Research Article

Feasibility of Flexible Term Concessions based Real Options in Indian Highway Sector

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Abstract: Public Private Partnerships (PPPs) are considered as effective tools for transferring risks and responsibilities to the private sector for infrastructure creation, particularly in road transport sector. The uncertainty in demand forecasts makes choice of PPP model susceptible to errors, resulting in non-performing projects and demands for renegotiations. Multiple non-performing projects have resulted in falling competitiveness in Indian Highway sector and government absorbing most risks to attract investors. This article explores the feasibility of offering Flexible Term Concessions (FTC) as a real option over two ongoing Built Operate Transfer (BOT) highway projects in India. The forecast made from actual data using Geometric Brownian Motion and the risk neutral valuation through spreadsheet analysis indicated positive values and risk reduction with the flexibility. Subsequent interviews with key stakeholders in the sector presented some of the barriers to implement flexibilities in Indian PPPs.

Keywords: Real Options, Flexible Term Concessions, Public Private Partnerships, Indian Highway Projects

1. INTRODUCTION

 Outsourcing basic infrastructure development and service to the private sector is being explored in most countries for improving project delivery. PPPs are of larger importance to developing economies such as India due to the heavy demand on developing public infrastructure and the inability of governments to meet these demands by themselves. In India, road transport sector had received much attention for developing PPPs, with 47% of all PPPs developed in 2002-2016 being Highway projects (FICCI, 2017). PPPs allow transfer of risks and responsibilities between private and public stakeholders and, various PPP models were developed to facilitate this. Transfer of higher volume of risks to private sector comes at a premium cost, and prudent choice of PPP model with effective risk distribution between stakeholders is very important to create successful PPPs (Ng and Loosemore, 2007).

1.1 Demand Uncertainty

Of the many risks involved in using PPPs for project delivery, demand/ revenue risk is of major concern in the highway sector. Highway projects feature most of the cost incurred at
construction stage itself and is independent of the actual traffic flow. And in tolled highways projects, the revenue is entirely dependent on actual traffic turnout, thus posing a huge risk to project success, in the form of traffic demand. The initial project revenue model and bidding is based on traffic forecasts done prior to construction and is susceptible to significant errors and biases (Bain and Polakovic, 2005; Flyvbjerg et al., 2005). Estache et al. (2000) presents the lacking capacity of forecasting methods in delivering realistic forecasts. The uncertainty in forecasts result in actual revenues to drastically vary from the initial expectations. Flyvbjerg et al. (2005) also points out how the forecasts are usually overoptimistic, leading to a higher chance of revenue falling below the expectations than above it, increasing the revenue risk. A glance at the experiences gained over the past decade shows that the risk appetite of the private sector to take up these projects has been decreasing, with the government resorting to taking on more risk as evinced by the proliferations of delivery modes such as Engineer Procure Construct (EPC) and Annuity and Hybrid Annuity Models (HAM). There is a clear shift away from the Built Operate Transfer Model (BOT), with government thereby absorbing a higher level of demand and finance risks (FICCI, 2017). The next section presents some of the PPP models, relevant to Indian highway sector.

1.2 PPP Models Used in Indian Highway Sector

The Built Operate Transfer model had been a popular model to develop highway PPPs in India, however demand uncertainties is resulting in fewer applications for this model in recent years (Iyer and Sagheer, 2011). BOT concessions in India are of fixed duration, and the concessionaire is responsible for financing, constructing and operating the project till end of concession period. The revenues are almost completely driven by levying toll charges, posing a huge traffic demand risk on the concessionaire. This can lead to scenarios where concessionaire makes very high losses (profits) in lower (higher) than expected traffic (Vassallo, 2006). BOTs therefore feature a “high risk high return risk” project profile, limiting the sector to risk seeking investors. In India, the toll rates escalation is completely driven by the inflation rates, resulting in the revenues to be fully dependent on actual traffic turnout. Bidders are expected to conduct independent traffic counts and forecasts, in addition to the information shared by the government. As discussed earlier, these forecasts are prone to errors and uncertainties. The forecasts are particularly challenging in case of greenfield highway development (Vassallo, 2010b). The uncertainty has resulted in many project failures and demands for renegotiations due to lower traffic turnouts. The cases of multiple underperforming projects in the past has been a cause of distress to both private and public stakeholders. Use of BOT model as a common method to develop Highway projects is therefore not in the best interest of investors and has resulted in many underperforming projects and demand for renegotiations in India. The aggressive bidding to win the project is also a cause for underperformance in PPPs. All this has led to a losing interest of private sector and financing agencies in highway PPPs, forcing the government to create novel models to increase the competition.

