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Role of Bidding Method and Risk Allocation in the Performance of Public Private Partnership (PPP) Projects

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Abstract

The Public Private Partnership (PPP) model has recently gained a lot of attention in the infrastructure creation literature. Selection of the right private partner in PPP is important for the success of this model. The bidding method along with appropriate risk allocation plays a critical role in this regard. This paper analyses the Indian PPP framework, including its bidding process and the standard concession agreement. The paper argues that the existing bidding method (i.e. premium/grant based method) can result in over-valuation of the projects due to optimism bias. When optimism about high traffic volumes do not materialize in the long run, projects could come under stress or fail, which is quite visible for Indian PPP road projects. This paper discusses an alternative bidding method called least present value of revenue (LPVR) and compares this method for the Indian PPP set-up with the help of Monte Carlo simulations by creating various real-life kind of scenarios. Results show that both methods have their own advantages depending on what was expected and what is actually realized. If expectations are low, then both methods gives more or less competitive results, but as expectations increase the LPVR method starts giving better results with a reasonably high certainty.

Keywords: Public Private Partnership, Road Sector, Bidding Method, Contract Design, Monte Carlo Simulation, Sensitivity Analysis

JEL Code: D44, H54, C15

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1. Introduction

Public policy for infrastructure development has moved from EPC (Engineering-Procurement-Construction) model (a traditional method) to the PPP (Public-Private Partnership) model. In a typical traditional method, government procures the infrastructure assets or service using the government budget and assumes most of the project associated risks. Whereas, PPP is the partnership between government and private parties to provide infrastructure facilities and in this format, government specifies about the required infrastructure facilities (including quality and quantity of the final output) and private partner brings in finances to provide the infrastructure for a specified period. In the PPP model, private player assumes greater risks as compared to traditional method, which leads to efficiency gains in the project execution (Fourie & Burger, 2000). Hence, PPP model can have two-fold benefits, first, to bring in capital for the resource constrained governments, and second, the better project execution. However, the extent of realization of both kinds of benefits is subject to regulatory and institutional set-up required for the same, especially the risk allocation, and selecting the right partner.

In India, PPP was adopted in late 1990s as important method to bring private capital and efficiency in the provision of infrastructure provision. Among all the infrastructure sectors, Road sector has the highest share of projects both in numbers and capital involved in it. It contributes roughly half of the total amount invested through PPP model in the infrastructure sector[2] (Government of India, 2011).

However, the progress so far, in the development of the road sector through PPP model cannot be considered satisfactory. The overall investment in this sector is far below than the expected (Government of India, 2008). However, the private investment picked up for a short period, but again got stagnated. Apart from that, many of the Indian PPP (Public-

[2] Till now, road sector has more than 650 PPP projects with the total project cost of Rs. 390,477.59 crores, on which government is providing support through Viability Gap Funding (VGF) of worth Rs. 22750 crores to these projects. More than one-third of these projects (i.e. 250 projects) are signed by NHAI (National Highway Authority of India).

Private Partnership) road projects are facing various kinds of problems. Some of the projects are under dispute, many are delayed and underperforming (in terms of revenue fetching), and many private players are asking for either renegotiations or reschedule their due payments to the government and lenders. Private players are now shying away from the new PPP projects. Over and above it, many new projects could not fetch even a single bidder[3]. It raises several questions like why PPP model could not perform as expected. What could be the reasons behind such problems?

Experiences from other countries (for instance, Chile, Mexico (Vassallo, 2006) and Hungary (V. Cuttaree, M. Humphreys, S. Muzira, 2009)) also highlight similar kind of problems for their PPP programs. It leads the private players to ask for renegotiations or bail outs (Guasch, Laffont, & Straub, 2008). Many reasons have been discussed for these problems in the literature. Along with the issue of appropriate risk allocation, the issue of bidding method (or selection criterion) is widely discussed amongst the other reasons.

Most countries follow the fixed term bidding methods. In the fixed term bidding method, contracts are awarded on the basis of minimum of either fixed time period or toll price or subsidy or revenue share or similar kind of bidding parameter (Vassallo, 2006). India also has the minimum subsidy (positive or negative) method to select the private partner for their PPP road projects.

The fixed term bidding methods are considered better than the earlier methods of awarding contracts like negotiation based or cost plus basis contracts or extending direct subsidies. It meant to bring in competition in the bidding, which is usually absent in the infrastructure sector due to its monopolistic characteristics. The fixed terms methods have advantages of better risk allocation than the earlier methods. However, the fixed term methods, too, have their own set of issues and limitations. In these methods, bidders have to bid on the basis of long term expectations, where uncertainties for many parameters are very high. And by design, only the most optimistic bidder (not necessarily the most

[3] This information and the scope of the paper are confined to National Highway Authority of India (NHAI) projects only, which is the nodal agency responsible for building the national highways in India.

efficient bidder) wins and as optimism fades away, winner starts facing trouble, which is called winner's curse[4].

To overcome this problem, various scholars have proposed further improved versions of bidding method. But a method called LPVR (Least Present Value of Revenue) (proposed by (Engel, Fischer, & Galetovic, 2001, 1997) and adopted in Chile for road projects), is discussed predominantly in literature and theoretically proved better than the fixed term bidding methods (Vassallo, 2006). In the Indian context, (Anupam Rastogi, Prem Kalra, & Ajay Pandey, 2008) and (Kumar V Pratap, 2014) also talked about this method and recommended to adopt in India.

The question is that, are Indian PPP road projects underperforming or under stress due to bidding method issue? If yes, then how? And given the Indian PPP setup, is the LPVR method better for Indian PPP projects? This paper attempts to find answers to these questions. It analyzes the selection (bidding) process of the PPP model and a standardized concession agreement (Model Concession Agreement – *here onwards* MCA), which is signed between government authority and private player. Next, it discusses about the LPVR method, its advantages and issues involved in this method.

Further, it tests both the methods with the help of a hypothetical project by using the Monte Carlo Simulations technique. Though, this is a hypothetical project, but, it tries to capture all the possible real life conditions of the Indian PPP project including all the clauses applied in the MCA. It will also reflect the role of expectations for the bidding method and its impact on the project outcomes and implications for the major stakeholders. Further, the sensitivity analysis checks the robustness of the results and their sensitivity against some parameters. To understand the whole exercise more clearly, it would be imperative to look into the overall mechanism of the PPP model for the road sector, roles and responsibilities of different stakeholders, and peculiar features of the PPP model in terms of risk sharing among stakeholders.

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[4] In the common value auction set-up, participants make unbiased estimates of the value of auctioned item. However, the judgmental errors in estimates lead to profits below than expected, which is known as *Winner's Curse* (Kagel & Levin, 1986).

With the backdrop of this, the organization of this paper is as follows. The next section illustrates the role and responsibilities of the major stakeholders. Section 3 discusses risk allocation among its stakeholders. Section 4 describes the current bidding process in detail along with the relevant articles and clauses from the MCA. Section 5 explains the alternative bidding method LPVR and its advantages and issues involved with this method. Section 6 tests both the methods with the help of a hypothetical project by using the Monte Carlo Simulations technique and a sub-section presents Sensitivity Analysis. Section 7 concludes the paper.

2. Major Stakeholders: Roles and Responsibilities

Government Agency/authority: It (i.e. NHAI for Indian highways) is responsible for managing and overlooking the project on the behalf of the government (and indirectly for users also). It also has to play a balancing role between various stakeholders, for instance, it needs to look into the welfare of road users, while keeping in mind the viability of the projects in terms of adequate returns for private players along with protecting the interests of the lenders.

In the PPP process, the government agency (i.e. NHAI) takes care of the projects since its inception. It does feasibility studies, and invites the private players for bidding. On the basis of the bidding method, it awards the project to the bid winner. After awarding the projects, it takes the responsibility of monitoring of the projects along with the Independent Engineer[5].

Private Player: Private company or consortium bids for the project with the available information and their own calculations based on the certain assumptions about future economic outlook of the project, and the winner of the bid gets the responsibility of building, financing, maintaining and operating of the project. For the financing of the project, private player puts its equity share and arranges debt by leveraging its equity. To run the project, it is mandatory to form a Special Purpose Vehicle (SPV) Company,

[5] For each PPP road project, NHAI appoints an Independent Engineer firm to monitor the project throughout its life-cycle.

which is a limited liability company and it is also an independent subsidiary of its parent company or consortium.

Lenders: Lenders could be banks or consortium of banks or Non-Banking Financial Corporations (NBFCs) or other financial organizations. It provides the debt to the project company on the basis of its equity input and future outlook of the project. Project company i.e. SPV services back the debt from the revenue of the project. As the debt is given to an SPV and there is no collateral involved in it, it is a non-recourse or limited recourse loan[6]. In case of project failure or termination, lenders will get back money according to the Concession agreement's terms and conditions.

Users: Users are the important stakeholders for the PPP road projects. Though, they are not directly involved in any formal process related to the PPP projects, but they create demand for the project, which is a vital part for the commercial and financial viability of the project. Users are the main source of the revenue generation in the Toll based PPP projects. From user's perspective, the objective is to get the highest quality with the minimum congestion and at the minimum cost.

3. Major Risks and Their Allocations in PPP

Like any other infrastructure projects, road projects, too, carry various kinds of risks. It can be categorized mainly into two groups, i.e. Project related risks (or endogenous risks) and Global risks (or exogenous risks). In the first category, risks would be construction risk, design risk and traffic or demand (commercial) risk.

Second kind of risks (i.e. exogenous risks) are such as legal and political, regulatory and environmental risks. Out of these risks, some are crucial risks, which have larger impact on the performance of the project and serious financial implications for the stakeholders. Various interview based studies have ranked *Traffic* risk as the largest risk followed by

[6]Non-recourse or limited recourse loans are the loans where lenders either have no claims or collateral to claim or limited claim at the time of default. Hence, these loans are not considered secured loans. However, as per the new RBI (Reserve Bank of India) guideline for PPP projects 'Concession Agreement with the rights (entitled to private player) to collect the user charges', can be considered as collateral. It makes these loans now secured loans (RBI, 2013).

Construction risk for the road sector PPP projects (Thomas, Kalidindi, & Ananthanarayanan, 2003).

Risk allocation is the key, which makes all the procuring methods different from each other. The question is: who should bear what risks, i.e. what should be the allocation of risks?

For the PPP road projects, in principle, the project related risks are to be assigned to the private player, because they are in better position to control and manage these risks. Assuming project risks make the private players to be more efficient in order to maximize their profit. On the other hand, global risks should remain with the government authorities, as the project promoters may not have any controls on such risks (Grimsey & Lewis, 2004).

However, in practice, it is always difficult to assign the risk to one party only. For the Indian PPP road projects, the MCA attempts to allocate the risks between the government agency and private players (Table 1 summarizes it). However, at many occasions, it is possible that the main risk bearing party can pass some part of the risk to the other party.

