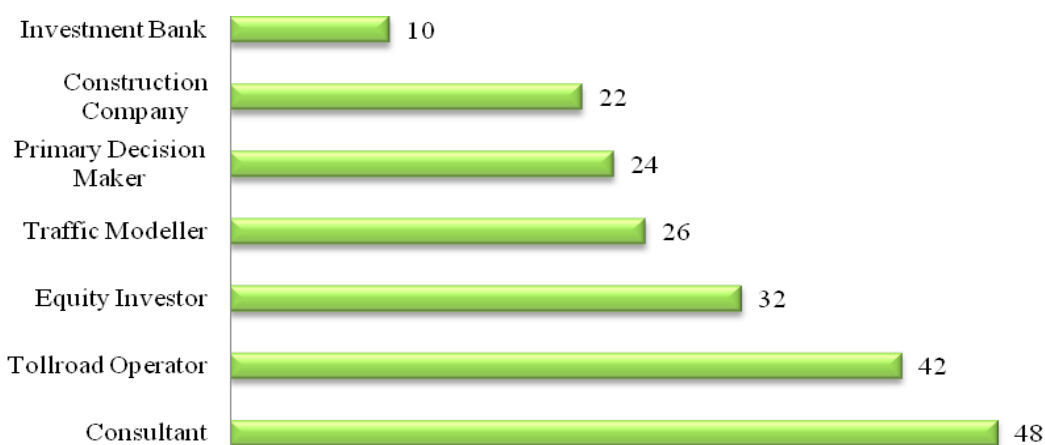
Figure 20: Ranking of focus on upside gain = 3 by PRIVATE[15]

Part 4: Prior experience as the reference level

The design

In addition to the choice experiment that provides the variability to parameterise the source of risks, a reference point is needed to define the level for calculating the PPPRI. In the screen shown in Figure 21, the respondents were asked to complete the boxes for downside risk and upside gain for each risk, based on their prior experience in relation to risks borne. The percentage of the risk-neutral attribute was automatically calculated after the data were entered into the other two boxes, so the percentages across the three boxes sum to 100.

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[15] Only the seven highest numbers that rank upside gain=3 are displayed.

Figure 21: Revealed preference data – prior experience

Descriptive data of prior experience

Table 3 contrasts the mean values of PUBLIC and PRIVATE for each risk attribute. The contrast shows that respondents have experienced inequitable risk-sharing. The PRIVAT have mostly borne downside risks associated with traffic volume (54.07 per cent) and financial return (45.47 per cent), with their shares of the related upside gain (17.38 for traffic upside gain and 22.30 per cent for financial gain) being far less than the losses they have suffered.

Downside risk of unclear project objecitves appears to have a much worse impact on PUBLIC (33.24 per cent) relative to PRIVATE (18.60 per cent). The higher mean values associated with PUBLIC for downside risks of a social dimension, such as political and reputational, media and public perception, suggest that these risks rest mainly with the public sector.

Table 3: Prior experience of risk borne (contrast of mean)

	PUBLIC	PRIVATE	Ratio
	Mean (%)	Mean (%)	PRIVATE/PUBLIC
Traffic_downside risk (TRA_D)	14.15	54.07	3.82
Traffic_upside gain (TRA_U)	11.37	17.38	1.53
Financial_downside risk (FIN_D)	13.41	45.47	3.39
Financial_upside gain (FIN_U)	15.20	22.30	1.47
Network_downside risk (NET_D)	19.32	22.78	1.18
Network_upside gain (NET_U)	21.15	31.50	1.49
*Force majeure*_downside risk (FOR_D)	21.88	14.57	0.67
*Force majeure*_upside gain (FOR_U)	5.98	8.12	1.36
Sovereign_downside risk (SOV_D)	23.90	17.40	0.73
Sovereign_upside gain (SOV_U)	7.93	9.63	1.21
Unclear project objectives_downside risk (UNC_D)	33.24	18.60	0.56
Unclear project objectives_upside gain (UNC_U)	12.20	16.43	1.35
Political and reputational_downside risk (POL_D)	39.20	21.87	0.56
Political and reputational_upside gain (POL_U)	13.41	21.03	1.57
Media_downside risk (MED_D)	41.17	25.13	0.61
Media_upside gain (MED_U)	13.10	18.05	1.38
Public perception_downside risk (PUB_D)	45.37	27.63	0.61
Public perception_upside gain (PUB_U)	12.68	20.57	1.62

In Table 4 we compare the risk percentage with the highest count between PUBLIC and PRIVATE, revealing that 13.33 per cent of PRIVATE have suffered the consequence of traffic demand being 60 per cent lower than forecast (see TRA_D under PRIVATE). *Prima facie*, the real gain for the private sector stems from an innovative financing solution – the number of PRIVATE who have reaped the benefits from financial upside gain (18.33 per cent, see FIN_U under PRIVATE) is 3.33 per cent higher than the number of PRIVATE who have suffered from financial downside risk (15 per cent, see FIN_D under PRIVATE).

Network risk, however, has generated a negative experience for a greater number of PRIVATE (28.33 per cent, see NET_D under PRIVATE) than the number of PRIVATE who have gained (16.67 per cent, see NET_U under PRIVATE) from changes made to the surrounding transport network by government. The majority of the PUBLIC on the other hand, have experienced little gain or loss in matters related to traffic numbers, project finance and network developments.

A number of interesting observations can be made from the evidence in Table 3 and Table 4. As indicated by the higher proportion of PRIVATE in POL_D, adverse public opinion toward a project has a harder impact on the reputation of some PRIVATE, although the average impact on PUBLIC is greater (see Table 3). Media exposure has negatively affected both sectors, but the effect was felt more deeply by PUBLIC (see MED_D under PUBLIC in Table 4).

We will revisit the effects of these risks on repondents' choice of procurement methods through the testing of H4.

Table 4: Prior experience of risk borne
(comparison of risk percentage with the highest count)

	PUBLIC			PRIVATE		
	risk % with the highest count	count	%=count/41	risk % with the highest count	count	%=count/60
TRA_D	0	20	48.78	60	8	13.33
TRA_U	0	18	43.90	0	13	21.67
FIN_D	0	21	51.22	20	9	15.00
FIN_U	0	13	31.71	20	11	18.33
NET_D	0	10	24.39	10	17	28.33
NET_U	0	10	24.39	10	10	16.67
FOR_D	0	17	41.46	0	21	35.00
FOR_U	0	31	75.61	0	33	55.00
SOV_D	0	12	29.27	0	21	35.00
SOV_U	0	27	65.85	0	29	48.33
UNC_D	0	7	17.07	0	14	23.33
UNC_U	0	22	53.66	0	19	31.67
POL_D	10	6	14.63	20	14	23.33
POL_U	0	14	34.15	0	16	26.67
MED_D	50	9	21.95	10	11	18.33
MED_U	0	12	29.27	0	19	31.67
PUB_D	10	5	12.20	10	11	18.33
PUB_U	10	13	31.71	0	19	31.67

Part 5: Attitudinal questions

The design

To further understand stakeholders' personal views on optimal risk-sharing arrangments, we included attitudinal questions seeking respondents' views on risk-sharing in PPP tollroads. In the screen presented in Figure 22, each respondent rated the extent to which each of the nine risks had been adequately dealt with in the PPP tollroad contracts that they had been involved in, by rating them on a 1-to-7 likert scale (1=not very well; 7=very well).

We designed a second set of attitudinal questions to obtain a feeling about respondents' preference for the PPP procurement method. In Figure 23, respondents rated on a 1-to-7 likert scale whether they preferred PPPs over other methods (1=PPPs are the most preferred method; 7=other methods are the most preferred or PPPs are the least preferred).

Figure 22: Attitudinal questions (1)

Figure 23: Attitudinal questions (2) Screen

Descriptive data

Views on optimal risk-sharing

The chart in Figure 24 contrasts the mean values of the ratings by PUBLIC with those of PRIVATE. The largest difference exists in their views on traffic risk: views of PRIVATE on optimal sharing of traffic risk are well distributed across the 7-point scale, whereas opinions shared among the PUBLIC are quite different (see Figure 25). Repsondents provided a number of accounts for the differing views in the 'reason' section.