The Hybrid Annuity model is a PPP model developed to reduce the risks borne by private sector stakeholders in highway concessions and its relevance to India is studied by Garg and Mahapatra (2019). Under this model, the concessionaire is paid 40% of the project cost during the construction phase, tied to project milestones. The rest 60% of the costs are paid semi-annually during the operational phase. The concessionaire is responsible for construction as well as operation of the project, but the risks in project financing is reduced and traffic risk is entirely borne by the government. The revenue assurance and risk reduction successfully increased the competition in the sector over the subsequent years (FICCI, 2017). Projects are
also being developed under the EPC model, where the responsibility of private sector is limited to construction alone. However, the use of EPC and HAM have not entirely eliminated the aggressive bidding behaviour, leading to creation of distressed projects (FICCI, 2017), which can subsequently lead to demand for renegotiations. Also, extensive use of these models, pose higher demand on governmental resources, unlike BOT model where many responsibilities were shifted to the concessionaire. Therefore, a judicious choice of PPP model that controls the uncertainty with minimum impact on public resources is needed to effectively use PPPs for developing highway projects in India.

High levels of uncertainty often render choice of PPP model and risk sharing mechanisms devised prior to project commencement ineffective. Introducing flexibility into projects through real options is one way to manage complex projects developed in uncertainty. This article explores if offering a real option to switch to flexible term concession to the concessionaire of a fixed term BOT road project can improve the project revenues and is it an attractive solution to project stakeholders. The analysis is done on actual traffic data collected from two operational highway projects in India, that were tendered as fixed term concessions. Representatives of both government and private sector stakeholders in these projects were interviewed to assess the perception towards the value addition from this real option.

2. LITERATURE

2.1 Real Options

Real Option (RO) is a powerful tool to create flexible project models. Real option is defined as “the right but not the obligation to take specific future actions depending on how uncertain conditions evolve” by Amran and Kumaratilaka (1999). Real options are derived from options theory in finance and can tackle uncertainty in PPPs by delaying the enactment of certain decisions into the operations phase of the project. Real options can be of great aid to public sector in the effort to manage project uncertainties and various types of real options were developed to this cause (Trigeorgis, 1993).

1) Option to Defer
2) Staged Investments
3) Option to Abandon
4) Option to Switch
5) Growth Options
6) Multiple Interacting Options

The value addition with such flexibilities are not captured in conventional NPV and discounted cash flow analysis. Real options analysis acknowledges the underlying uncertainty and can identify the value associated with these flexibilities. Martins et al. (2013) presents the five common techniques used for valuing such options, namely the Black Scholes Option Pricing Model (BSOPM), Binomial Option Pricing Model (BOPM), the Risk-Adjusted Decision Trees (RADT), the Monte Carlo Simulation (MSC), and Hybrid Real Options (HRO).

Wang and de Neufville (2005) categorized real options in Engineering as options ‘in’ projects and ‘on’ projects. The ROs ‘in’ projects are embedded in the design, whereas real options ‘on’ projects are built over the project, treating the basic model as a ‘black box’. While options ‘in’ projects add much more flexibility and value, it is also challenging to identify and model them. In highway PPPs, most literature on real options ‘in’ highway projects explore the value creation through phased development (Krüger, 2012; Ashuri and Kashani, 2011).

Literature exploring the real options ‘on’ projects mostly aims at contractual options providing flexibility in operations. Value of offering revenue aids such as minimum guarantees
as a contractual real option ‘on’ projects were explored by many authors (Carbonara et al., 2014; Iyer and Sagheer, 2011; Ashuri et al., 2010a; Ashuri et al., 2010b; Shan et al., 2010). Asao et al. (2013) uses the real options approach to compare demand risk mitigation through flexible term concessions and revenue guarantees and identify the higher advantage offered by FTC for governments operating within budgetary constraints.