Table 1: Types of Risk and Stakeholder

Type of Risk	*Risk Bearer Stakeholder*
Clearance Risk (such as Environmental/Forest clearances or other governmental clearances)	Government
Construction Risk	Private Player
Operation Risk	Private Player
Demand Risk	Private Player (Partially Mitigated)
Legal and Political Risk	Mainly Government (but has many open-ended clauses, which increases the uncertainty for Government's contingent liabilities)
Force Majeure Risk	Distributed between Government and Private Player

Source: Assessed and compiled from Model Concession Agreement (Planning Commission, 2006)

4. Bidding and Contract Awarding Process

Awarding any PPP project for the road sector in India passes through four stages. The first stage is the project identification, its pre-feasibility studies, and to select the mode of implementation (i.e. either the traditional approach or the PPP method). The next stage comes with more concrete level of assessments in terms of complete feasibility study of the project, and to get all the clearance from various ministries and departments and start acquiring land for the project. And if project is to come through the PPP mode, then this stage is very crucial to assess its financial and commercial viabilities; and start preparing all the documents such as contract agreements and other related documents.

At the third stage, the contracting authority (i.e. NHAI) asks the private players for RFQ (Request for Qualifications), followed by RFP (Request for Proposals). This stage is open for all the companies or consortiums. It is fairly open, transparent and competitive in nature. After clearing this step, the contracting authority calls for bids. In the final bidding stage after RFQ, the procuring agency calls for the detailed RFP (Request for Proposal). It contains two bids i.e. Technical and Financial bids. The technical bid is for the eligibility criteria only, whereas the actual selection criterion is the financial bid. Details of these bids are as follows:

Technical bid: In this bid, the government agency evaluates the technical capabilities of the bidding companies or consortium on the basis of their experience and capabilities. This bid is just for the eligibility purpose only. If the bidders satisfy the minimum criteria, they clear this stage. The actual contracts are not awarded on the basis of the technical bid.

Financial bid: In the financial bid, the bidders put their bid for the one parameter as decided by the government agency. This parameter could be construction cost, grant asked, revenue sharing or anything as per existing rule or practice. Currently, the NHAI is following the practice of bidding on the Maximum Premium Paid (or Lowest Grant Asked) or Highest Revenue Share. The details about this method of bidding are given below.

4.1 Bidding Criterion

Maximum premium paid (or lowest grant asked): In this method, the bidders are asked to bid on one financial parameter, i.e. either maximum premium paid to the government authority or minimum grant asked[7] . In this method, the bidders calculate the difference between their *expected benefit* and *expected cost* for the overall lifecycle of the project. The higher the difference, the bigger the share[8] bidders would like to bid for sharing (as a fixed amount[9]) with the government authority.

In case, if there are bidders with the bids with premium and others asking for grant, then bids for premium will be considered. And whoever will be paying the highest premium will get awarded the project.

Highest Revenue Share: The bidder, who shares highest share of their revenue (in terms of percentage, i.e. variable amount, depending upon the actual realized revenue) with the government authority, wins the bid. It is more or less similar to the first bidding method, except for one difference, i.e. the sharing amount with the government is variable unlike the fixed amount in the former method; and uncertain as well.

For the bidders, the two fundamental financial parameters that play crucial role in any of the bidding methods are the *expected benefit* and *expected cost*, which are estimated based on the numerous assumptions.

For the road sector PPP projects, two important underlying parameters are the projected construction cost and traffic revenue, which again depend on the expected inflation, traffic growth rate and some other factors. In the current practice, toll rates[10] are decided by the NHAI, but the total traffic revenue depends on the actual traffic realization. So, the bidders will have to estimate these parameters based on their own calculations and assumptions about the underlying factors.

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[7] Premium is what the private party will pay to the contracting authority, whereas grant is what contracting authority will pay to the private party to make the project financially viable in terms of VGF (Viability Gap Funding). However, there is a cap on VGF of maximum 40% (20% + 20%) of the Total Project Cost.
[8] In case of grant, the bidders would ask the lowest amount of the VGF.
[9] This fixed amount i.e. Premium payments can be paid in the installments as well. It depends on the negotiations at the time of finalizing the contract agreement.
[10] Currently, toll rates are indexed with WPI. For every one per cent increase in WPI, result in hike in 0.4 per cent in the toll rate at the time of revision.

It is obvious that the longer the period of expectations, the wider could be the expected values. The PPP road projects (mainly for the BOT[11] category) usually span between 20 to 30 years. For such long term projects, even a tiny difference in the assumed parameter values can result in a large difference in the outcome variables. It allows the bidders to choose the bid value from a wide range, which, in turn, makes this method vulnerable to have considerable differences in their bid values. And a bidder with most optimistic outcome expectations will win the bid[12]. But, the question is, how does it impact on the actual project outcomes? Does it affect other stakeholders if these optimistic scenarios do not come true? Answers to these questions lie in the contractual agreement. It guides the contracting parties about what actions to be followed if *ex-post* conditions are different than the expected. The next sub-section explains such relevant clauses from various articles of the MCA, if the actual scenario is different from the expected scenario.

4.2 Relevant MCA Clauses

In the Model Concession Agreement, few clauses deal with the uncertainties of traffic realization and, in turn, its consequences for the major stakeholders. These clauses from the MCA are discussed below.

Clause 28.1: Revenue Shortfall Loan

Clause 28.1.1 says, "If the Realisable Fee in any Accounting Year shall fall short of the Subsistence Revenue as a result of an Indirect Political Event, a Political Event or an Authority Default, as the case may be, the Authority shall, upon request of the Concessionaire, provide a loan for meeting such shortfall (the "Revenue Shortfall Loan") at an interest rate equal to 2% (two per cent) above the Bank Rate.".

Clause 29.2: Modification in the Concession Period

Clause 29.2.1 says, "... in the event Actual Average Traffic[13] shall have fallen short of the Target Traffic[14], then for every 1% (one per cent)[15] shortfall as compared to the Target Traffic, the

[11] BOT stands for Build, Operate and Transfer.
[12] The bidding is based on the First-price sealed-bid auction.
[13] The Actual Average Traffic is the average of the traffic on the date that falls one year prior to the Target Date, on the Target Date and on the first anniversary of the Target Date. Target Date is usually the mid-year of the Concession Period. If the Concession Period is for 20 years, then the Target Date would be on the Tenth Year, when the Contract was signed.

Concession Period shall, subject to payment of Concession Fee in accordance with this Agreement, be increased by 1.5% (one point five per cent) thereof; provided that such increase in Concession Period shall not in any case exceed 20% (twenty per cent) of the Concession Period. ...".

Clause 29.2.2 says, "... in the event Actual Average Traffic shall have exceeded the Target Traffic, then for every 1% (one per cent) excess as compared to the Target Traffic, the Concession Period shall be reduced by 0.75% (zero point seven five per cent) thereof; provided that such reduction in Concession Period shall not in any case exceed 10% (ten per cent) thereof. ...".

"Provided further that in lieu of a reduction in Concession Period under this Clause 29.2.2, the Concessionaire may elect to pay, in addition to the Concession Fee that would be due and payable if the Concession Period were not reduced hereunder, a further premium equal to [25% (twenty five per cent)] of the Realisable Fee in the respective year(s), ...".

Clause 29.2.3 says, "Notwithstanding anything to the contrary contained in this Agreement, if the average daily traffic of PCUs in any Accounting Year shall exceed the designed capacity of the Project Highway and shall continue to exceed the designed capacity for 3 (three) Accounting Years following thereafter, an Indirect Political Event shall be deemed to have occurred and the Authority may in its discretion terminate this Agreement by issuing a Termination Notice and making a Termination Payment under and in accordance with the provisions of Clause 34.9.2;...".

Clause 29.2.4 says, "If the Concessionaire shall have, prior to issue of a Termination Notice under Clause 29.2.3, completed the construction works necessary for augmenting the capacity of the Project Highway such that its capacity shall have increased sufficiently for carrying the then current traffic in accordance with the relevant provisions of the Indian Road Congress Publication No. IRC - 64, 1990 or any substitute thereof, the Indirect Political Event specified in Clause 29.2.3 shall be deemed to have been cured.".

According to the Clause 29.2.3, if the average daily traffic continues to exceed the target traffic for 3 years, then the government authority can terminate this contract. Adding the

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[14] As per their calculations, both the Concessionaire and the Authority estimate the expected Target Traffic (in terms of PCUs per day) on the Target Date.

[15] According to the Clause 29.1.2, this clause will be applicable only if the reduction or excess is more that 2.5 per cent.

Clause 29.2.1, it says that if the average traffic falls short by one per cent, then the Concession Period will be extended by 1.5 per cent. To avoid the Clause 29.2.3, every bidder has an incentive to project high volume of traffic than the actual, because even if projected traffic could not be achieved, then Clause 29.2.1 will help them to extend the Concession Period to reach at the same level of profitability as projected. Even, the Concessionaire can request the government authority for *'Revenue Shortfall Loan'*. It can be considered as an unwarranted responsibility for the government authority. In this case, users will be affected adversely, as they will have to pay the user charges for the extended period. The other practical possibilities are that the Concessionaire can ask for restructuring of debt payments or some kind of waive off either from the government or the lenders, which will have adverse impact on the lender's functioning.

In the other case (which may be less likely), where the average traffic is actually higher than the projected for continuing 3 years, authority can terminate the contract under the Clause 29.2.3, and will have to pay 110 per cent of the Adjusted Equity to the Private Player and Debt Due (less Insurance Cover) to the Lenders. In this case, Lenders will lose 10 per cent of the total debt amount, as the government gives protection to only 90 per cent of debt. Or according to the Clause 29.2.4, the Concessionaire can continue with the project by augmenting the road and continue to enjoy the profit higher than the expected. But there are no efficiency gains in terms of reducing the total costs for the users.

The bidding method discussed above have another serious problem. Since, it indirectly compels the bidders to take as optimistic as possible position, which indirectly creates two kinds of problems. First, the optimistic assumptions at the time of bidding make the project look commercially viable, but if these assumptions don't come true, it can turn the project unsustainable in the long-run. The second problem is that the optimistic calculations make the project unnecessarily over-valued.

It can lead to the actual visible problems like user's rejection (may be in the form of agitation or in some other form) or project failure or so. In such cases, either the Concessionaire can abandon the project or it may need to be terminated by the government. According to the Clause 37.3, termination may have serious financial

implications for the government, which are *Contingent Liabilities* to the government. It can also impact the lenders adversely.

Clause 37.3: Termination Payment

Clause 37.3.1 says, "Upon Termination on account of a Concessionaire Default during the Operation Period, the Authority shall pay to the Concessionaire, by way of Termination Payment, an amount equal to 90% (ninety per cent) of the Debt Due less Insurance Cover; provided that if any insurance claims forming part of the Insurance Cover are not admitted and paid, then 80% (eighty per cent) of such unpaid claims shall be included in the computation of Debt Due. For the avoidance of doubt, the Concessionaire hereby acknowledges that no Termination Payment shall be due or payable on account of a Concessionaire Default occurring prior to COD.".