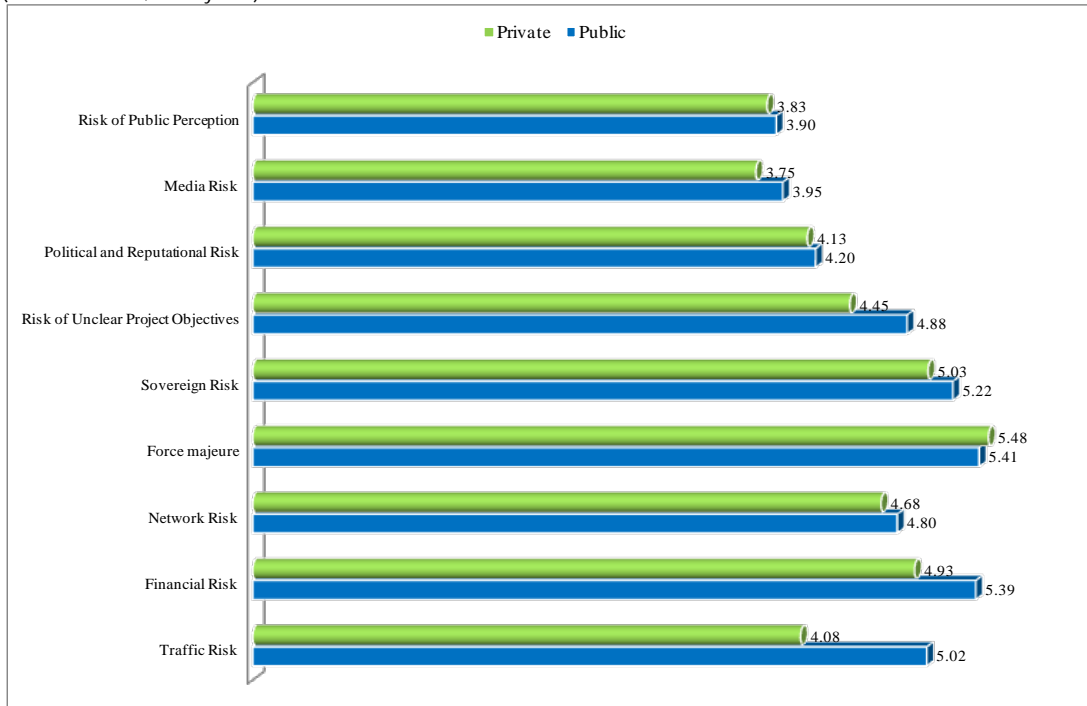(1=not well at all, 7=very well)

Figure 24: Personal view on risk-sharing – contrast of mean

(1=not well at all, 7=very well)
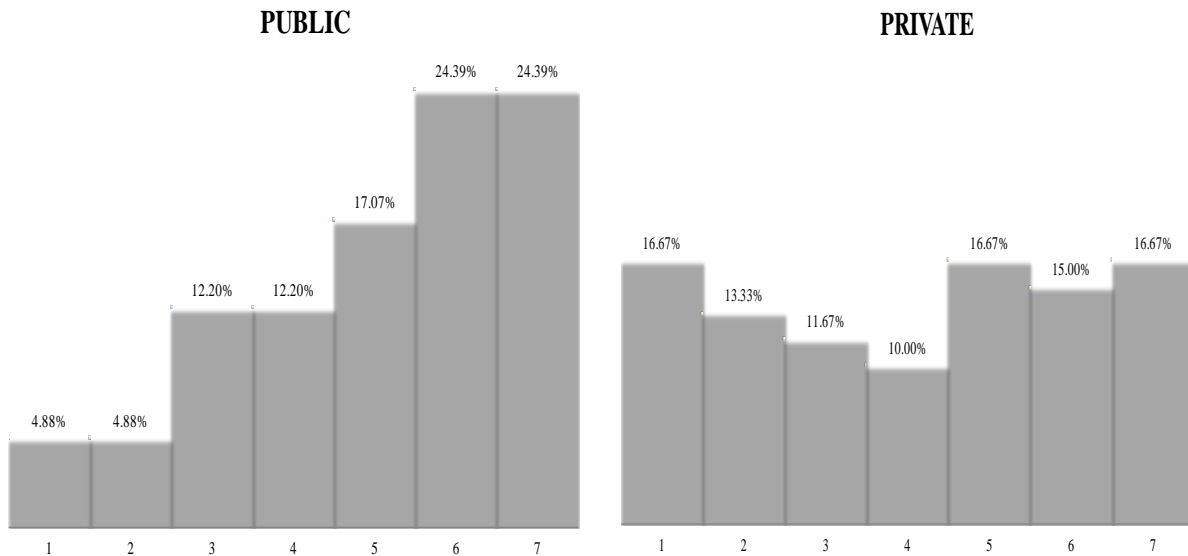
Figure 25: Personal views on optimal sharing of traffic risk –PUBLIC vs. PRIVATE

Some PUBLIC believed that over-transferring traffic risk to the private sector would be to the detriment of the PPP policy. Although benefiting the government, transferring too much risk to the private sector is not good for the whole road network, or the PPP, and government should consider the bigger picture. Some PUBLIC considered that technical error was partly to be blamed for the poor handling of traffic risk in contracts. Others critiqued that traffic demand was driven by strategic motivations associated with the structure of the consortium and bidding process, leading to unrealistic traffic forecasts.

Preferred procurement method

On average, PUBLIC – with a mean value of 3.49 compared with 2.37 for PRIVATE – appear to be more in favour of PPPs over other methods. But Figure 26 shows that there is a much higher proportion of PRIVATE that prefer PPPs (71.67 per cent in ratings 1 and 2 combined) than PUBLIC (24.39 per cent 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. To investigate further what affects respondents' choice of procurement methods, we will test a range of variables against the choice of procurement as the dependent variable in the next section.

(1=PPP most preferred model, 7=PPP least preferred model)
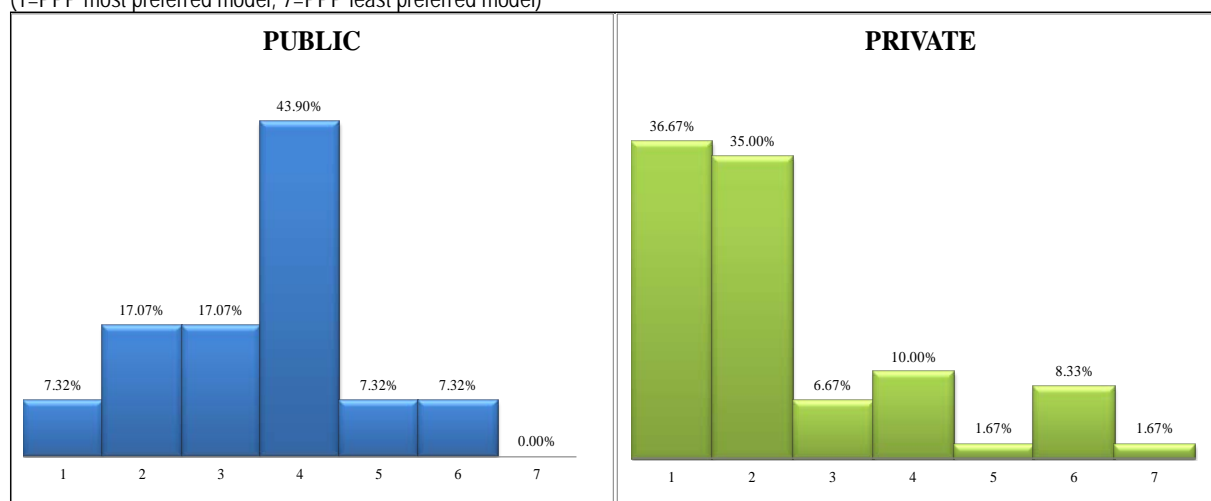
Figure 26: Prefer procurement method – PUBLIC vs. PRIVATE

Part 6: Other factors

The design

This is part six of the CAPI survey; data were collected through the screen depicted in Figure 27.

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. At the time of the survey design, the world was experiencing a significant economic downturn caused by the GFC. In particular, the crisis substantially impacted on lenders' ability and willingness to invest. Further, during the pilot study, it was drawn to our attention that the availability model and the responsibility of land acquisition are two important considerations in countries outside Australia.

The addition of these two variables to our factor list has enhanced the international relevance of the study. The mean values[16] reported in Table 5 show that PUBLIC and PRIVATE share similar views on the importance of these factors.

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[16] The data were collected through a 1-to-7 likert scale: 1 indicates that the factor is very <u>un</u>important, whereas 7 indicates that the factor is very important.

Figure 27: Other factors of influence

Table 5: Other factors – PUBLIC vs. PRIVATE

	PUBLIC (mean)	PRIVATE (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 workforce at arms length (PVOWNW)	3.10	4.18
Private ownership as a way of making it easier to charge 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

5. Derived risk index and hypothesis testing

RQ1: Public-Private-Partnership risk index

We estimated a LCM by pooling both segments of data, i.e., PUBLIC and PRIVATE.[17] After the weights are identified, we multiply each attribute level associated with the RP data in 'prior experience' by the relevant weight, and sum these calculations across all attributes for each of the 101 respondents to produce the sector-specific risk index as specified in Equation (1).

A respondent is risk-averse if the outcome of Equation (1) is negative; a respondent is risk-seeking if the outcome is positive; and a respondent is risk-neutral if the outcome is zero.

The values of risk indices associated with PUBLIC (PUBRI) are in the range of -18.53 per cent and zero per cent, with a mean value of -7.26 per cent; the range of risk indices associated with PRIVATE (PRVRI) lies between -56.98 per cent and -3.47 per cent, with a mean value of -23.15 per cent. These results suggest that all but one PUBLIC, who displays risk neutrality, are risk-averse. None displays a risk-seeking preference, not even consultants or construction companies, as we had suspected. We convert all indices into the positive range by normalising the index of the PUBRI (PRVRI) with the highest relative value to a base of zero (see Figure 28).[18]
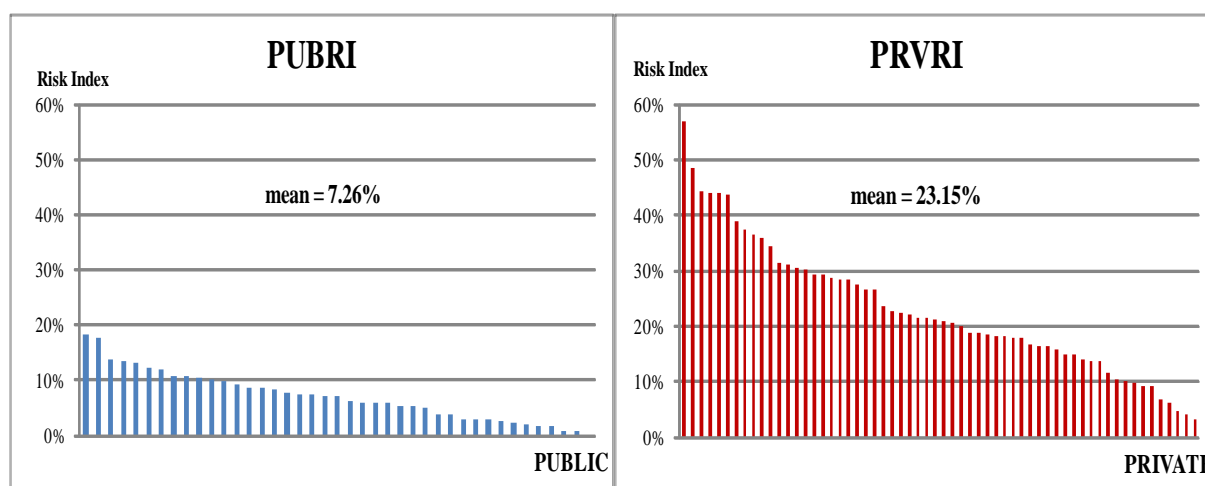
Figure 28: Risk indices – PUBRI versus PRVRI