2.2 Flexible Term Concessions (FTC)

Least Present Value of Revenue (LPVR) based FTC is an approach to effectively manage the traffic revenue risk through a flexible concession period that extends till a pre-determined value of revenue is attained. LPVR based auctions were developed in Chile as a bidding mechanism to award BOT highway projects (Engel et al., 2001). The bids are made on the required NPV of traffic revenue from the project, discounted at a predetermined rate and the lowest bidder is selected as winner. FTCs are a modified version of BOT, featuring a flexible concession duration with the traffic risk borne by the highway users, rather than concessionaire or government (Carpintero et al., 2013). The concessionaire shall operate the project till the NPV of actual toll revenues match the target LPVR value demanded in the bid. The concessionaire is therefore indemnified from traffic revenue risks by use of LPVR based FTCs. Since the operational progress is linked to revenue targets, the project termination and contract transfer can be conducted with increased transparency, as net payments to the concessionaire at any time can be computed as the deficit in NPV of revenues (Engel et al., 1997). Mathematical comparison across normal BOT model with the LPVR approach resulted in superior value proposition with the use of LPVR. The model yields more value to the consumers and government without major burden on the concessionaire (Engel et al., 2001). During an economic recession in Chile, traffic demand fell short of the predictions and led to the renegotiation of most projects except the one awarded through LPVR scheme (Vassallo, 2006). This proves the relative advantage to the government in employing LPVR as a mechanism for Highway concession allocation and creating flexibility in otherwise rigid PPP models. Albalate and Bell (2009) also verified the capacity of FTCs in managing traffic risk and improving social welfare.

LPVR based FTC were however not very popular among private sector players, when it was used for launching highway projects in Chile, due to its asymmetric risk profile (Vassallo, 2010b). The termination of contract on attaining revenue target ensures that concessionaire cannot avail any benefit from a higher than expected traffic flow. Moreover, in the case of extremely low traffic turnout, the duration can extend beyond practical limits, resulting in very high operational costs. Also, in the later years, the actual traffic flow might even exceed the highway capacity, but the compounding effect of discounting minimize its effect in the NPV of revenues. Such possibilities can even lead to scenarios that can never attain revenue targets and end up as non-performing assets for the concessionaire. Also, the uncertainty in project duration with the use of FTCs, add complexities in managing resources of concessionaire across different projects.

To make FTCs more attractive to concessionaires, it was proposed to ensure a minimum and maximum duration for FTC (Vassallo, 2010b). The minimum duration ensures that concessionaire is benefitted in the events of higher than expected traffic turnout, and maximum duration protects the concessionaire from the burden of a non-performing project. A form of revenue guarantee was also proposed, computed as the deficit between NPVs of actual revenues and target revenue, if revenue target cannot be attained at the end of concession period (Vassallo, 2010b). Such efforts were proposed to make the flexibility attractive to the private participants, by eliminating the traffic risk entirely, with minimal financial impact on the government. In the
afore-mentioned situations, revenue targets were formulated based on actual toll revenues. In order to also protect the concessionaire from rising operational cost in the later stages of project, a variation to LPVR called Least Present Value of Net Revenue (LPVNR) was developed by Nombela and Rus (2004). In the LPVNR approach, the net revenues are used to set target revenues in place of toll revenues. The reluctance from concessionaire to share operating expenses might make actual use of LPVNR difficult. Despite the many mentioned advantages of using LPVR and FTCs, the actual adoption remains highly limited. Very few countries have attempted using FTC as a mode for creating Highway PPPs.

Literature presents flexibility in the form of real options can be used to effectively manage the demand risks and thereby increase the competitiveness in the sector. Focusing on Indian highway sector, FTCs is one such flexibility which can address demand uncertainty. However, the application of FTCs in India is still pending and the literatures exploring the application of FTCs as real options on fixed term BOT projects are limited.

3. METHODOLOGY

Traditional methods of project revenue analysis follow a deterministic modelling approach, ignoring the uncertainty in forecasts. Such approach therefore cannot identify the value of flexibilities such as real options. Stochastic modelling of revenues based on actual traffic is done on two BOT highway projects and Monte Carlo simulations are used to capture the probabilistic nature of the outcomes and identify the risk neutral value with the proposed real option. All the models presented in this article were developed using MS Excel® spreadsheet software and the comparison of revenues was based on NPVs, discounted at 12% per annum.

3.1 Projects Considered

Two highway projects were considered for modelling the real options. The first one, hereafter referred to as project A was a short urban corridor that was developed as a greenfield project. The second, hereafter referred to as project B was a brownfield project in rural India, which involved widening an existing 2 lane corridor to 4 lanes. At the time of analysis, both projects were in the operations phase, with traffic data available for 7 years. Both projects were awarded in same year to two consortia led by the same project sponsor. The concessioning authority was the National Highway Authority of India (NHAI), the governing body for highway projects in the country. Both projects were offered under BOT mode with a concession duration of 20 years. In order to compare the actual performance of both projects with the expectation at the bidding stage, two types of models were developed. To create the bid-time expectations, information as available from the Model Concession Agreement (MCA) was used along with information directly collected from the lead firm on the distribution of capital expenditure, loan schedule etc. To develop the actual project revenue model, the weekly traffic data across vehicular segments were collected from the lead firm and information on costs were obtained from secondary sources as well as the concessionaire directly. The comparison of the expected toll revenue and actual toll revenue as calculated from the data collected is represented in Figures 1 and 2, respectively for project A and project B.
From Figure 1, it can be noted that the actual revenues till 7\textsuperscript{th} year, were much lower than the expected revenues for project A (greenfield project). The actual traffic in project B, was comparable to the expected revenues.