Clause 37.3.2 says, "Upon Termination on account of an Authority Default or in case of Political Event, the Authority shall pay to the Concessionaire, by way of Termination Payment, an amount equal to:

(a) Debt Due; and

(b) 150% (one hundred and fifty per cent) of the Adjusted Equity.".

According to the Clause 37.3, if the Concessionaire defaults or leaves the project, the lenders are entitled to have the protection of 90 per cent of debt due. It means they will lose 10 per cent. But if the government terminates the project, it will have to pay 100 per cent debt and 150 per cent of the adjusted equity. Basically, more than the total project value, where the project was already over-valued.

Apart from the given clauses, private players still can ask for the bail outs or requests for restructuring of the premium amounts or some other incentives. As the declaration of project failure or termination may not be politically viable options, it compels the government to find the solutions to keep running these projects, even if they are not serving the true value for money. In such scenario, it is imperative to find out other alternatives, which can actually help to solve the problem. One such alternative has been discussed below, which was adopted in the Chile and Mexico after facing similar kind of problems.

5. LPVR (Least Present Value of Revenue): An Alternative Bidding Method

The LPVR is based on the parameter of total revenue. In this method, bids are invited for the present value of the total revenue calculated on the basis of discount rate pre-defined by the authority. The project gets awarded to the least value quoting bidder. The bid winner gets the responsibility of building, financing and maintenance of the road against the rights of collecting the toll fee from the users. In this method, the duration of contract is variable. If the traffic growth rate is slower than expected, then contract period is usually for the longer time than the expected and vice-versa. However, the total revenue from the project remains constant. As soon as the concessionaire collects the total revenue (in present value terms) equal to its bid, the contract gets over. It solves many problems, which are quite common and crucial in the infrastructure projects. It also helps to reduce the complexity of the contract. The next sub-section discusses this in detail.

5.1 The LPVR: Advantages and Issues

It has many advantages over the existing method.

- *Risk reduction*: it mitigates the most crucial risk of the road project that is the traffic or demand risk (Engel et al., 1997; Vassallo, 2010). Because of the flexibility of the contract period, concessionaire gets enough time to recover its cost and margin over it. In the current bidding criteria, the demand risk is borne by the private player with very limited mitigation.
- *Financial Certainty*: In the current bidding method, with the fixed term (or with little flexibility in the contract period) coupled with other uncertain parameters like traffic growth rate, inflation and others, it increases the uncertainty of the profit to the private player. Even the users remain uncertain about the term of the contract and the total amount to be paid. The LPVR method removes these uncertainties up to an extent by giving the fixed (guaranteed) amount to the private player and users will be more certain about the total cost to be paid out (Vassallo, 2006).
- *Income certainty* for the private player will significantly reduce the scope for the renegotiations or disputes on the financial aspects or request for restructuring of

payments. It will be easy for the government to assess the value (compensation) of the project in case of termination (Engel et al., 2001).

- *Independence of Toll Rate Policy*: As the total revenue is fixed irrespective of the toll rates, so the toll rate revision policy is independent from the profitability of the project. The government can revise toll rates whenever it is required without affecting the total revenue of the concessionaire (Engel et al., 1997; Tan & Yang, 2012). It may not need to connect the toll rate to the inflation index like WPI as in the current mechanism for the Indian national highways.
- *Additional (Macro) Feature*: It can also create a very liquid and the fast moving infrastructure project's secondary market. Once the project reaches its operation stage and its earnings are well known before hand, it would be easy for the other players to buy the existing projects with lesser risks and kind of risk free returns. On the other hand, construction specialized companies can liquidate their investments and move on to the next construction project. This will also help to the overall economy as the construction will speed up, and additional private capital will get into the sector by the non-construction companies too.

Issues: The LPVR method has also some concerns, which are discussed below:

- *Discount rate issue*: Discount rate plays crucial role in this method. It is very difficult to define the optimal discount rate for all the projects across the sectors or regions. Different countries use different methods to decide the discount rate, such as UK uses social discount rate to calculate the financial worth (Grout, 2003). However, once this method is implemented, it may not affect the outcome of the project. Because, the government announces the discount rate before the bidding take place. And it is known and remains same for all the bidders. Even in the existing method, discount rate is being used to calculate the NPVs of the cash flows and costs incurred. The same can be used in the LPVR method too, till the optimal discount rate is found.
- *Uncertain Maintenance cost*: Since the duration of the contract is variable, hence the maintenance cost over the contract period is uncertain. It introduces the uncertainty part in the financial calculations of the project. However, it is not a

very serious problem, as the maintenance cost is a fraction of total net cash flow. Deducting a small fraction from the net cash flow will also be lower, but at the same time, maintenance cost required would also be lesser due to lower wear and tear of the road, and it applies to the high traffic flow scenario as well (Vassallo, 2010).

- *Cap on upside profitability*: The biggest concern for the private players is the cap on the upside profitability under the LPVR method. However, it has no limits on the downside risk, where the project may run into loss due to unfavorable circumstances, for instance, unexpected high costs due to the extra-ordinary high inflation (Vassallo, 2006, 2010).
- *Debt servicing uncertainty*: The lenders may be uncomfortable with the unfixed term of the contract, because it is general practice to provide the loan for a fixed term with a fixed debt service schedule. However, this issue can also be handled by adding or modifying some rules. For example, MCA Article 28 has the provision of providing soft loan to the concessionaire, in case it is not able to pay back the loan due to the lower traffic revenue.

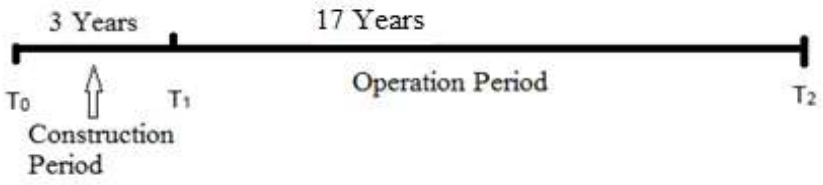
6. A Hypothetical Project (Experiment)

This experiment takes a hypothetical road project. The main objective of this experiment is to compare the two bidding methods as discussed above. And to find out how it will impact on the main stakeholders like Private Player, the Government and the Users. This experiment covers project's complete life cycle since the bidding stage to the end of the project. In this set up, the attempt is to incorporate all the possible aspects of the real life project including the clauses and sub-clauses discussed in the earlier section, and their possible impact in terms of private player's profitability and certainty for it, total cost incurred by the users and fiscal implications for the government.

6.1 Setting Up of Experiment

Set up of the experiment is as follows: the government authority (say, NHAI) decides to build a road project through the PPP model (BOT Toll). The project has three milestones in its life-cycle i.e. T_0, T_1 and T_2 (see Figure 1).

Figure 1: Life cycle of a hypothetical PPP project



The bidding will take place at Time T_0. As per the government's estimations, it requires three years to build the road at a cost of INR 100 (at the current prices) at the time of bidding, i.e. T_0. The construction will be completed at Time point T_1 and the bidder will have to pay the entire cost at the time point T_1. The project will come into operation for the next 17 years from time point T_1 to T_2. However, for the LPVR method, the operation period will depend on the actual traffic realization.

At the time point T_1, the traffic flow on this road is five units per year. For the next 17 years, the concessionaire will collect the user charges to get back its invested capital and its profits after paying back its debt. The toll rates would be decided by the government authority. To make this project financially and commercially viable, each unit of traffic will generate revenue of INR 2 to the concessionaire and it is indexed to the inflation by the formula given in the MCA (i.e. 40 per cent indexation to the Wholesale Price Index).

The calculation framework of the project is denoted by a set of equations. A brief description of the input and outcome variables, and some assumptions used in these equations are given below.

(Cost) $$\boldsymbol{C = c * (1 + i)^n} \qquad \ldots \textit{Eq. 1}$$

where, C = Expected Total Cost

c = Base Cost at Time T_0 (Assumed c = Rs. 100)

i = Expected Inflation Rate

n = Number of Years for construction period (Assumed n=3)

(Benefit) $$\boldsymbol{B = \left[X0\left\{\frac{(1+g)^{t+1}-1}{g}\right\} - X0\right] * p} \quad \ldots \textit{Eq. 2}$$

where, B = Expected Total Benefit

X0 = Traffic Volume at Time T_1 (Assumed X0 = 5units per year)

g = Expected Growth Rate in Traffic Volume[16]

t = Number of Operation Years (17 years)[17]

p = Price or Toll/User Charges (Assumed p =Rs.2 at T_1 and 40% indexed to WPI)

(Gross Returns) $$\boldsymbol{G = B - mf * C} \quad \ldots \textit{Eq. 3}$$

where, G = Expected Gross Returns

mf = mandatory fraction of cost required for maintenance, operation and interest payments of debt

(Net Returns) $$\boldsymbol{P = G - (\pm Pr)} \quad \ldots \textit{Eq. 4}$$

where, P = Expected Net Returns/Profit after sharing the revenue or paying the premium (or receiving the grant) for P/G method only.

Pr = Premium Paid (+)/Grant Received (-)

Details of all the input and outcome variables are discussed at length in the next sub-section on simulations.