Figure 28 clearly illustrates that PRIVATE are, on average, much more risk-averse than PUBLIC; the average risk index of the agent (23.15 per cent) is more than three times higher than that of the principal (7.26 per cent). This is supported by the t-test in Equation 2, where the two index values are statistically different from each other at the one per cent level.

$$t_n = \frac{\overline{x}_{PUBRI} - \overline{x}_{PRVRI}}{\sqrt{se^2_{PUBRI} + se^2_{PRVRI}}} = \frac{7.26 - 23.15}{\sqrt{(0.00711)^2 + (0.01533)^2}} = |-9.40| > 2.575 \tag{2}$$

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[17] We specified two latent classes, but changes in class did not improve model fit nor increase the number of significant parameters. Results are available on request from the first author.

[18] 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.

Differences in risk preference associated with specific risk attribute

To understand the differences in risk preference across the two sector cohorts using the parameter estimates of the LCM model with two classes, we converted each risk attribute from two classes, i.e., $\beta_{(k|q_1)}$ and $\beta_{(k|q_2)}$, (q denotes class) into a single β_k, and applied the Krinsky and Robb (1986) procedure[19] to generate confidence intervals (CIs) for $\beta_{k_{PUBLIC}}$ and $\beta_{k_{PRIVATE}}$ in order to test whether $\beta_{k_{PUBLIC}} = \beta_{k_{PRIVATE}}$.

The results depicted in Figure 29 were generated using the estimated CIs. The figure plots the parameter estimates that are significant for both cohorts[20] to illustrate whether the CIs overlap. The figure shows that six out of seven significant risk preferences associated with PUBLIC are significantly different from their PRIVATE counterparts at the five per cent level i.e., 95 per cent of CIs of the two data segments do not cross.

In order to make a comparison, we scaled the mean value of $\beta_{k_{PUBLIC}}$ by the ratio of $\dfrac{RANGE_{x_{D_1}}}{RANGE_{x_{D_2}}}$, and multiplied the inverse of this ratio by the mean value of $\beta_{k_{PRIVATE}}$. Results are presented in Table 6.

Table 6: Degree of differences in risk preferences

	Column A: $\dfrac{RANGE_{x_{D_1}}}{RANGE_{x_{D_2}}}$	Column B: $\dfrac{\beta_{k_{PUBLIC}}}{Column\ A}$	Column C: $\dfrac{\beta_{k_{PRIVATE}}}{Column\ B}$
TRA_D	0.66	-0.06	2.29
FIN_D	0.72	-0.03	3.93
UNC_U	0.82	0.02	2.53
POL_D	2.80	-0.01	1.64
MED_D	0.02	-0.09	-0.64
MED_U	0.01	1.28	0.05

As shown in Table 6, after scaling, the differences associated with MED_D and MED_U become negligible; however, significant differences remain in each cohort's risk preference in TRA_D, FIN_D, UNC_U and POL_D. The implications are as follows.

Traffic risk downside (TRA_D)

Respondents from both sectors are averse to this risk, but they are significantly different in terms of their degree of risk aversion – results in Table 7 suggest that PRIVATE are 2.3 times more averse to the risk than PUBLIC.

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[19] Assistance from Matthew Beck of ITLS to perform the Krinsky and Robb procedure is much appreciated.

[20] Results generated from the Krinsky and Robb procedure are available on request from the first author.

Contractual approach to optimising risk sharing: A quantitative study of the multidimensional nature of risk in private provision of road infrastructure.

Chung, Hensher and Rose

	TRA_D1	TRA_D2
LOWER	-0.05093	-0.15205
UPPER	-0.02602	-0.11426
- MEAN	-0.03828	-0.13318

	FIN_D1	FIN_D2
LOWER	-0.03693	-0.14448
UPPER	-0.00940	-0.10621
- MEAN	-0.02294	-0.12545

	UNC_U1	UNC_U2
LOWER	0.00444	0.02990
UPPER	0.02148	0.05076
- MEAN	0.01309	0.04047

	POL_D1	POL_D2
LOWER	-0.02409	-0.01364
UPPER	-0.01883	-0.01176
- MEAN	-0.02153	-0.01261

	MED_D1	MED_D2
LOWER	-0.00327	0.05866
UPPER	-0.00115	0.06189
- MEAN	-0.00233	0.06023

	MED_U1	MED_U2
LOWER	0.01389	-0.01127
UPPER	0.01475	-0.00460
- MEAN	0.01415	-0.00783

	PUB_D1	PUB_D2
LOWER	-0.03871	-0.06454
UPPER	-0.01603	-0.01799
- MEAN	-0.02720	-0.04124

Figure 29: Confidence Intervals – test of differences in risk preferences (PUBLIC vs. PRIVATE)

Financial risk downside (FIN_D)

PRIVATE are overwhelmingly (four times) more averse to financial downside risk compared with PUBLIC. Examination of Table 7 reveals that the largest difference between the two cohorts lies in this category. This is not a surprising result because PPPs are essentially a means of project finance, and financial risk is one that governments want to divest the most, therefore exposing private capital to a great deal of risk.

Unclear project objectives upside (UNC_U)

PRIVATE are three times more in favour of well-defined projects compared with PUBLIC; this sends a strong message to public procurers. Projects with good planning and clear objectives can facilitate the fulfilment of policy goals. A favourable perception from PRIVATE suggests that such projects can drive risk premiums down; so clear project objectives are a key driver of VFM.

Political and reputational risk downside (POL_D)

Here, the difference between the two cohorts arises as the result of PUBLIC being almost twice as averse to the risk than PRIVATE. This finding implies that both sectors are wary of the repercussions from political backlash due to the controversial nature of the PPP scheme. It signals to both sectors that the scheme's welcomeness, to a large extent, can be enhanced through having ongoing dialogue with users and with the community.

RQ2: Risk preferences and choice of procurement method

Armed with the knowledge of respondents' risk preferences, we are able to proceed to answer RQ2. Since respondents' choice of procurement method, as depicted in Figure 23, are presented in an ordered outcome scale of seven levels, we ran two ordered logit models to investigate the relationship between PUBRI (PRVRI) and their preferred procurement method, because an ordered response model recognises the nonlinearity of a ranking scale and defines points on the observed rating scale as thresholds (μs) (Jones and Hensher, 2004). The results are presented in Table 7.

A direct interpretation of the parameter estimates in Table 7 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 ends of the scale, i.e., Prob(Y=1) (PPP is the most preferred method) and Prob(Y=7) (PPP is the least preferred method). These are 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*.

From Table 7, the number of threshold parameters associated with PUBRI is five instead of six because the ranking scale of seven by PUBLIC has zero entries (see Figure 26). The parameter estimates of marginal effects are statistically significant at the five per cent level suggesting PUBRI has a substantial impact on PUBLIC's choice of procurement methods. The positive marginal effect of Prob(Y=1) (0.29074) and negative marginal effect of Prob(Y=6) (-0.28862) indicate that an increase in risk aversion of PUBLIC increases their preference for the PPP method and decreases their preference for other methods at a similar magnitude. For example, a one unit increase in PUBRI will increase the probability of PPP being the most preferred method by 29 per cent *ceteris paribus* while decreasing the preference for other methods by 29 per cent *ceteris paribus*.

PRVRI has a strong statistical but opposite impact on the preference of PRIVATE for PPPs. Both marginal effects are significant at the one per cent level on the probability of choosing PPP as the most preferred procurement method. The negative marginal effect of Prob(Y=1) indicates that a one unit change in the mean of PRVRI leads to a -0.56 change in the probability of Y=1, i.e., one unit increase in the risk aversion of PRIVATE reduces the probability of PPP being favoured by them by 56 per cent, *ceteris paribus*. The positive marginal effect of Prob(Y=7) suggests otherwise, although at a much lower magnitude, i.e., a one unit increase in risk aversion increases the odds of non-PPP

methods being chosen by four per cent, *ceteris paribus*. Overall, the results suggest that the greater the risk aversion of PRIVATE the _less_ preferred is the PPP method.