### 3.2 Deterministic Revenue Modelling

The bid time assumptions on traffic and project costs were collected from the MCA document. The traffic growth rate presented were deterministic in nature and monthly traffic across vehicular categories were computed using these rates using the following formulation, till end of concession period (20 years)

\[
T_{n+1} = T_n (1 + r)
\]

where,
- \(T_{n+1}\) : forecast for \(n+1\)\textsuperscript{th} time interval,
- \(T_n\) : forecast traffic at \(n\)\textsuperscript{th} time interval, and
- \(r\) : deterministic growth rate for interval (from MCA).
This traffic forecast based on the MCA does not consider the uncertainty and presents deterministic outcomes. The annual toll rates were calculated as directed in the MCA to compute annual toll revenues from project operations. Approximate construction and operational costs were obtained from the concessionaire to construct the annual net revenue from the project and was validated from the concessionaire. The NPV of these net revenues discounted at 12%, thus serves as a good measure of the expected returns from the project at the time of bidding. Since the proposed FTC is offered as an option, this NPV was considered as the target for marking the completion of FTC.

3.3 Stochastic Traffic Forecast

The deterministic model is incapable of acknowledging the variability in traffic forecasts as discussed in section 1.1 and therefore cannot capture the value associated with flexibilities, such as FTC. The 7 years of traffic data presented an opportunity to capture actual observed growth rates and use it to develop a probabilistic forecast of traffic for subsequent years. Geometric Brownian Motion method was chosen to forecast future traffic, as it is commonly used for traffic demand forecasts under risk (Phong et al., 2017).

The exponential growth rates from actual traffic growth curves for each vehicular segment was obtained using the method of curve fitting and iterated to minimize the mean squared error in fitting. However, complete reliance on actual data can bias the forecast with short term trends and miss out on long term macroeconomic trends that the forecast in MCA might have captured. Therefore, growth rate used for forecast was based on both observed rates, from curve fitting as well as the initial forecast rates, presented in the MCA. The exponential growth rate for subsequent years was arrived using the relation presented in equation 2.

\[ r_u = \sqrt{(r_o \times r_f)} \]  

where,
- \( r_u \): actual used rate,
- \( r_o \): observed rate,
- \( r_f \): initial forecast rate.

The use of geometric mean, brings \( r_u \) closer to the smaller of \( r_o \) and \( r_f \), limiting any over optimism present in either \( r_o \) or \( r_f \) due to short term trends and biases.

In the Geometric Brownian motion approach, the forecast at every point for each vehicle segment is only based on the outcome at previous point and the growth rate. This relation is presented in equation 3.

\[ T_{n+1} = T_n (1 + (dr + vol)) \]

where,
- \( T_{n+1} \): forecast for \( n+1^{th} \) time interval,
- \( T_n \): forecast/ actual traffic at \( n^{th} \) time interval,
- \( dr \): drift factor,
- \( vol \): volatility factor.

The drift component is the average exponential rate at which demand is expected to grow. In this model, the growth rate \( r_u \) as computed from equation 2 for each vehicle segment, was used as the drift factor. In Geometric Brownian motion, while the demand is expected to grow exponentially, it is also expected to demonstrate random variations. Possibility of such variations necessitates a stochastic forecast and the volatility factor (\( vol \)) in the equation 3, is
responsible for such variations. In this model, the forecasts are based on actual data and hence such variations in forecast can be expected to be similar to the variations actual data had demonstrated in the exponential curve fitting. Such fluctuations in actual data were captured as the standard deviation of the square of errors in curve fitting. Hence the volatility factor was modelled as a normal random variable with mean 0 and standard deviation as square root of the standard deviation of square of errors observed in curve fitting.