6.2 Monte Carlo Simulations (2-Step Simulation)

The main objective of using Monte Carlo Simulations is to see how both the bidding methods will result under the range of different scenarios. This simulation exercise consists of two parts (see Figure 2). Each part has three cases. The first part develops bidding scenarios. In each scenario, five qualified bidders take position, i.e. they put

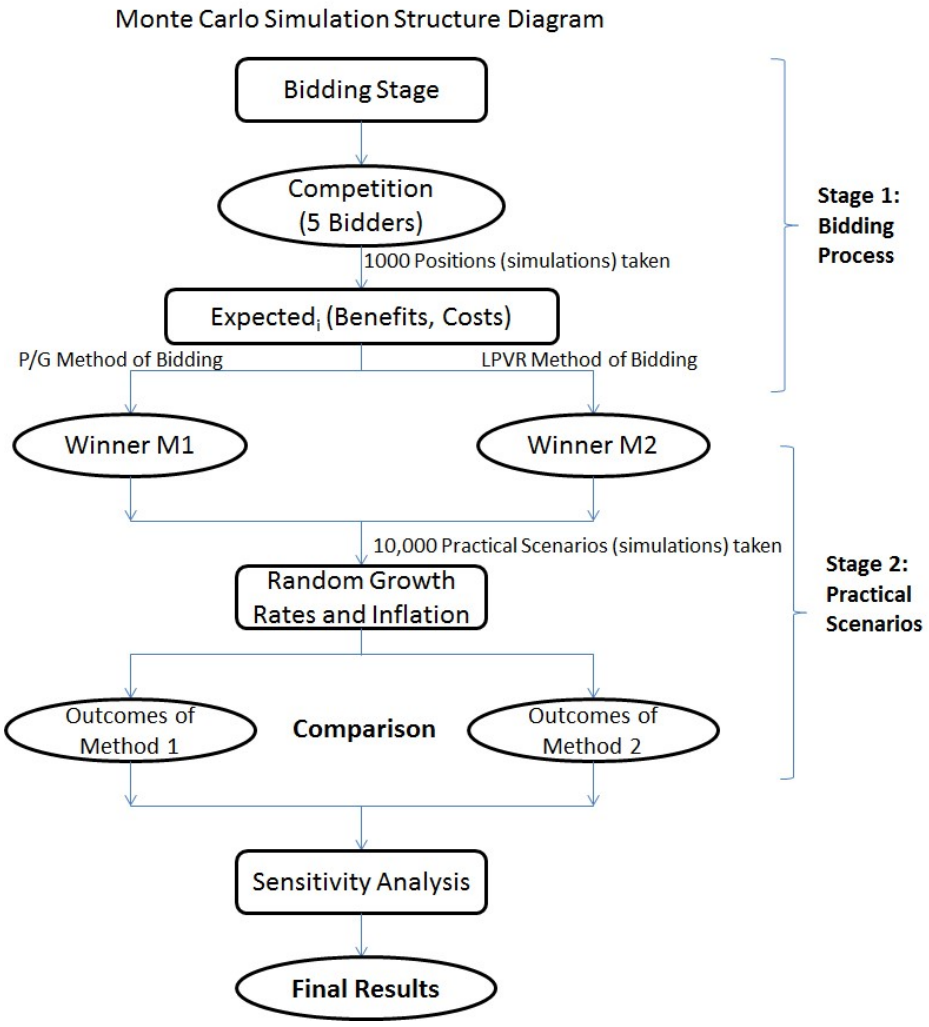
[16]To understand it clearly, in this sub-section Expected Growth rate is constant throughout the operation period. However, in the simulations (for the next sub-section), it will be variable and drawn randomly.
[17] For P/G method, according to Clause 29 discussed in the section 4.2 above, the concession period ($n+t$) here can vary between 18 to 24 years. For LPVR method, it is completely variable.

forward their expected costs and benefits, and they bid under both the bidding methods. Their expectations are based on the prevailing economic conditions. So there are three kinds of possible cases, i.e. low expectations due to low economic scenario, medium (or business as usual case scenario) expectations or bullish expectations from the project.

In the second stage, the project (from both the methods) is exposed to the practical scenarios. Here, practical scenarios depict the various real life kind scenarios with random[18] growth rate based traffic realization and inflation rates during the construction and operation periods. As the PPP projects are usually for long term (like 20-30 years) and the future economic conditions are always unpredictable for such long run, so it tests both the methods for all the possible economic scenarios.

[18] These random numbers are drawn from normal distribution with mean and standard deviation corresponding to economic situations. Detailed discussion on this is given in the next sub-section.

Figure 2: Monte Carlo Simulation Structure



Hence, the complete set of simulation has been run for each expected economic scenario vis-à-vis each realized economic situation. Finally, it will produce the results for all combinations in terms of a 3x3 matrix (as shown below, henceforth called *Scenario Matrix*).

Table 2: Scenario Matrix

Expected Economic Scenario	Realized Economic Scenario		
	Low Expected Low Actual	Low Expected Medium Actual	Low Expected Boom Actual
	Medium Expected Low Actual	Medium Expected Medium Actual	Medium Expected Boom Actual
	Boom Expected Low Actual	Boom Expected Medium Actual	Boom Expected Boom Actual

6.2.1 Bidding Stage

The first part develops bidding scenarios with five bidders, who have their expected cost of the project and expected benefits based on their knowledge about prevailing economic conditions and assumptions about the future economic environment and, in turn, about expected traffic growth and inflation. Based on their calculations, they will take their positions, i.e. they will bid for the project.

In the next step, using the two selection criterion, one winner each from both the methods will get selected. Under the P/G method, the highest premium paid[19] (or lowest grant asked) is the criterion, whereas for the LPVR method, lowest value of total revenue required in the present value term is the selection parameter. Winner from both methods may or may not be the same bidder. If the winner of the P/G method also has the minimum cost along with required margin, then he will win the bid in the LPVR method too. However, it is not always possible, due to the given nature of the former bidding method. Here, the assumption is that their expectations remain same irrespective of the bidding method. The positions taken by the bidders stem from the prevailing economic scenario and the present future outlook at that time. However, in the real terms, the economic scenario keeps changing and so the bidders' expectations about the future. Hence, to capture as many as possible scenarios, it runs these bidding stage simulations for 1,000 times. In each run, the bidders take their position and bid for the project.

[19] In the simulation exercise, Premium paid is a decreasing function of the profit earned beyond the minimum required margin from the project. That means, for every extra profit beyond the margin, the share from that extra profit will be lesser subsequently, because of increasing risk premium charged for the increased uncertainty of realizing the expected profit.

6.2.2 Practical Scenario Stage

In the second stage, the winner(s) (from both the methods) of each bidding simulation are exposed to the various real life practical scenarios with different growth rate based traffic realization and inflation rates during the construction and operation periods. These growth rates and inflation rates have been drawn from normal random distribution, where long-term values remain more or less stable, but vary in the short term.

These simulations do provide some outcome variables related to projects such as profit for the private player, duration of the project and some other parameters, which help to compare these results from both the bidding methods. Details of these variables and related assumptions are given in the next sub-section. For each bidding scenario, it generates 10,000 practical scenarios. That means total 10,000,000 (i.e. 10 Million) scenarios have been generated for the whole exercise. This exercise has been repeated for each case of *Scenario Matrix*, i.e. 9 times, so finally it runs 90 Million iterations in total.

Input - Outcome Variables of Monte Carlo Simulation

This simulation exercise has two sets of variables. One is for the input variables, while the other set is for the outcome variables. A set of equations along with other clauses from the Model Concession Agreement convert these inputs into the outcome variables, which, in turn, helps to compare the results for both the bidding methods.

Input Variables

The above set of equations have a number of input parameters such as base cost, inflation, base traffic volume, growth rate of traffic, contract period (it is outcome variable too), construction period, toll rate i.e. user charges, discount rate and mandatory fraction of cost required for maintenance & operation and interest payments. Out of these input parameters, some are variable by nature, while others are taken constant for the simulation exercise.

The constant variables are base cost (assumed at INR 100), base traffic volume (assumed at 5 units per year), construction period (assumed at 3 year), toll rate (assumed at initial price INR 2), discount rate (assumed at 10 per cent) and mandatory fraction of cost for maintenance & operation and interest payments (assumed at 25 per cent of the base cost).

However, these constant variables can also vary and have impact on the overall results too. Hence, the sensitivity analysis has been carried out to check the sensitivity of results against the variability of these input variables. The results of sensitivity analysis will be discussed in the sub-section 6.4.

Variables like inflation and growth rate of traffic are the most uncertain and critical for project's financial health. These variables represent the risks involved in the project, e.g. uncertainty in inflation leads to risk for construction cost overruns, whereas fluctuations in growth rate of traffic makes revenue (in turn, benefits) uncertain, i.e. demand risk (or commercial risk) of the project.

In the simulation exercise, these two parameters are taken as uncertain input variables, and have been drawn randomly from a normal distribution of a fixed mean and a variable standard deviation with the range of 1.5 to 3.5. The fixed mean signifies the long term average of both growth rate and persisting inflation. The mean for different cases of *Scenario Matrix* are taken as follows: mean of growth rate for low economic conditions is three per cent, for business as usual case it is five per cent[20], and seven per cent for the cases of economic boom. However the mean for inflation has been taken at five per cent only, as it affects the project outcome partially, especially during the operational phase. A variable standard deviation depicts the highly uncertain nature of inflation and growth rates in the short run. A lower standard deviation depicts the steady growth with very less fluctuation, whereas the greater standard deviation shows more volatile economic scenarios, but the mean remains fixed to represent the long term trend.

During the bidding stage of simulation, bidders take their positions from randomly drawn inflation and growth rate along with other given constant input parameters. It is important to point out that randomly drawn values of inflation and growth rate remain constant for the calculations of all the expected values in the bidding stage. For example, if bidder 1 assumes the inflation is at four per cent and growth rate six per cent, then, in all his calculations at bidding stage, both numbers will remain constant. However, in the

[20] Even the MCA has taken the average of 5 per cent growth rate as a standard.

practical scenarios of simulations, inflation and growth rates will entirely be random from the given normal distribution.

Outcome Variables

With the help of set of equations (discussed above) and the overall PPP framework (including MCA), input variables will result into outcome variables. A set of outcome variables have been derived. These variables are *Actual Cost, Realized Total Revenue, Realized Contract Period, Actual Profit, Producer Surplus, Consumer Surplus* and *Social Welfare*. A brief description of these variables is given below.

Actual Cost is the final cost after realizing the random inflation rate from the time T_0 to T_1 (i.e. the construction period) in the Practical scenario simulation stage. It will be different from the *Expected Cost* of *Equation 1* with an expected and constant inflation rate. *Actual Cost* will be same for both the bidding methods.

Realized Total Revenue is the actual total revenue from the project after realizing the inflation and growth rate in the practical scenario simulations. Each bidding method will face the inflation and growth rates drawn from the same distribution, but will have different values of realized revenue.

Realized Contract Period is the exact number of years for the project execution. According to the Article 29 of the MCA, the contract period under the P/G method can vary between 18 to 24 years for this project set-up. Under the LPVR, the actual contract period is variable, because it is connected to the actual realized revenue. As soon as the actual revenue equals the bided value of revenue, the contract period will be over.

Actual Profit is equal to *realized total revenue* less sum of *Actual Cost* and *premium paid* for the P/G method. *Premium paid* is not part of the LPVR method.

Producer Surplus is the difference between *Actual Profit* and *Expected Profit*. If it positive, i.e. private player has earned more than it's expected profit and vice versa.

Consumer Surplus is equal to the required cost of the project including the minimum required margin to maintain the project and reasonable profit for the concessionaire *less* actual total cost for the users i.e. *Realized Total Revenue*. If it is positive, then it represents that project has been delivered less than the cost expected and vice versa.

Social Benefit is the sum of *Producer Surplus*, *Consumer Surplus* and *Premium Paid* to the government. In other words, it is the sum of differences between what is expected *ex-ante* and what is realized *ex-post*.

Difference Matrix: For analysis and presentation purposes, a new set of variables have been derived from the above discussed each outcome variable. It will help to compare the two bidding methods on the case to case basis.