Table 7: PPP method versus PUBRI/PRVRI

Dependent Variable	Independent Variable	Parameter	t-value	Independent Variable	Parameter	t-value
Choice of PPP procurement method	Constant	2.85525	(15.94)	Constant	-0.00114	(-0.01)
	PUBRI	-4.30202	(-2.08)	**PRVRI**	2.41940	(3.77)
	Threshold parameters			*Threshold parameters*		
	μ (1 to 2) MU (1)	0		μ (1 to 2) MU (1)	0	
	μ (2 to 3) MU (2)	1.41340	(14.08)	μ (2 to 3) MU (2)	1.50508	(18.22)
	μ (3 to 4) MU (3)	2.20078	(22.18)	μ (3 to 4) MU (3)	1.86967	(20.15)
	μ (4 to5) MU (4)	4.31891	(30.55)	μ (4 to 5) MU (4)	2.61391	(21.14)
	μ (5 to 6) MU (5)	5.09460	(26.83)	μ (5 to 6) MU (5)	2.78739	(20.98)
				μ (6 to 7) MU (6)	4.67470	(14.69)
	Marginal effects			*Marginal effects*		
	Independent variable	Prob(Y=1)	t-value	Independent variable	Prob (Y=1)	t-value
	PUBRI (at mean)	0.29074	(2.05)	PRVRI (at mean)	-0.55997	(-3.75)
		Prob(Y=6)	t-value		Prob (Y=7)	t-value
		-0.28862	(-2.03)		0.03821	(3.30)
	AIC	*1269.66300*		*AIC*	*1787.60500*	
	LL function	*-628.83175*		*LL function*	*-886.80233*	
	N	*41*		*N*	*60*	

In short, these results suggest that the PPP method has in the past yielded better outcomes for PUBLIC in terms of risk-sharing, whereas they have not been viewed favourably by PRIVATE, as reflected by their preferences for the procurement method between PPPs and other alternatives.

Within the PPP umbrella, there exist different compensation structures, one of which is the availability payment (AM), which involves a series of periodic payments of a fixed sum to the concessionaire as long as their performance satisfies the prescribed standards. *Prima facie*, the purpose of the fixed-price contract in PPPs is to remove revenue uncertainty for the agent so that they will exert greater effort in managing performance risks. An implicit but overpowering purpose of the AM is its budget certainty to the responsible public authority. From an incentive viewpoint, a fixed-price compensation has the private sector agent bearing all the cost of operations and maintenance (Bajari and Tadelis, 2001) leaving them with all of the risk of cost uncertainty.

Based on the marginal effects of PRVRI on the AM from an ordered logit model (Table 8), the marginal effects of -0.13 for Prob(Y=1) and 0.23 for Prob(Y=7), suggest that the more risk-averse is the PRIVATE, the less effective is the AM to induce them to exert greater performance effort.

Table 8: Risk aversion versus preference for availability model

Dependent Variable	Independent Variable	Parameter	t-value
AM (descriptive statistics are reported in Table 5)	Constant	1.63782	(9.48)
	PRVRI	1.21517	(1.92)
	Threshold parameters		
	μ (1 to 2) MU (1)	0	
	μ (2 to 3) MU (2)	0.75994	(10.31)
	μ (3 to 4) MU (3)	1.04253	(13.74)
	μ (4 to 5) MU (4)	1.89818	(23.65)
	μ (5 to 6) MU (5)	2.26617	(27.30)
	μ (6 to 7) MU (6)	3.01077	(30.29)
	Marginal effects		
	Independent variable	Prob (Y=1)	t-value
	PRVRI (at mean)	-0.13476	(-1.90)
		Prob (Y=7)	t-value
		0.22959	(1.92)
	AIC	*2042.06900*	
	LL function	*-1014.03447*	
	N	*55*	

NB: N= (60-5); 5 PRIVATE took the pilot survey, questions related to AM and Land (see Figure 27) was added as the result of feedback from the pilot

Figure 30 compares the risk indices of respondents from construction companies, who generally lead the consortium bid team, with that of the other members of the bidding consortium. The comparison shows that the leader is less risk-averse (the mean value is 21.97 per cent) compared with other members of the bid team, whose mean value is 26.09 per cent.

This evidence suggests there is a second level of agency problem in that the leader can pass on risks to other members of the consortium. This problem is further supported by test results of a linear regression model summarised in Table 9, which demonstrates that construction companies are the least risk-averse among all members of the consortium.

The results are consistent with our earlier analysis that construction companies and consultants are most aggressive in making investment decisions.

Risk Index: Consortium Leader (Construction companies)

Risk Index: Other Members of the Consortium
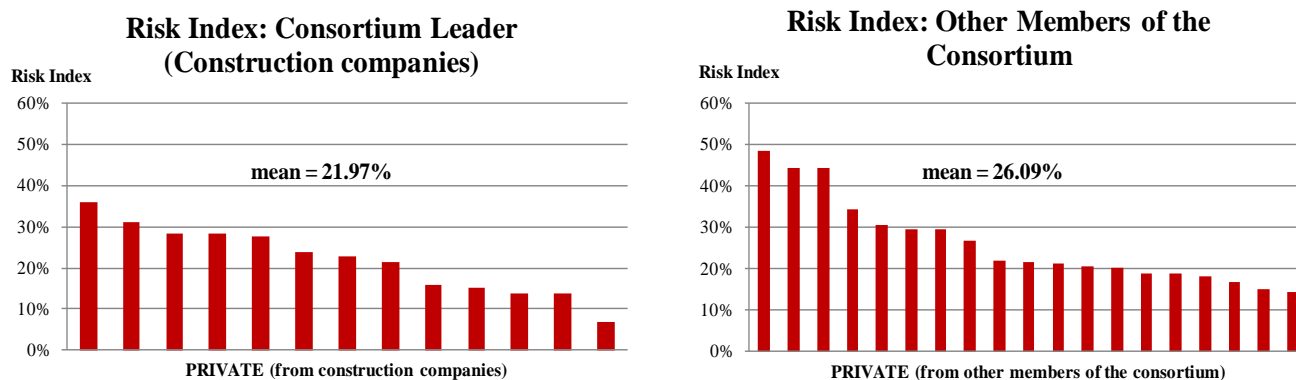
Figure 30: Risk Indices – consortium leader versus other members of the consortium

Table 9: Second level of agency problem within members of consortium team

Dependent Variable	Independent Variable	Parameter	t-value	Adjusted R^2
PRVRI	Constant	0.09580	(16.58)	0.20805
	Construction Company	0.02972	(3.24)	
	Consultancy	0.03581	(4.46)	
	Investment Bank	0.07433	(7.20)	
	Tollroad Company	0.07928	(10.10)	
	Other Organisation	0.08595	(10.03)	
	N	*60*		

Hypothesis testing

Theory of incomplete contract

Here we test the effect of property rights on the incentives of contracting parties. We test this proposition from the private sector agent's perspective in a number of dimensions: (a) ownership effect on protecting PRIVATE from unclear project objectives; (b) ownership effect on the willingness of PRIVATE to exercise pricing control; and (c) reaction of PRIVATE to public perception that ownership transfer is seen transferring government's accountability for issues related to labour productivity. Results are reported in Table 10.

Table 10: Ownership effects on PRIVATE

Dependent Variable	Independent Variable		Parameter	t-value	Adjusted R^2	Hypothesis	Reject	Model
PRVRI	Constant		0.20622	(27.54)	0.09180			
	UNC_{D2}		0.00180	(7.65)		1a	NO	Multivariate linear regression
	$FREETOLL_{D2}$		0.04292	(2.97)		2a	YES	
	$PVOWNW_{D2}$		-0.02727	(-2.88)		3a	YES	
	N			*600*				
Choice of PPP Procurement Method	Constant		0.72181	(6.92)	N/A	1b	NO	Ordered logit
	UNC_{D2}		-0.00899	(-2.36)	N/A			
	Threshold parameters							
	μ (1 to 2)	MU (1)	0					
	μ (2 to 3)	MU (2)	1.48719	(18.15)				
	μ (3 to 4)	MU (3)	1.84805	(20.07)				
	μ (4 to 5)	MU (4)	2.59356	(21.05)				
	μ (5 to 6)	MU (5)	2.76775	(20.90)				
	μ (6 to 7)	MU (6)	4.64902	(14.62)				

Marginal effects

Independent variable	Prob (Y=1)	t-value	Prob (Y=7)	t-value
UNC_{D2} (at mean)	0.00208	(2.36)	-0.00014	(-2.23)

AIC	*1796.03700*	
LL function	*-891.01858*	
N	*600*	

Data of UNC_{D2} are downside risk of unclear project objectives of PRIVATE from 'prior experience' (see Figure 21 and Table 3). Data of $FREETOLL_{D2}$ and $PVOWNW_{D2}$ are the 1-7 likert scale from 'other factors' (see Figure 27 and Table 5) and have been coded into dummy variables.

The parameter estimate of UNC_{D2} (0.00180) is highly significant at the one per cent level. The positive sign signals that the higher the risk of unclear project objectives by the procuring authority, the greater the risk aversion of PRIVATE; so H1a cannot be rejected.

After the significance of UNC_{D2} had been confirmed, we estimated an ordered logit model to analyse whether ownership transfer has the effect of shielding PRIVATE from the risk, by testing UNC_{D2} against their choice of procurement method. The positive (negative) marginal effect of Pro(Y=1) 0.00208 (Prob(Y=7), -0.00014) indicates that the higher the risk of unclear project objectives, the more preferred is the PPP method by PRIVATE; hence, H1b is not rejected.

Unclear project objectives by the public sector have in the past provided PRIVATE with greater opportunities to exercise their own discretion in terms of project scope and delivery; which may explain the preference of PRIVATE for PPPs because only PPPs give them the ownership freedom to make decisions for uncontracted for events.

The right to price control yields an effect similar to UNC_{D2}. The positive parameter of $FREETOLL_{D2}$ (0.04033)[21], which is significant at the one per cent level, shows that such ownership right increases the risk aversion of PRIVATE. We therefore reject H2a and conclude that PRIVATE are reluctant to exercise their entitlement to pricing control. The reason for this could be due to strong public averseness to toll pricing, and the private proponents not wishing to be seen to be using their right to set tolls for private gain at the expense of the public purse, which may have a detrimental effect on patronage.

PPPs are often perceived by the public as a facilitating mechanism for governments to transfer ownership-related risks, such as those arising from workforce disputes (PVOWNW). The parameter estimate of $PVOWNW_{D2}$ is significant at the one per cent level and is of negative sign. This means the higher the public perception, the lower the risk aversion of PRIVATE, so H3a is rejected.

Table 11 reports the results of testing ICT from the perspective of PUBLIC. All parameter estimates are significant at the one per cent level, signalling that ownership effects also have a significant impact on PUBLIC. The positive sign of UNC_{D1} (0.00093) confirms that PUBLIC dislike the risk of unclear project objectives, as the higher the risk, the greater their risk aversion. Accordingly, H1c is not rejected.

Table 11: Ownership effects on PUBLIC

Dependent Variable	Independent Variable	Parameter	t-value	Adjusted R^2	Hypothesis	Reject	Model
PUBRI	Constant	0.03760	(16.84)	0.57676			
	UNC_{D1}	0.00093	(19.68)		1c	NO	Multivariate linear regression
	$FREETOLL_{D1}$	0.01005	(3.06)		2b	YES	
	$PVOWNW_{D1}$	0.04454	(4.39)		3b	NO	
	N		*410*				

NB: $FREETOLL_{D1}$ combines scale=5, 6 and 7; $PVOWNW_{D1}$ combines scale=6 and 7.

The positive sign of $FREETOLL_{D1}$ (0.01005) means we reject H2b. ICT argues that when contracting parties are risk-averse, reservation of residual rights is most likely. Our data strongly upholds this proposition. Both cohorts are confirmed as risk-averse and are found to be restrained to exercise/release the right to price control. This finding represents a significant empirical contribution to the literature of property rights as it demonstrates that the effectiveness of ownership assignment as an incentive device hinges on the contracting parties' risk preferences. When both the agent and the principal are risk-averse, property rights to *ex post* surplus have little effect in incentivising the agent, and at the same time secure little support from the principal.

The positive sign of $PVOWNW_{D1}$ (0.04454) suggests that the public perception of ownership transfer is that accountability transfer increases the risk aversion of PUBLIC, i.e., such perception will have a negative effect on the political popularity of the PPP method. More needs to be done to correct these misperceptions if PPPs are to gain the public's support.

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[21] This is interpreted as follows: a PRIVATE who has a scale of 7=1 in FREETOLL has a risk index value that is four per cent greater than a PRIVATE with a scale of 1, ..., 6=1, other things being equal; a similar interpretation applies to other hypothesis testing using dummies as the independent variables.

Transaction cost economics

Institutional framework versus preference for procurement method (the shift parameter framework)

A set of shift parameters (Williamson, 1991) can change the comparative cost of governance, and in some cases shift the form of governance (González-Diaz *et al*., 1998; Oxley, 1999; Arruñada *et al*., 2004; 2009). We extend the notion of institutional parameters defined as the set of fundamental political, social, and legal rules that sets the boundary within which economic activity takes place (North, 1991), to determine a set of shift parameters in the PPP environment. These are sovereign risk (which defines the political environment), *force majeure* (as a proxy of the legal environment), unclear project objectives (proxy of political commitment), political and reputational risk (proxy of reputation and trust), media risk (proxy of the social perspective of PPPs), and public perception risk (proxy of public attitudes toward PPPs).

We hypothesised that these shift parameters have a significant effect on the choice of procurement method by all contracting parties. We test this using the data from 'prior experience'. Based on the results of an ordered logit model summarised in Table 12, we cannot reject H4.

For PRIVATE, five out of six or 83 per cent of the marginal effects of risks have a strong statistical impact on their preference for PPPs; the only insignificant effect is associated with PUB_D. For PUBLIC, only three out of six or half the marginal effects have a statistical impact on their preference for PPPs. The interpretations are summarised in Table 13.

Table 12: Shift parameter framework

Dependent Variable	Independent Variable	PRIVATE(D2)		PUBLIC(D1)	
		Parameter	t-value	Parameter	t-value
Choice of PPP Procurement Method	Constant	0.31036	(1.98)	3.16797	(17.02)
	FOR_D	0.01881	(5.30)	-0.00829	(-1.88)
	SOV_D	-0.00718	(-1.78)	-0.00757	(-1.21)
	UNC_D	-0.02120	(-4.99)	-0.00449	(-0.74)
	POL_D	0.03185	(4.98)	-0.00445	(-0.65)
	MED_D	-0.01634	(-2.59)	-0.01535	(-2.23)
	PUB_D	0.00897	(1.46)	0.01742	(3.12)
	Threshold parameters (only 5 for PUBLIC due to no entries in Y=7)				
μ (1 to 2)	MU (1)	0		0	
μ (2 to 3)	MU (2)	1.59530	(18.45)	1.49282	(14.31)
μ (3 to 4)	MU (3)	1.98219	(20.50)	2.29667	(22.43)
μ (4 to 5)	MU (4)	2.78328	(21.85)	4.52372	(31.28)
μ (5 to 6)	MU (5)	2.96870	(21.73)	5.32128	(27.77)
μ (6 to 7)	MU (6)	4.88765	(15.29)		
Marginal effects					
	Independent variable	Prob (Y=1)	t-value	Prob (Y=7)	t-value
	FOR_{D2} (at mean)	-0.00430	(-5.24)	0.00025	(4.08)
	SOV_{D2} (at mean)	0.00164	(1.78)	-0.95877E-04	(-1.69)
	UNC_{D2} (at mean)	0.00485	(4.94)	-0.00028	(-4.04)
	POL_{D2} (at mean)	-0.00729	(-4.90)	0.00043	(4.00)
	MED_{D2} (at mean)	0.00374	(2.58)	-0.00022	(-2.44)
	PUB_{D2} (at mean)	-0.00205	(-1.46)	0.00012	(1.43)
		Prob (Y=1)	t-value	Prob (Y=6)	t-value
	FOR_{D1} (at mean)	0.00052	(1.82)	-0.00050	(-1.85)
	SOV_{D1} (at mean)	0.00047	(1.22)	-0.00045	(-1.19)
	UNC_{D1} (at mean)	0.00028	(0.73)	-0.00027	(-0.74)
	POL_{D1} (at mean)	0.00028	(0.65)	-0.00027	(-0.66)
	MED_{D1} (at mean)	0.00095	(2.21)	-0.00092	(-2.13)
	PUB_{D1} (at mean)	-0.00108	(-3.00)	0.00105	(2.92)
	AIC		*1745.12400*		*1248.28000*
	LL function		*--860.56183*		*-613.41015*
	N		*60*		*41*
	H4	**Reject: NO**			

Table 13: Interpretation of marginal effects in Table 12

Shift Parameters	PRIVATE$_{D2}$		PUBLIC$_{D1}$	
	Interpretation (Prob(Y=1))	Interpretation (Prob(Y=7))	Interpretation (Prob(Y=1))	Interpretation (Prob(Y=6))
FOR$_D$	-0.00430 (-5.24) Significant at 1% level; 1 unit ↑ in the average value of the risk experienced will ↓ PRIVATE's preference for PPPs by 0.43%, *ceteris paribus*.	0.00025 (4.08) Significant at 1% level; 1 unit ↑ in the average value of the risk experienced will ↑ PRIVATE's preference for non-PPPs by 0.03%, *ceteris paribus*.	0.00052 (1.82) Significant at 10% level; 1 unit ↑ in the average value of the risk experienced will ↑ PUBLIC's preference for PPPs by 0.05%, *ceteris paribus*.	-0.00050 (-1.85) Significant at 10% level; 1 unit ↑ in the average value of the risk experienced will ↓ PUBLIC's preference for non-PPPs by 0.05%, *ceteris paribus*.
	The results across two segments suggest that in the past, the private sector may have taken on greater shares of the risk. A more balanced sharing of this risk will strengthen the social benefits that the policy can offer.			
SOV$_D$	0.00164 (1.78) Significant at 10% level; 1 unit ↑ in the average value of the risk experienced will ↑ PRIVATE's preference for PPPs by 0.16%, *ceteris paribus*.	-0.95877E-04 (-1.69) Significant at 10% level; 1 unit ↑ in the average value of the risk experienced will ↓ PRIVATE's preference for non-PPPs by 0.01%, *ceteris paribus*.	0.00047 (1.22) Insignificant	-0.00045 (-1.19) Insignificant
	The results imply that the PPP projects experienced by PRIVATE occurred in countries where supportive policy and legal frameworks were present.		**This is consistent with our conclusion drawn from Figure 17; in fact, all PUBLIC informed the first author that they believed that their political frameworks were mature and stable for PPPs.**	
UNC$_D$	0.00485 (4.94) Significant at 1% level; 1 unit ↑ in the average value of the risk experienced will ↑ PRIVATE's preference for PPPs by 0.49%, *ceteris paribus*.	-0.00028 (4.04) Significant at 1% level; 1 unit ↑ in the average value of the risk experienced will ↓ PRIVATE's preference for non-PPPs by 0.03%, *ceteris paribus*.	0.00028 (0.73) Insignificant	-0.00027 (-0.74) Insignificant
	The results are consistent with H1b.		**This indicates that insufficient consideration was given by public authorities to assessing the ramifications of unclear project objectives on government's overall infrastructure planning and policy implementation.**	

Contractual approach to optimising risk sharing: A quantitative study of the multidimensional nature of risk in private provision of road infrastructure.