6.3 Results from Monte Carlo Simulations

The results of six outcome variables have been discussed below in the form of six figures. Each figure has nine sub-plots to represent the each cell of the *Scenario Matrix*, basically to compare the expected outcomes vis-à-vis realized values of each outcome variable for different cases. Each outcome variable has three indicators. First two indicators represent the outcome variable of two bidding methods respectively (suffix 1 is for P/G method and suffix 2 is for LPVR method). These two indicators provide the probability density function of the outcome variable at the aggregate level for all the simulation runs.

The third indicator shows the difference between the particular outcome variable for each simulation run. This is also a probability density graph. The first two moments of these sub-plots are also given in their respective tables. The description of the results for each outcome variable is given below.

Actual Profit

In terms of actual profit earned by the private player, results show that probability of earning profit under the P/G method is well distributed, i.e. the range of profit could be very high, and it can go to negative side too, that means, it can incur loss also. On the other hand, profit under the LPVR method is concentrated near the mean, and will earn the profit with greater certainty (95 per cent probability to earn some profit). However, in the low growth rate period, there is roughly two per cent probability that under the LPVR method, the project can never fetch the required revenue and another two per cent chances are that it will incur the loss in the cases low traffic growth.

The interesting results are the stark differences between the probabilities of earning profits under the P/G method for the different cases of *Scenario Matrix*. On the other

hand, profit under the LPVR method is quite stable and insensitive towards the *ex-ante* expectations. Another interesting part is that even in the boom period, the mean of P1 is lower because of high expectations and paying the premium amount due to high expected profit. Hence, P1 is likely to remain lower than P2 except in some cases when realized growth rate is higher than the expected. While comparing both the method for each simulation case, the third indicator shows that the profit gap becomes larger when the expectations do not realize or in other words, as optimism fades away (see Figure 3 and Table 3).

Figure 3: Probability Distribution of Profit

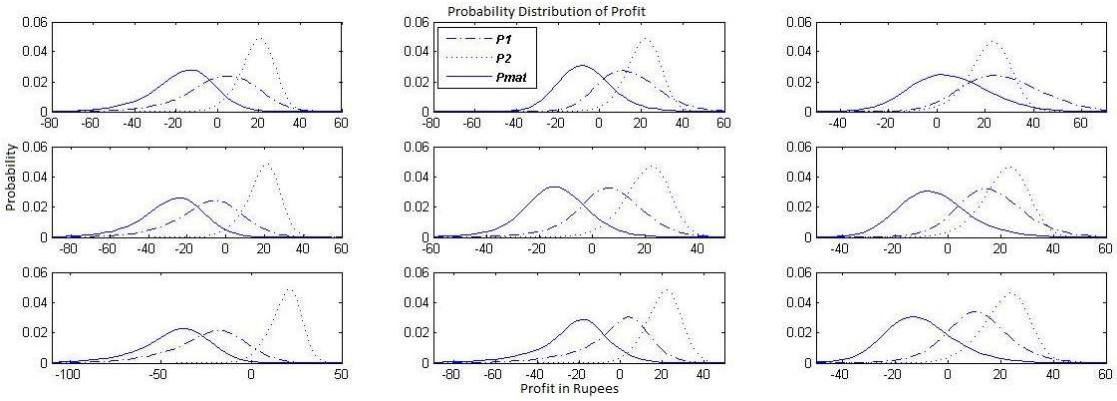


Table 3: Probability Matrix of Profit

Expected ↓	Realized →	G.R. 3			G.R.5			G.R. 7		
		P1	P2	Pmat	P1	P2	Pmat	P1	P2	Pmat
G.R. 3	Mean	1.95	19.07	-17.12	13.82	20.65	-6.82	26.83	21.51	5.32
	Std.	17.85	8.57	16.07	15.51	8.55	14.28	16.70	9.15	16.52
G.R.5	Mean	-9.37	19.03	-28.40	5.60	20.27	-14.66	16.23	21.55	-5.33
	Std.	18.89	8.98	17.51	14.83	9.06	14.29	13.60	9.03	14.23
G.R. 7	Mean	-24.03	18.76	-42.78	-3.36	20.42	-23.78	10.81	21.68	-10.87
	Std.	21.98	8.79	20.95	20.35	8.73	20.95	13.82	9.17	14.85

Notes: G.R. Stands for Growth Rate (Mean with 3, 5 and 7)
P1 is for the P/G method and P2 for the LPVR method

Producer Surplus

In terms of the producer surplus i.e. difference between expected profit and actual profit earned, the range is again very wide in the P/G method and mostly remains in negative. It means the actual profit remains less than the expected profit. It results in certainly negative producer surplus if the expected economic scenario does not realize and the

magnitude also increases with the increasing gap between the expected and the realized growth rates. With the increasing competitiveness and aggressiveness in the bidding, the possibility of negative producer surplus (as well as its magnitude) increases. It can explain the current lack of interest shown by private players for the PPP road projects.

On the other hand, for the same set of scenarios, the LPVR method also results in negative producer surplus for more than half of the time, but the magnitude is relatively smaller and stable near the mean. In a case to case comparison, the producer surplus mostly remains greater in the LPVR method, except in the non-expected boom periods though with smaller probability (see Figure 4 and Table 4).

Figure 4: Probability Distribution of Producer Surplus

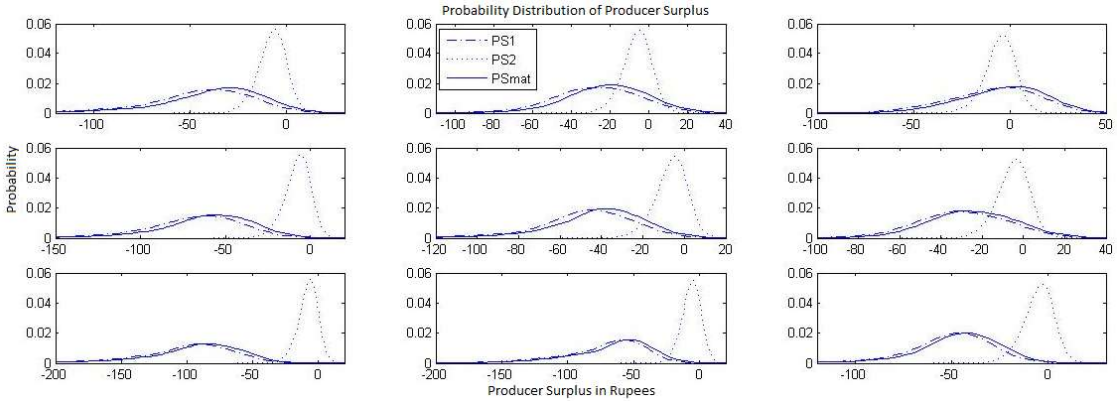


Table 4: Probability Matrix of Producer Surplus

Expected ↓	Realized →	G.R. 3			G.R.5			G.R. 7		
		PS1	PS2	PSmat	PS1	PS2	PSmat	PS1	PS2	PSmat
G.R. 3	Mean	-45.96	-7.54	-38.42	-27.46	-6.01	-21.45	-9.45	-5.06	-4.39
	Std.	29.34	7.48	27.84	24.79	7.52	23.51	25.01	8.04	24.20
G.R.5	Mean	-70.12	-7.57	-62.56	-49.24	-6.31	-42.93	-30.45	-5.02	-25.43
	Std.	32.40	7.78	31.15	28.05	7.89	26.81	23.92	7.94	23.46
G.R. 7	Mean	-103.08	-7.79	-95.30	-76.10	-6.19	-69.91	-53.04	-4.92	-48.12
	Std.	40.48	7.64	39.54	40.17	7.65	39.54	26.45	8.06	25.90

Notes: G.R. Stands for Growth Rate (Mean with 3, 5 and 7)
PS1 is for the P/G method and PS2 for the LPVR method

Realized Total Revenue

The realized total revenue is equal to what users pay as total cost for the project. For the P/G method, the total revenue is more than half of time greater than the total revenue of the LPVR method. The probability increases with the better economic situations, and

even the gap also becomes larger in better economic situations. However, the greater revenue does not guarantee the concessionaire a larger profit. Because results show that half of the time, with high R1, P1 is still lower than P2, and the likelihood of P1<P2 increases when realized traffic growth rate is lower than the expected. And in such cases, the P/G method even takes longer contract period than the LPVR method. However, there are chances when realized growth rates are lower and R1<R2, P1<P2 and also contract period is lower in the P/G method. It means that during the unexpected low economic periods, contract will get over sooner under the P/G method and it will also cost low to the users, but with low profit for the concessionaire.

Hence, both methods have their own advantages depending on what was expected and what is actually realized. If the expectations are low, then both methods give more or less competitive results, but as expectations increase, the LPVR method starts giving better results with a reasonably high probability (see Figure 5 and Table 5).

Figure 5: Probability Distribution of Revenue

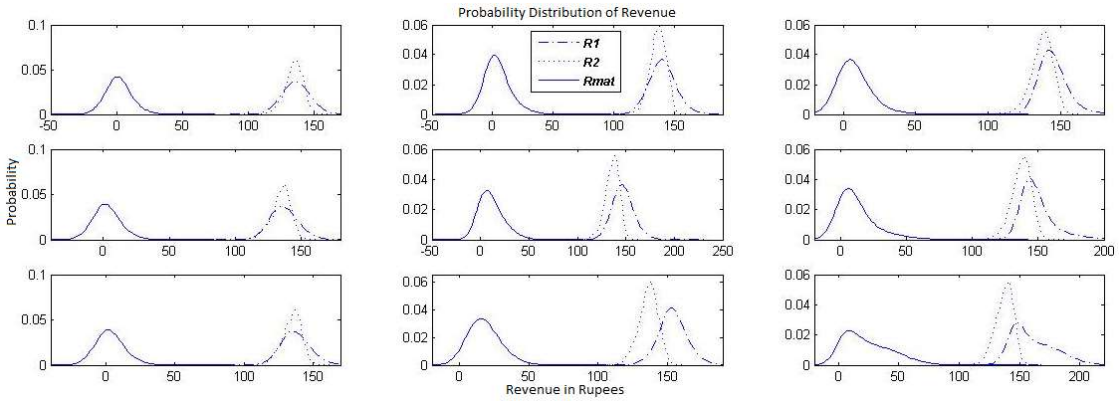


Table 5: Probability Matrix of Revenue

Expected ↓	Realized →	G.R. 3			G.R.5			G.R. 7		
		R1	R2	Rmat	R1	R2	Rmat	R1	R2	Rmat
G.R. 3	Mean	136.37	134.83	1.54	140.44	136.41	4.03	145.13	137.27	7.86
	Std.	11.01	7.00	10.17	11.40	7.00	11.40	10.96	7.72	12.65
G.R.5	Mean	137.39	134.79	2.60	147.01	136.03	10.98	149.20	137.31	11.88
	Std.	11.12	7.49	10.80	11.60	7.60	13.46	13.65	7.61	15.60
G.R. 7	Mean	137.55	134.52	3.03	154.02	136.18	17.84	160.95	137.44	23.51
	Std.	11.08	7.26	10.97	10.74	7.21	10.97	18.29	7.72	20.56

Notes: G.R. Stands for Growth Rate (Mean with 3, 5 and 7)
R1 is for the P/G method and R2 for the LPVR method

Consumer Surplus

The consumer surplus is the difference between users' willingness to pay (as a reasonable cost for the project) and what they actually pay. For both the methods, consumer surplus mostly remained negative, i.e. users were paying higher cost than the expected. However, the magnitude and likelihood of negative consumer surplus is relatively lower in the LPVR method, and the difference between consumer surplus from both the methods increases when traffic growth rate is higher, and it even further increases with the private player's expectations.