Chung, Hensher and Rose

Shift Parameters	PRIVATE$_{D2}$		PUBLIC$_{D1}$	
	Interpretation (Prob(Y=1))	Interpretation (Prob(Y=7))	Interpretation (Prob(Y=1))	Interpretation (Prob(Y=6))
POL$_D$	-0.00729 (-4.90) Significant at 1% level; 1 unit ↑ in the average value of the risk experienced will ↓ PRIVATE's preference for PPPs by 0.73%, *ceteris paribus*.	0.00043 (4.00) Significant at 1% level; 1 unit ↑ in the average value of the risk experienced will ↑ PRIVATE's preference for non-PPPs by 0.04%, *ceteris paribus*.	0.00028 (0.65) Insignificant	-0.00027 (-0.66) Insignificant
	The results across two cohorts offer useful insights into understanding how political risk was perceived by PRIVATE and PUBLIC respectively. For PRIVATE, political risk lowers their incentive to invest in PPPs, in particular because PPPs are long-term projects; this perception is also reflected in their investing behaviour revealed by SOV$_D$, explained earlier in this table. On the other hand, PUBLIC did not consider POL$_D$ was an important factor; this is not because they did not believe political risk would have a decisive influence on the future of PPPs (in fact they did, as evidenced by the interview data), but rather, the risk was in the hands of politicians and therefore beyond their control.			
MED$_D$	0.00374 (2.58) Significant at 1% level; 1 unit ↑ in the average value of the risk experienced will ↑ PRIVATE's preference for PPPs by 0.37%, *ceteris paribus*.	-0.00022 (-2.44) Significant at 5% level; 1 unit ↑ in the average value of the risk experienced will ↓ PRIVATE's preference for non-PPPs by 0.02%, *ceteris paribus*.	0.00095 (2.21) Significant at 5% level; 1 unit ↑ in the average value of the risk experienced will ↑ PUBLIC's preference for PPPs by 0.10%, *ceteris paribus*.	-0.00092 (-2.13) Significant at 5% level; one unit ↑ in the average value of the risk experienced will ↓ PUBLIC's preference for non-PPPs by 0.09%, *ceteris paribus*.
	The results are consistent with our conclusion to RQ1; i.e., the risk is significant to both cohorts and magnitudes of difference are negligible. The effects of media risk are similar across the two cohorts, indicating on average that media was supportive of the scheme (taking into account experience was collected from 32 countries). This sends a strong signal to all scheme participants, public and private, that media is one of the powerful influences to either the success or the demise of the scheme.			
PUB$_D$	-0.00205 (-1.46) Insignificant	0.00012 (1.43) Insignificant	-0.00108 (-3.00) Significant at 1% level; 1 unit ↑ in the average value of the risk experienced will ↓ PUBLIC's preference for PPPs by 0.11%, *ceteris paribus*.	0.00105 (2.92) Significant at 1% level; one unit ↑ in the average value of the risk experienced will ↑ PUBLIC's preference for non-PPPs by 0.11%, *ceteris paribus*.
	The results strongly suggest that this risk of social dimension is of primary concern to the public sector. Although past experience related to this risk has not generated any significant impact on PRIVATE, it should not be interpreted that this risk should be managed by the public sector alone. As we argued in Chung *et al*. (2010), commitments from the private sector to make the PPP scheme welcome by the community can help in reducing the risk.			

Contract and institutional conditions versus risk preferences

We call on the Chiles and McMackin (1996) model to incorporate variable risk preferences into the TCE framework in order to explain the governance choice as a function of risk preferences. This enables us to test the power of influence of uncertainty exerted by institutional factors and contractual conditions on each of the sector-specific risk indices respectively. Results shown in Table 14 confirm that these variables do have some power of influence on uncertainty (all are significant at the 10 per cent level), albeit in different ways with respect to PRVRI and to PUBRI.

Table 14: Power of influence of institutional factors and contractual conditions on uncertainty

Dependent Variable	**PRVRI**			**PUBRI**		
Independent Variables	Parameter	t-value	Adjusted R^2	Parameter	t-value	Adjusted R^2
Constant	0.21421	(15.05)	0.19264	0.09261	(16.87)	0.34738
	Institutional Factors					
$GFC_{D2/D1}$	0.05420	(5.64)		-0.02582	(-3.80)	
$FGROWTH_{D2/D1}$	-0.03779	(-3.02)		0.03326	(3.87)	
$TPRICETD_{D2/D1}$	-0.02957	(-2.22)		-0.01773	(-3.74)	
	Contractual conditions					
$FREETOLL_{D2/D1}$	0.04649	(2.77)		-0.04344	(-4.77)	
$DURATION_{D2/D1}$	0.02458	(2.39)		0.02738	(4.60)	
$PERSDR_{D2/D1}$	0.08740	(5.28)		-0.02832	(-4.61)	
$FPENALTY_{D2/D1}$	-0.10906	(-6.30)		0.00966	(1.83)	
$TRSHARE_{D2/D1}$	0.08967	(5.07)		0.07316	(8.08)	
$LAND_{D2/D1}$	-0.02395	(-1.66)		-0.02332	(-4.42)	
	N	55		*N*	32	
H5a	**Reject: NO**		**Model: Multivariate linear regression**			
NB: N_{PUBLIC}=32, 9 PUBLIC took the pilot survey in which LAND was not included; and						

For example, the different signs with respect to GFC, FGROWTH, FREETOLL, PERSDR and FPENALTY suggest that these parameters significantly influence the two cohorts in very different ways. Respectively, the GFC factor and the condition of FREETOLL in contract will increase the risk aversion of PRIVATE, *ceteris paribus*. The GFC worsened the market's ability to finance these mega infrastructure projects and we have demonstrated repeatedly that PPPs are perceived as a financing mechanism for governments to circumvent fiscal constraints.

As explained in the preceding section, the private partner having the right to set toll pricing will create the public perception that PPP projects accrue benefits to private investors at the cost of motorists, which will have a detrimental impact on patronage. The private sector understands this ramification and therefore prefers not to exercise this entitlement. The signs of parameter estimates of GFC and FREETOLL for PUBLIC are negative, indicating that the presence of these conditions will reduce the risk aversion of public sector authorities. The reason for this result is unclear; this could be an area for future research.

The factor of FGROWTH increases the risk aversion of PUBLIC but decreases the risk aversion of PRIVATE, *ceteris paribus*. The growth factor implies the expansion of the PPP scheme, however, the result here signals that PUBLIC do not prefer to see a greater adoption of PPPs in delivering transport infrastructure. This is in contrast to the outcome in Table 7, where based on respondents' real experience, PUBLIC viewed PPPs favourably in the presence of other alternatives. A possible explanation may be that the greater public scrutiny and higher transaction costs associated with PPPs make them less appealing to PUBLIC.

These contrasting outcomes demonstrate that behavioural perceptions can be very different from reality. The growth factor has generated a positive impact for the PRIVATE (the negative sign associated with PRVRI means risk aversion is lessened), because it signals that greater opportunities will open up for private investment.

FPENALTY$_{D2}$ has a negative sign, indicating that the risk-averse PRIVATE prefer an outcome-based model that rewards their efforts based on agreed performance standards, with corresponding abatements for failing to adhere to these standards.

The negative sign of PERSDR$_{D1}$ for PUBLIC explains their strong desire to have in place clear performance measures to evaluate the outcome of service efforts by PRIVATE (the negative sign means embedded performance standards will lower the risk aversion of PUBLIC *ceteris paribus*).

However, the condition of imposing financial penalties on under-performance increases the risk aversion of PUBLIC, *ceteris paribus* (FPENALTY$_{D1}$ is positive). Some PUBLIC explained to the first author that they found this kind of model presented too much operational difficulty because it was not easy to prove that the private proponent had failed to meet the standards and most of their arguments did not get upheld in court. Their view is in line with the proposition of ICT and TCE that court-ordering is not a solution to incomplete contracts due to the bounded rationality of the outside arbitrator.

Respondents from both sectors are risk-averse to the idea of sharing toll revenue, as indicated by the positive TRSHARE$_{D2/D1}$. This is because they do not wish to be perceived as making a financial gain from commuters travelling on the facility, with the ramifications of reduced patronage and political backlash.

The duration of the concession has a negative impact on respondents from both sectors (the positive DURATION$_{D2/D1}$ represent worsening risk aversion due to this condition, *ceteris paribus*). This suggests that it will take longer to recover the costs of investment and there is a higher chance of change in environment factors, hence producing higher uncertainty.

The condition of LAND reduces the risk aversion of respondents of both sectors, *ceteris paribus*. Both PRIVATE and PUBLIC believed that government has the power and resources to acquire the necessary land for constructing the underlying facility. Future PPP concessions should consider allowing government to retain this risk, as it will translate into greater VFM by lowering the risk premium charged by the private proponents. This approach has been adopted in a recent project – the Peninsula Link in the State of Victoria in Australia.

Interestingly, the negative TPRICETD$_{D2/D1}$ hint that both sectors consider toll pricing can do more than just act as a means of finance, as it currently stands (the condition lessens their risk aversion *ceteris paribus*). This is a strong message for politicians, who should consider structural reforms to the PPP tollroad scheme in order to gain a greater benefit at the macroeconomic level. Market discipline can enhance the benefit of pricing mechanisms to help change people's travelling habits (e.g., de Palma *et al.*, 2007a; de Palma *et al.*, 2007b), a benefit that is presently not being exploited to its fullest extent.

Not only do these results lead us not to reject H5a, they also offer useful insights into ways of minimising uncertainty. Changes to contractual conditions (which can be negotiated) and prudent financial regulations by government (to avoid further disasters like the GFC) that will make the environment more welcome to private capital investments can help enhance VFM.

Among the key arguments of TCE is the power the institutional background has on the uncertainty effect, which channels through to the choice of governance mode, affecting contracting parties' risk preference. Our sample data supports this proposition (Table 15), where the positive parameter associated with SOV_{D2} (0.00238) showing that greater sovereign risk causes higher risk aversion of PRIVATE leads us to not reject H5b.

Reputational effect

TCE maintains that economic actors who engage in repeated transactions value their reputation with their transacting parties. Media is a powerful source of influence on reputational risk. How supportive local media had been to PPPs in the past (captured by 'prior experience') would have an influential impact on the private proponents' risk preferences.

We cannot reject H6 based on the results in Table 15, where the positive MED_{D2} (0.00184) suggests that a higher risk of negative media coverage increases the risk aversion of PRIVATE. Therefore, we confirm that media exposure can help contain opportunistic behaviour by private partners due to the consequent future economic consequences of negative reputational effects.

Table 15: Institutional and reputational effects

Dependent Variable	Independent Variable	Parameter	t-value	Adjusted R^2	Hypothesis	Reject	Model
PRVRI	Constant	0.14399	(20.66)	0.35240			Multivariate Linear regression
	SOV_{D2}	0.00238	(13.87)		5b	NO	
	MED_{D2}	0.00184	(8.07)		6	NO	
	N	*60*					

Risk preferences versus risk-sharing

The Chiles and McMackin model (1996) predicts that contractual conditions can change transactors' risk preferences. We argue that in a risk-sharing partnership, the allocation of risks can affect contracting parties' risk preferences.

We have established in RQ1 that private sector agents are much more risk-averse compared with public sector authorities. This implies that governments and users of the facilities are being charged a high risk premium to compensate for the risks undertaken by private sector partners. But what if risks were allocated on a more equitable basis – would that reduce agents' risk aversion?

We test this proposition by simulating the data of risk allocations in the 'prior experience', where we allocate traffic risk and financial risk 50/50 between the two sectors, i.e., they are shared equally. Figure 31 shows that both risk indices have decreased after the simulation. The average PUBRI has dropped slightly (the average value is down by 28 per cent, from 7.26 per cent to 5.24 per cent) while the PRVRI has fallen dramatically (the average value is down by 38 per cent from 23.15 per cent to 14.40 per cent).
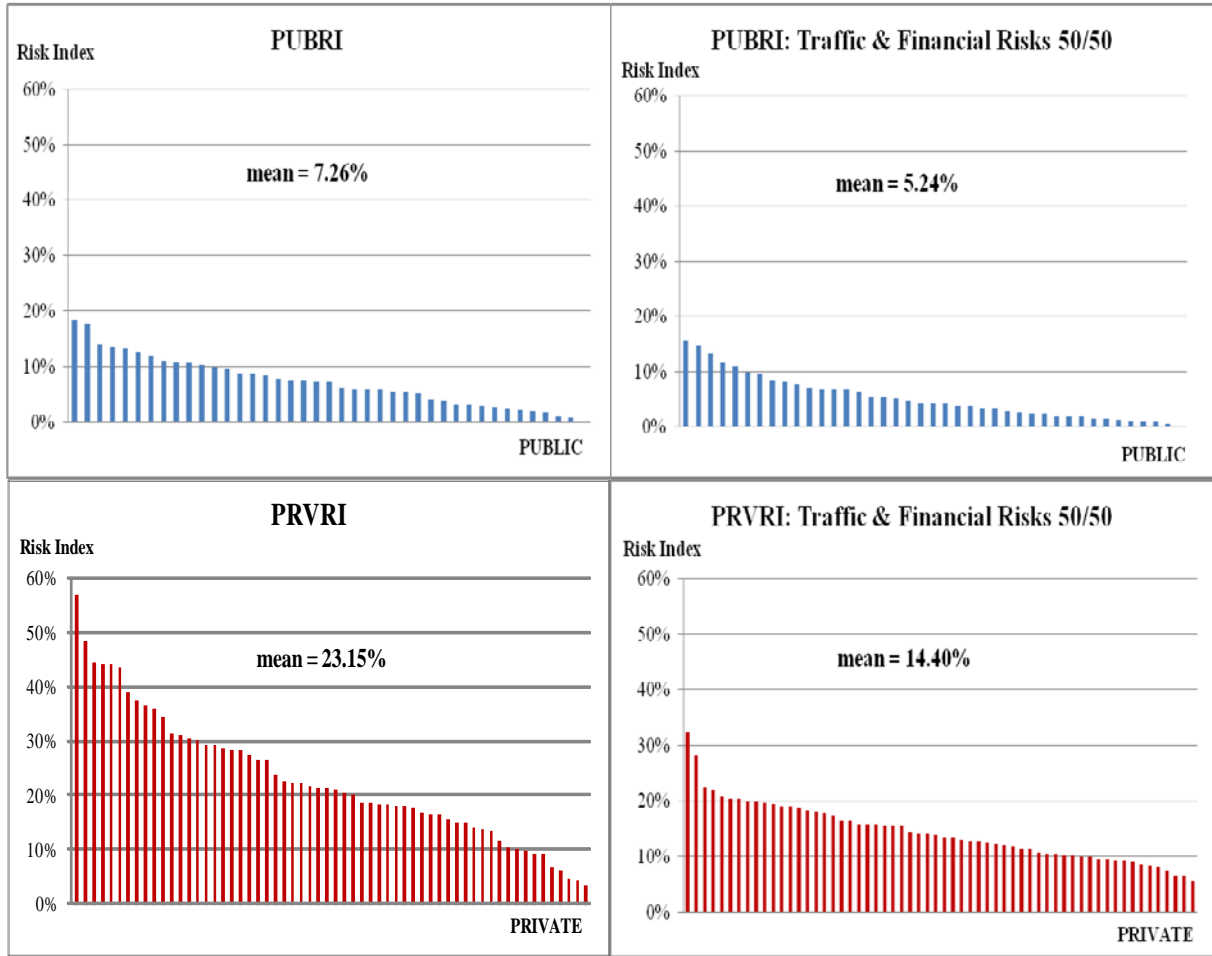
Figure 31: Risk index comparison – before versus after simulation

The fall in the PRVRI is within expectations, which corresponds to the point we raised earlier, that the norm in the current risk-sharing regime is to shift all risks to the private sector. The fall in the PUBRI is also reasonable. Recall the discussion in Section 4 that most PUBLIC cared about project risks simply because they did not want the project to fail. Taking on the responsibility of sharing some of the traffic and financial risks will assure them higher certainty in terms of project success and budget certainty.

Two t-tests in Equations (3) and (4) indicate that the risk indices after the simulation are significantly different to those prior to the simulation. Hence, we cannot reject H7 at the five per cent significant level, that risk preferences are significantly affected by contractual conditions; in this case, how risks are shared.

$$t_{PUBRI} = \frac{\bar{x}_{PUBRI\,(after)} - \bar{x}_{PUBRI\,(before)}}{\sqrt{se^2_{PUBRI\,(after)} + se^2_{PUBRI\,(before)}}} = \frac{5.24\% - 7.26\%}{\sqrt{(0.00624)^2 + (0.00711)^2}}$$
$$= |-2.133| > 1.96 \tag{3}$$

$$t_{PRVRI} = \frac{\bar{x}_{PRVRI\,(after)} - \bar{x}_{PRVRI\,(before)}}{\sqrt{se^2_{PRVRI\,(after)} + se^2_{PRVRI\,(before)}}} = \frac{14.40\% - 23.15\%}{\sqrt{(0.00682)^2 + (0.01533)^2}}$$
$$= |5.21| > 1.96 \tag{4}$$

6. Conclusions, policy implications and future research

Optimising risk-sharing among parties that are profoundly different in terms of interests, objectives and risk preferences is the rationale underlying the VFM rhetoric in the current PPP procurement policy. This study has brought together the literature in a number of disciplines to investigate the extent to which the risk-sharing rationale in PPPs can facilitate the realisation of VFM, and to search for mechanisms of risk-sharing optimisation.

The evidence collected through the CAPI survey has affirmed that risk-sharing is a crucial element in deriving VFM. The conclusions drawn and recommendations made herein are backed up by evidence collected over 32 countries, strengthening the international credentials of the study. We believe that this study can make a significant contribution to the betterment of policy-making in the private provision of public infrastructure delivery.

In spite of the VFM rhetoric, the survey data strongly suggested that PPPs were essentially considered to be a financing method rather than a procurement method of infrastructure-based service. The caveat is that too much emphasis is being placed on cost savings and budget certainty for the public sector agency without truly acknowledging the power of the pricing mechanism, which can help realise the full potential of an integrated, multi-modal transport network. A further implication of PPPs being primarily a financing instrument is that it is questionable whether they can deliver VFM in terms of social benefit. PPPs have tended to be selected for projects that are fairly unambiguous about the benefits to the private sector. Thus, investment priorities have been steered toward focusing on projects in corridors that the private sector can understand, and away from networks and systems that ultimately are areas where the overall economic welfare benefit should be identified. These projects in corridors are only a subset of the network, the strong focus on which may result in the rest of the network being either underpriced or neglected.