On a case to case basis comparison, CS2>CS1 for more than 55-60 per cent with low growth rate, but this number increases in better economic scenarios, i.e. in the boom periods, the consumers will get more benefits in the LPVR method with the probability ranging between 60-94 per cent. It highlights the positive feature of distributing the benefits among the stakeholders (see Figure 6 and Table 6).

Figure 6: Probability Distribution of Consumer Surplus

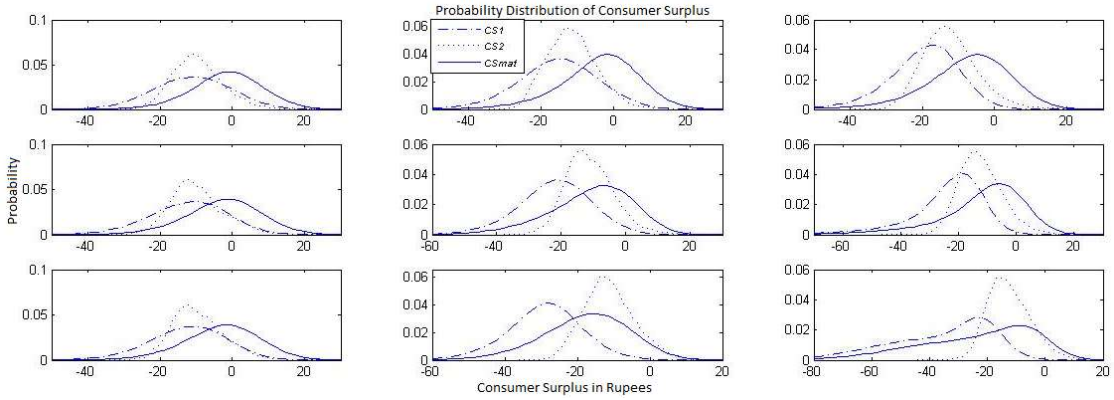


Table 6: Probability Matrix of Consumer Surplus

Expected ↓	Realized →	G.R. 3			G.R.5			G.R. 7		
		CS1	CS2	CSmat	CS1	CS2	CSmat	CS1	CS2	CSmat
G.R. 3	Mean	-11.37	-9.83	-1.54	-15.44	-11.41	-4.03	-20.13	-12.27	-7.86
	Std.	11.01	7.00	10.17	11.40	7.00	11.40	10.96	7.72	12.65
G.R.5	Mean	-12.39	-9.79	-2.60	-22.01	-11.03	-10.98	-24.20	-12.31	-11.88
	Std.	11.12	7.49	10.80	11.60	7.60	13.46	13.65	7.61	15.60
G.R. 7	Mean	-12.55	-9.52	-3.03	-29.02	-11.18	-17.84	-35.95	-12.44	-23.51
	Std.	11.08	7.26	10.97	10.74	7.21	10.97	18.29	7.72	20.56

Notes: G.R. Stands for Growth Rate (Mean with 3, 5 and 7)
CS1 is for the P/G method and CS2 for the LPVR method

Realized Contract Period

At the time of bidding, the P/G method has a fixed contract period, but to mitigate the demand risk partially, the MCA (Article 29) provides flexibility to increase or decrease the contract period as per the actual demand realization. However, this flexibility remains within a pre-specified range. As per the specifications, this project will have the contract period within the range of 18 to 24 years, instead of fixed 20 years at the time of bidding. The simulation results give very interesting insight about how expectations play critical role for the final project outcomes.

For the P/G method, the mean contract period increases along with the expectations irrespective of the realized economic scenarios. Hence, for the similar kind of economic scenarios but with high expectations, it will certainly end with longer contract period. However, due to cap on the upper side of contract period, it gives early completion as compared to the LPVR method during the low traffic turn out periods. But as the mean of realized traffic growth rate increases, the LPVR method starts performing better. However, the range of the contract period under the LPVR method is greater than the P/G method, but remains immune from expectations (see Figure 7 and Table 7).

Figure 7: Probability Distribution of Time Taken

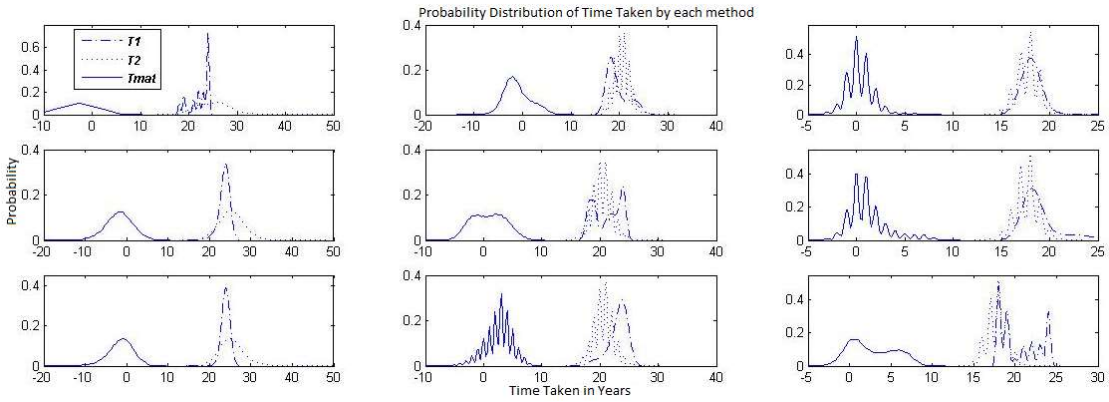


Table 7: Probability Matrix of Time Taken

Expected ↓	Realized →	G.R. 3			G.R.5			G.R. 7		
		T1	T2	Tmat	T1	T2	Tmat	T1	T2	Tmat
G.R. 3	Mean	22.24	25.39	-3.15	19.35	20.42	-1.07	18.24	17.67	0.58
	Std.	2.07	3.73	4.30	1.98	1.76	2.72	0.92	1.24	1.57
G.R.5	Mean	23.60	25.40	-1.80	21.34	20.36	0.98	18.78	17.67	1.11
	Std.	1.02	4.03	4.16	2.29	1.81	3.04	1.59	1.22	2.07
G.R. 7	Mean	23.96	25.30	-1.35	23.11	20.38	2.73	20.26	17.69	2.57
	Std.	0.31	3.79	3.81	1.49	1.78	3.81	2.28	1.24	2.69

Notes: G.R. Stands for Growth Rate (Mean with 3, 5 and 7)
T1 is for the P/G method and T2 for the LPVR method

Social Welfare

The PPP model of procurement is considered more complex as it involves many parties and some of them may have conflicting interests. For example, the users would like to pay minimum cost, whereas the private player would like to maximize their profit from the revenue. Hence it is necessary to have a parameter to assess the overall social benefit, where all stakeholders will get their reasonable share of benefits. That is why, this variable '*Social Welfare*' will capture the benefit of the main stakeholders i.e. private player, users and government (adding both Producer Surplus and Consumer Surplus and the Premium amount paid to the government). The simulation results show that in both the methods, both producer surplus and consumer surplus are more likely to be negative except the positive premium paid to the government, hence the overall negative social benefit for the society, but the magnitude is better for the LPVR method with lower variability.

In a case to case comparison, the LPVR method mostly provides greater social benefit than the P/G method with more than 95 per cent probability under all economic conditions and with 100 per cent probability when expectations are higher than the actual economic scenarios (see Figure 8 and Table 8).

Figure 8: Probability Distribution of Social Welfare

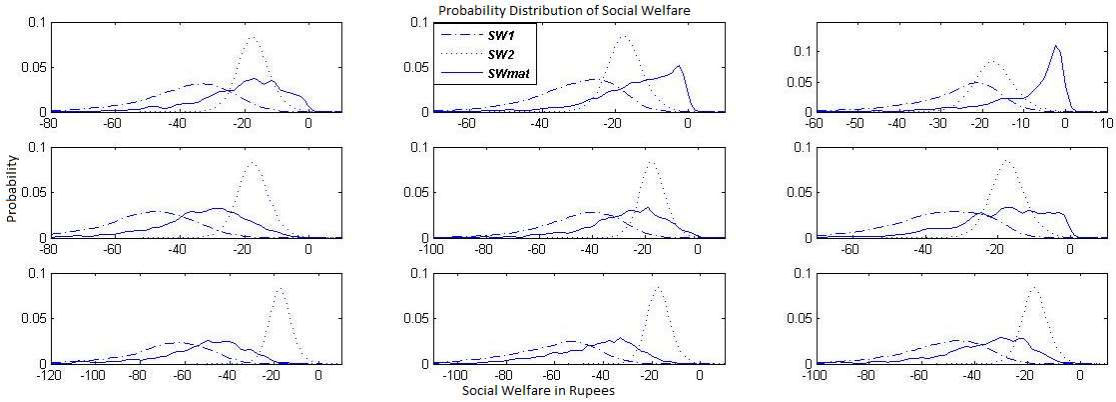


Table 8: Probability Matrix of Social Welfare

Expected ↓	Realized →	G.R. 3			G.R.5			G.R. 7		
		SW1	SW2	SWmat	SW1	SW2	SWmat	SW1	SW2	SWmat
G.R. 3	Mean	-38.67	-17.37	-21.30	-32.05	-17.42	-14.63	-27.03	-17.33	-9.71
	Std.	14.74	5.15	13.64	13.48	5.10	12.23	12.63	5.13	11.32
G.R.5	Mean	-51.52	-17.36	-34.16	-45.61	-17.34	-28.27	-37.44	-17.33	-20.11
	Std.	16.63	5.18	15.67	16.89	5.15	16.09	15.41	5.07	14.40
G.R. 7	Mean	-69.82	-17.30	-52.52	-63.50	-17.37	-46.13	-54.61	-17.36	-37.25
	Std.	21.37	5.17	20.64	22.50	5.11	20.64	19.44	5.15	18.71

Notes: G.R. Stands for Growth Rate (Mean with 3, 5 and 7)
SW1 is for the P/G method and SW2 for the LPVR method

6.4 Sensitivity Analysis

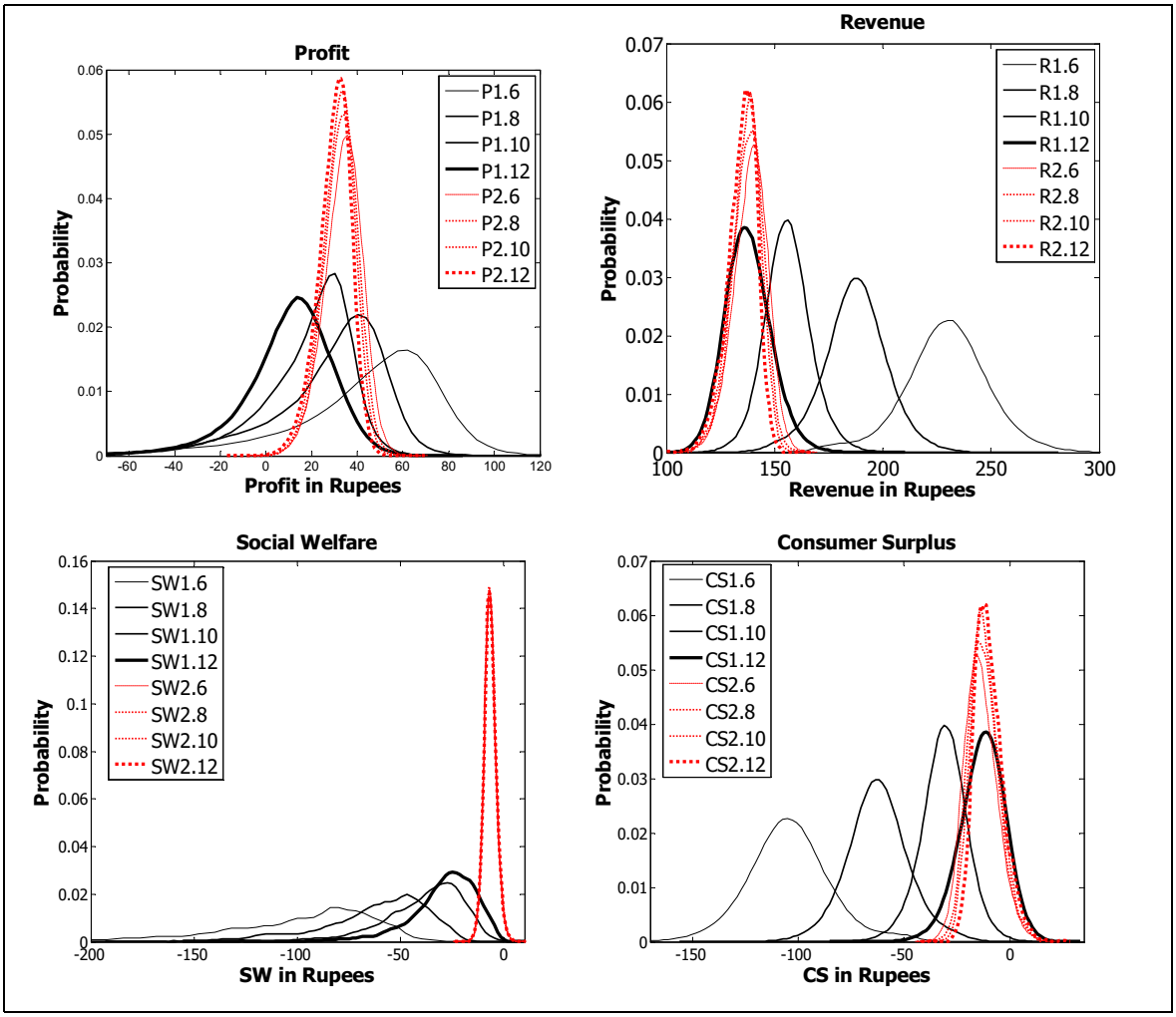
In the Monte Carlo Simulation exercise, some of the input variables have been taken constant, but their different values may have impact on the results. Sensitivity analysis helps to decipher the sensitivity of results against the changes in input variables. To find the sensitivity of the input variable on the final results, four sets of sensitivity analysis have been carried out for the four input variables. These variables are discount rate, toll price, mean of inflation and mandatory fraction of cost required for maintenance, operation and interest payments of debt (i.e. *mf*). A brief summary of the results are being presented here.

Discount Rate

Results of outcome variable for the P/G method are more sensitive than the LPVR method against the discount rate. As the discount rate increases, profit from the P/G method declines more sharply and vice-versa. A similar pattern is seen for the revenue. It

results as positive impact on the consumer surplus proportionate to the decline in the revenue. Overall, the social welfare rises more in the P/G method than the LPVR method due to sharp rise in the consumer surplus (see Figure 9). It signals that discount rate may not be a serious concern for the stakeholders for adopting the LPVR method.

Figure 9: Sensitivity against Discount Rate

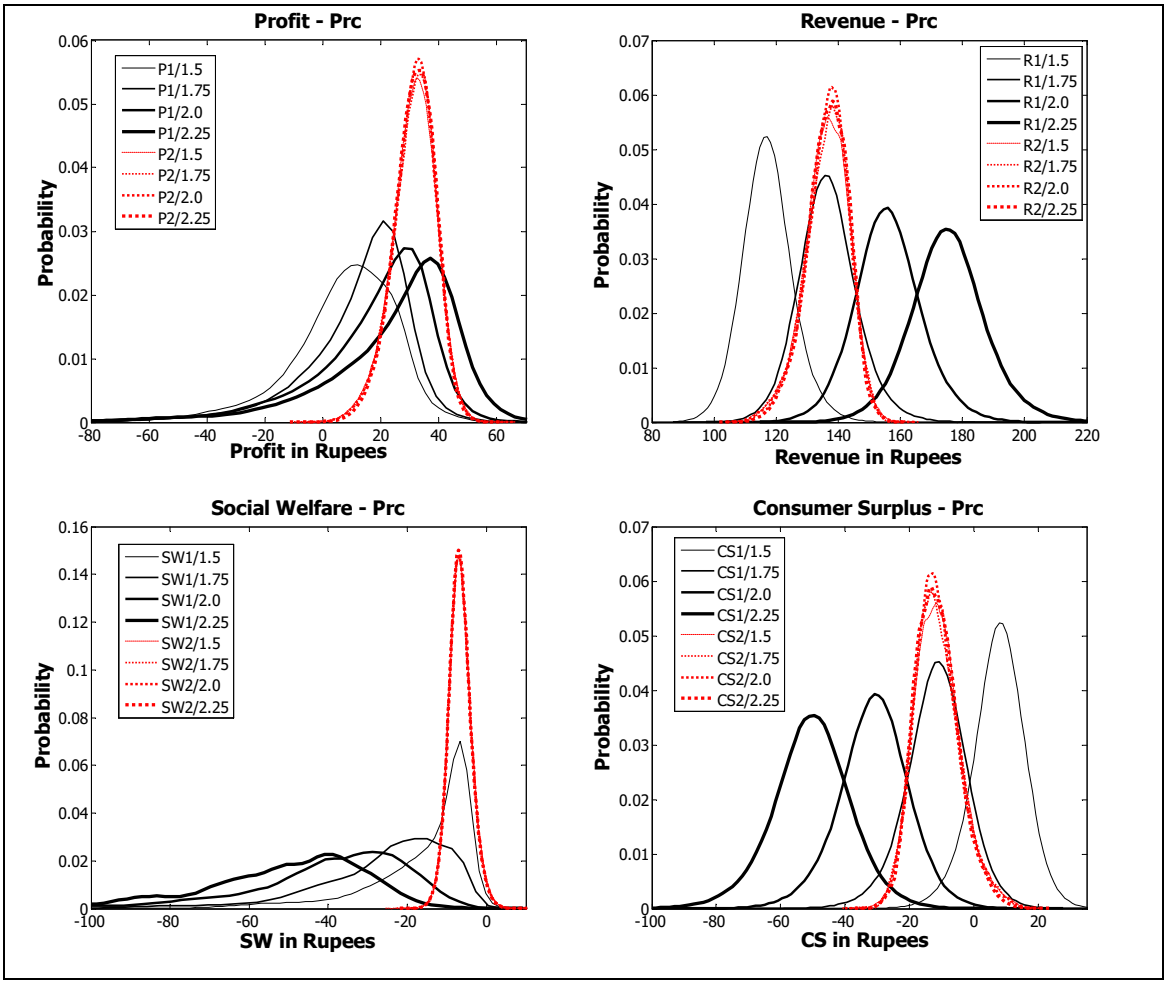


Toll Price

Like discount rate, results from the P/G method are more sensitive than the LPVR method. As the toll price increases, the profit and revenue increase sharply, which reduces the consumer surplus, and finally reduces the social welfare. In case of the LPVR method, most of the output indicators are fairly stable (see Figure 10). Results highlight

that the LPVR method can bring much more flexibility for the government authorities to adjust the user charges as per the changing economic scenarios or other relevant developments.