In an effort to answer the questions posed, this research has affirmed a number of significant relationships that involve the risk preferences of contracting parties: choice of procurement method, contractual conditions, the institutional environment (which includes the legal system and the political system), the clarity of government's strategic objectives, property rights, and the way in which risks are shared among contracting parties. We conclude that risk-sharing can be optimised through more equitable risk allocation, better handling of public misperception about the scheme and misperceived social risks associated with ownership transfer, undertaking reforms at the institutional level to make the environment more conducive to PPP investments, and selecting a reputable private partner for a sustainable partnership.

Contributions to policy making

This study not only quantifies risk preferences, but also provides an internally consistent framework in which the trade-off between risks can be identified, and the extent to which barriers that might prevent both parties in identifying areas where they may need to compromise can be gauged.

Within this framework is the PPPRI – derived based on the direct experience of stakeholders in a large number of tollroad projects from 32 countries. The PPPRI has great potential. 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 trade-offs between different risk combinations and decide what risks they wish to take on and those they can transfer, taking into account the risk premium they would require.

The PPPRI 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. Our

hypothesis testing has demonstrated this potential. This contribution is significant, in that policy makers can now make adjustments to the contract and the procurement policy to influence contracting parties' risk preferences to correspond to the level of risk premium that the procurer is willing to and able to afford.

Future research

We have uncovered potential avenues of risk-sharing optimisation through data simulation to create scenarios of risk allocation. This is only the beginning of an exciting research agenda; much greater discoveries could be unearthed by extending the process to other risk attributes, contractual as well as institutional conditions.

Finally, while our focus is on risk-sharing during contract design, PPPs are long-term contracts, so there will be ongoing issues during the operation and maintenance period. Future research can investigate post-implementation risks and post-concession risks, which form part of an important line of research on incentive schemes.

Appendix A: Definitions of risk attributes

	Downside risk of X% **indicates that there is a X% probability that**	**Risk neutral of Y%** **indicates that there is a Y% probability that**	**Upside gain of Z%** **indicates that there is a Z% probability that**
Traffic risk	the actual traffic volume will be below forecast	the actual traffic volume will be meeting the forecast	the traffic volume will be above the forecast
Financial risk	changes in economic conditions will adversely affect the financial returns the tollroad is expected to earn	changes in economic conditions will make no difference to the financial returns the tollroad is expected to earn	changes in economic conditions will increase the financial returns the tollroad is expected to earn
Network risk	future transport network developments by government may reduce traffic flows to the tollroad	future transport network developments by government may have no major impact on traffic flows to the tollroad	future transport network developments by government may increase traffic flows to the tollroad
force majeure	the occurrence of uninsured events may worsen the tollroad's performance	in the event that uninsured events occur, the other party will agree to a transparent approach to redress the aggrieved party	all events are well insured, or if not both parties are willing to negotiate in good faith to redress the aggrieved party
Sovereign risk	future changes in government policies may worsen policy fragmentation across different levels of government	future changes in government policies may not have an effect on the existing overall PPP policy framework	future changes in government policies may result in a more consistent and coherent PPP policy framework across all political jurisdictions
Risk of unclear project objectives	project objectives are unspecified or are unclear to contracting parties and the community	project objectives are clearly specified and there are clear communications amongst contracting parties and the community	project objectives are made clear to the market and project deliveries will adhere to stated objectives throughout all project phases
Political and reputation risk	contracting parties will not deliver the project in the public interest, the public sector is seen as offloading public accountability, thus causing public resentment to the PPP scheme and the project	political and reputational risk is not of significant concern	all parties understand this risk and are willing to internalise this risk within its own sector as well as to collaborate with the other party to resolve public resentment
Media risk	the media is critical of the PPP scheme/project, thus exposing the tollroad to poor publicity	the media is neutral to the PPP scheme/project, thus resulting in low publicity for the tollroad	the media is supportive to the PPP scheme/project, it conveys to the community the public benefits of the tollroad, resulting in welcome publicity
Risk of public perception	public acceptance of private ownership of tollroad, public expectations of benefits derived from the tollroad, and of both sectors' commitment to the community are poor	public perceptions of private ownership of tollroad, public expectations of benefits derived from the tollroad, and of both sectors' commitment to the community are of insignificant concern	the public welcomes private ownership of tollroad and public expectations of benefits derived from the tollroad and of both sectors' commitment to the community are high

Appendix B: List of survey respondents

The table below lists, in alphabetical order, the people who generously offered us their valuable time in filling out the experiment survey and shared with us their invaluable expertise in the field of PPPs and tollroads. We wish to take this opportunity to acknowledge their generosity and kindness, as well as the people who wish to remain anonymous, without whom, this research would not have been possible.

Comments expressed in this report do not represent the views or opinions of any individual who participated in the survey.

LAST NAME	OTHER NAMES	ORGANISATION
Adam	Wendy	PB, AUSTRALIA
Akers	Gillian	Strategic design + Development
Allen	Bob	Sydney Harbour Tunnel Company Ltd
Alli	Nazir	South African National Roads Agency Ltd
Arndt	Raphael	Future Fund
Arriaga	Javier Lopez	Acciona, SPAIN
Ashley	David	SKM, AUSTRALIA
Aubert	Julian	Scott Wilson, UK
Balfe	Peter	Balfe & Assoc
Bleach	Murray	Intoll
Brock	Tom	GHD Pty Ltd, AUSTRALIA
Brown	Stephen	Access Capital Advisers
Burns	Brett	
Camarsh	Chris	CP2, USA
Canavan	Tony	Department of Treasury and Finance, VIC
Cantan	Linda	Plenary Group
Carew	Mark	Transfield Services
Carr	John	PwC, UK
Cavanagh	Gerard	Arup
Chilov	Robert	Macquarie Group
Clark	Sarah	Partnerships British Columbia, CANADA
Cleary	Flan	RiverCity Motorway
Cleary	Michael	ANZ
Coertjens	Ton	Rijkswaterstaat, NETHERLANDS
Daley	Ken	Transurban, USA
Dawson	Ken	Crosscity Motorway
de Vera	Fernando Gutiárrez	
DEAU	Thierry	Meridiam Infrastructure
D'Elia	Mario	PwC, AUSTRALIA
Dent	Des	10,000 Friends of Greater Sydney
Devoil	Neal	John Laing, UK
Dobinson	Ken	Dobinson & Associates Pty Ltd

Dunn	Matthew	NSW Treasury
Easson	Michael	EG Funds Management
Foster	Paul	AMP Capital Investors
Gardiner	John	
Gavilanes	Gerardo	Ministry of Fomento, Spain
Godley	Robert	Halcrow, UK
Goldsmith	Paul	RTA, NSW
González	J. Dionisio	CRTM (Madrid Region PTA), SPAIN
Gordon	Cameron	University of Canberra
Heavener	Norman	Westpac Banking Corporation
Hombergen	Leon	Rijkswaterstaat, NETHERLANDS
Humffray	Howard	John Holland Group, AUSTRALIA
Jellie	David	
Johnston	Neal	Ernst & Young, AUSTRALIA
Kessler	Peter	John Holland Group, AUSTRALIA
Lackey	Sam	RTA NSW
Larocca	David	Ernst & Young, AUSTRALIA
Laughton	Graeme	GRL Consulting Services
Lay	Max	Connect East
Lee	Joung	American Association of State Highway and Transportation Officials, USA
Locke	M. S.	PwC, AUSTRALIA
Lord	Thomas	Abigroup
Mathers	Ken	Linking Melbourne Authority, VIC
McKerral	John	
Milcz	Chris	CBA
Misko	Marko	Clayton Utz
Morris	Rob	
Mounsey	Graham	AECOM
Munro	Ian	Queensland Treasury, QLD
Murray	Peter	Ernst & Young, AUSTRALIA
Murray	Steve	Clayton Utz
O'Shea	Paul	Transurban (till 2008)
Papantoniou	Peter	City North Infrastructure Pty Ltd, QLD
Paradis	Charles	Bouygues Construction, FRANCE
Perez-Diaz	Marcos	Egis Projects, FRANCE
Plant	Tom	Macquarie Capital
Priddis	John	CBA
Read	Graham	Blake Dawson, AUSTRALIA
Reynolds	Ken	Baulderstone, AUSTRALIA
Rubio	Nicolas	Cintra, USA
Sandrejko	Ed	CrossCity Tunnel
Scarcella	Vincent	Department of Transport and Main Roads, QLD

Scott	William	QIC, AUSTRALIA
Smith	Alf	Department of Industry, Innovation and Regional Development, VIC
Soliño	Antonio Sánchez	Universidad Politécnica de Madrid, SPAIN
Sonego	Massimo	Atlantia, ITALY
Stevens	Craig	Dept of Infrastructure & Planning, QLD
Theau	Ludovic	Hastings Funds Management, FRANCE
Tiong	Robert	NTU, SINGAPORE
Vann	Brad	Clayton Utz
Vassallo	Jose Manuel	Universidad Politécnica de Madrid, SPAIN
Ware	Julian	TfL, UK
Warren	David	Corrs Chambers Westgarth, AUSTRALIA
Warwick	Richard	GHD Pty Ltd, AUSTRALIA
Webb	Matthew	RTA NSW
Wilson	Bruce	Bilfinger Berger Services, AUSTRALIA
Wilson	Chris	Halcrow, AUSTRALIA
Wilson	Ray	BrisConnections

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