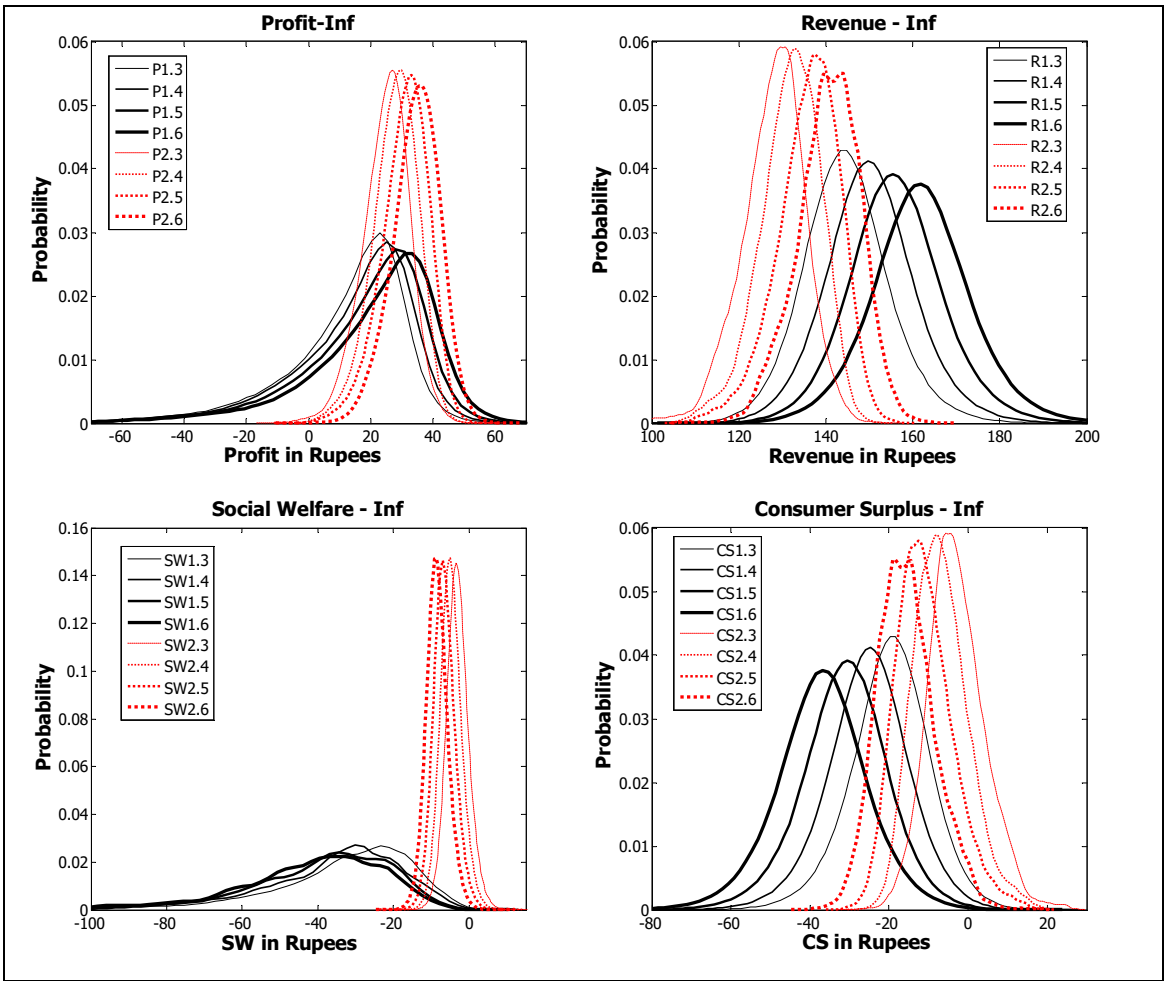
Figure 10: Sensitivity against Toll Price



Mean of Inflation Rate

The user charge (i.e. toll price) is indexed to inflation, if the mean of inflation rate increases, then the profit and revenue increase under both the methods. But the intensity is higher in the P/G method. Due to increase in the revenue, consumer surplus declines, and the overall social welfare declines in both the methods (see Figure 11).

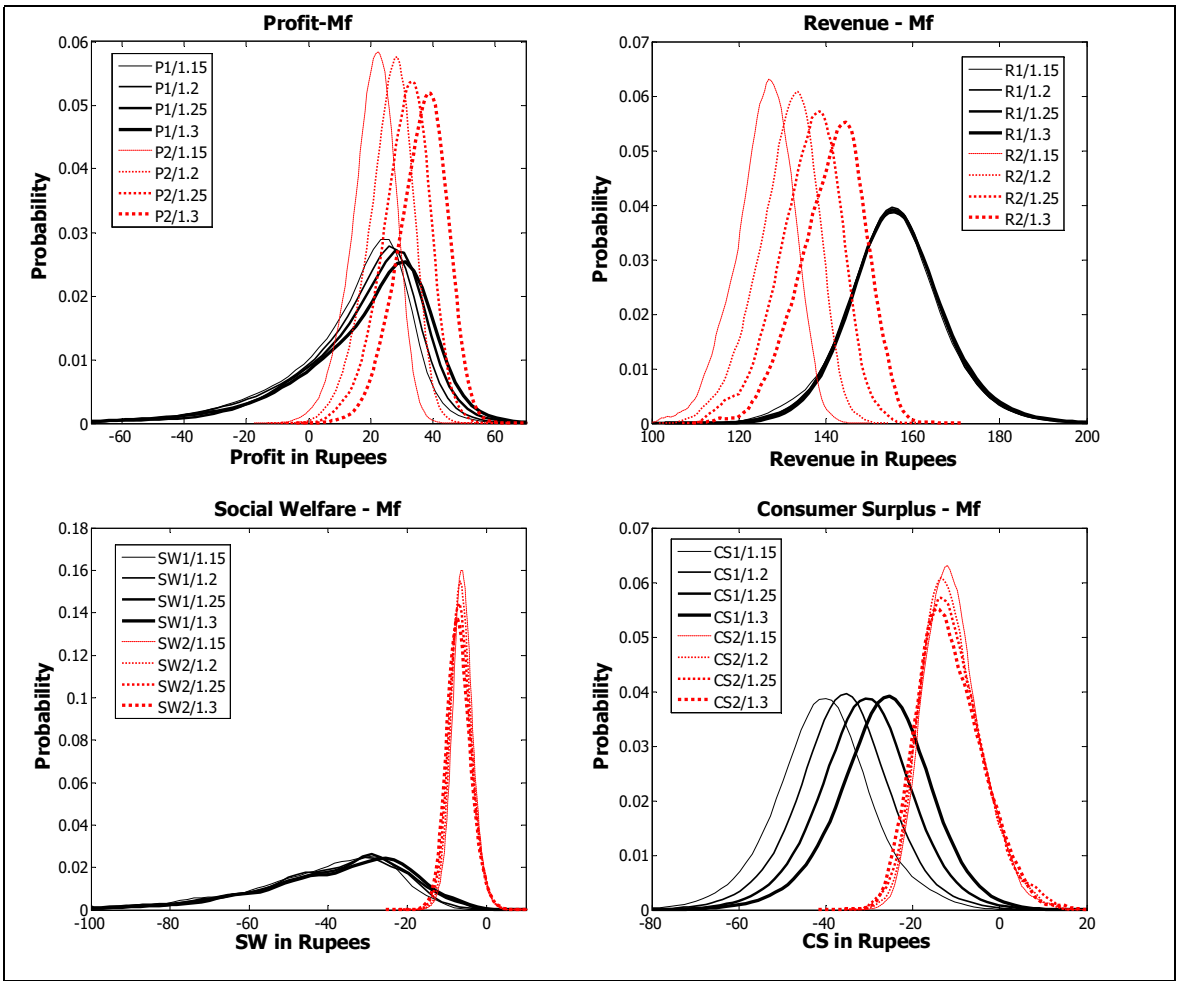
Figure 11: Sensitivity against Inflation Rate



Mark-up

In contrast with the other input variables, the LPVR method is more sensitive against the mark-up value. It has positive impact for the private player's profitability, but decline in the consumer surplus in the LPVR method. Whereas, in the P/G method, consumer surplus increases due to the acceptability of the users to provide greater mark-up to the private player (which represents the minimum required profitability from the project). Overall, the social welfare has very limited variation (see Figure 12).

Figure 12: Sensitivity against Mark-up



6.5 Discussion and Summary of Findings

The argument of this paper is that the Article 29 of the MCA incentivizes the bidders to take extra risk to bid more optimistically (with high expectations) and the current bidding (P/G) method makes the projects over-valued. It could lead to financial unsustainability of the projects in the long run, which can further cause to many unwarranted situations like renegotiations, requests for bailouts or reschedule of due payments to the government and project lenders. Many of these problems are now visible for various Indian PPP road projects.

With the increasing competitiveness and entrance of new players in the PPP market, the P/G method may worsen the situation by unnecessarily over valuing the projects. The

alternative bidding method i.e. LPVR can provide better outcomes (with relatively greater probability) due to pressure put on the private players to improve their technical and operational efficiencies to compete with their competitors[21]. Under this method, the Article 29 will no longer be applicable.

The LPVR method has many other advantages over the P/G method. The most important aspect of the LPVR is the mitigation of the largest risk of the road project, i.e. Traffic Risk. As simulation results show that the LPVR have better chances to earn a profit with relatively high probability as compared to the P/G method's uncertainty over profit, and the profit under the LPVR method is confined within a small range. The users will also get benefitted by paying lesser total cost over the entire life cycle of the project. It helps to distribute the benefits.

The toll fee revision policy will also be independent of the any financial implications for the private players and users too. The government can decide the toll rate depending upon the prevailing situations without affecting the financial position of the private players. It will bring more certainty in the project finances. The certainty of the minimum total revenue of any project can also help in developing the secondary market for the PPP projects.

However, under the LPVR method, the government may not get any premium, but it will certainly reduce its interference, and minimize its contingent liabilities in terms of guarantees given at various stages of the project. It will also reduce the chances of renegotiations.

Though the LPVR method has its own issues but these are not unsolvable. There are few issues, such as variable maintenance cost, uncertain contract period and lender's concern about uncertainty of loan service schedule.

The problem of variable maintenance cost can be solved very easily by keeping a fraction of cash flow for the maintenance. In case of low traffic realization (hence low cash flow),

[21] Simulations results show that with 80 per cent probability, LPVR method has lower expected cost. And this probability increases as expectations about future economic scenarios increases.

the maintenance cost required will also be lower, and the same will be applicable in case of high traffic turn out.

The issue of uncertain contract period is precarious. As simulation results show that there is a probability (though very small) that under the very low traffic growth scenarios, the LPVR method either may not be able to fetch the required revenue forever, or will take longer time to get over, which can have problems like user's rejection in the long run or political agitations. For the uncertain contract length, government can put a cap on the maximum of contract length and terminate the project as it reaches to the cap and the government's liability will be certain, which can go maximum equal to the bided value of the project, which is not the case under the P/G method.

The concerns of the lenders can also be addressed on two grounds. First, as results from the above exercise show that the LPVR method has high chances to fetch the revenue with guaranteed profit (except under the persisting low economic turn-out). Even under the very low growth rate scenarios, the LPVR method has better chances to get profit as compared to the P/G method, which will incur loss. And second, the overall project value (hence, proportionate debt) will be lesser in the LPVR method, so it would be easy for the project promoters to pay back the loan earlier than the P/G method case.

7. Conclusion

The premium and grant bidding method, even though a transparent, open and competitive mechanism, has some serious problems. Coupled with the contract clauses, it compels the bidders to be over-optimistic to win the project, which, in turn, can lead to commercial non-viability of the project if such expectations do not realize in the long run. Increasing competitiveness in the sector can exaggerate it further. This argument explains the recent problems faced by the PPP road projects in India where competitiveness has increased due to new entrants. Players are bidding aggressively with high expectations, and are not able to fetch the expected revenue, and therefore unable to pay their due payments to the government and the lenders. Results also indicate towards the possible problem of adverse selection, i.e. selection of inefficient player.

Given the contract design, the LPVR method seems to provide a better alternative. Under the LPVR method, the increasing competitiveness will compel the private players to be technically and operationally more efficient to win the bid. However, it will still provide better chances to earn a minimum level of revenue. At the same time, under the better economic scenarios, the LPVR method has the positive feature of distributing the benefits among the stakeholders, especially to the users. Importantly, it mitigates the largest risk of the road projects i.e. traffic risk, which, in turn, lower the chances of renegotiations or requests for bailouts due to unexpected lower traffic realization. It can boost the interest of private players in the PPP model. It also limits the role of the government.

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