3.4 Monte-Carlo Simulations

The revenue model developed in section 3.2 was based on expected costs and a deterministic traffic forecast. To compute the real returns from the project, information on actual costs and schedule were collected from the concessionaire and secondary data sources. The revenues were calculated from the traffic forecasts made from actual data, as mentioned in section 3.3. The NPV of total returns till end of 20\textsuperscript{th} year (BOT concession duration) was calculated as the possible returns from the projects by continuing in BOT model. However, the returns thus calculated represents only one of the many possible outcomes from the stochastic traffic forecast. Therefore, Monte Carlo simulations were applied on the fixed term BOT revenue model to obtain outcomes from 1000 iterations, and thereby identify the probabilistic nature of the returns. Plotting a value at risk curve for this provide insights into what actual returns from both projects A and B will look like at end of the concession period.

3.5 Real Options Modelling

This article explores the feasibility of offering FTC as a real option. The value of such an option can be calculated as the incremental revenue the concessionaire can incur from a flexible term concession, compared to a fixed term concession. To arrive at the returns from using FTC, first the stochastic traffic forecasts developed as mentioned in section 3.3 was extended till NPV target was met, and the revenue model developed as mentioned in section 3.4 also similarly extended. The FTC duration was computed as the year at which NPV of actual toll revenues meet/exceed the NPV of expected toll revenues. Monte Carlo simulations was applied on this to obtain the distribution of FTC durations and note the probability of exceeding practical limits. For evaluating FTCs as real options however the duration was limited between 15 and 25 years as per recommendations of Vassalo (2010b). The value of the real option was computed as the average incremental net returns incurred by the concessionaire on using flexible term concession (i.e. exercising the real option) compared to the fixed term concession using the following formulation

\[
Value \ of \ RO = NPV_{FTC} - NPV_{BOT} \tag{4}
\]

where,
\[
NPV_{FTC} : \text{NPV of net revenues from stochastic forecast, in FTC and}
\]
\[
NPV_{BOT} : \text{NPV of net revenues from forecast, in fixed term BOT model}
\]

Vassalo (2010b) had also recommended a guaranteed government payout of deficit revenues, if target was not attained within maximum permitted duration of FTC. This was modelled as another real option, where the flexibility was limited between 15 and 25 years, with a provision of government pay-out of deficit revenues on 25\textsuperscript{th} year. The government payout ensures that on exercising this option, the concessionaire is assured a minimum net revenue as presented in the deterministic model. The value of this real options was also calculated as the
incremental NPV of net revenues by using FTC compared to fixed term BOT, with the minimum net revenue from FTC set as the NPV of net revenue from deterministic model.

3.6 Interview with Stakeholders

To obtain the perception of stakeholders in highway PPPs, interviews of both private and public stakeholders were conducted. From the private sector, the chief financial officer of the lead partner in the consortium operating the projects was interviewed. From public sector, two senior government officials from the department of finance were interviewed. The interview consisted of demonstration of the analysis of the FTC based real options and questions on how such flexibilities can impact the projects considered, exploring the perceived value and willingness to pay for the options.

4. RESULTS

4.1 Expected Returns from Projects

The expected returns from projects A and B form the baseline for comparing viability of FTC based real options. Table 1 indicates the expected returns from both projects as calculated from the deterministic model developed in section 3.2.

<table>
<thead>
<tr>
<th></th>
<th>NPV of Net Returns (at 12%)</th>
<th>NPV of Toll Returns (at 12%)</th>
<th>IRR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project A</td>
<td>INR 0.3 Billion</td>
<td>INR 7.3 Billion</td>
<td>14.2 %</td>
</tr>
<tr>
<td>Project B</td>
<td>INR 0.7 Billion</td>
<td>INR 9.4 Billion</td>
<td>15.5 %</td>
</tr>
</tbody>
</table>

*As computed from the deterministic revenue model.

4.2 Duration of FTC

The major concern regarding applicability of FTCs is the possibility of attaining toll revenue targets within a reasonable duration. Very long extensions can result in extensive maintenance costs and repeated discounting can lead to situations where toll revenue target may never be met. Figures 3 and 4 respectively represents the probability histograms for FTC durations for projects A and B.

![Figure 3. FTC duration for project A](image-url)
The FTC duration was modelled for both projects till a maximum duration of 50 years, and the results indicated that the duration will exceed 50 years for project A and B with probabilities of 45% and 7% respectively. The figures 3 and 4 represent only the durations that were lower than 50 years. Since very large durations, as demonstrated by the stochastic modelling of project A is not practically feasible, it indicates that FTCs may not be able to benefit projects with extremely low traffic turnout, such as project A.

4.3 Real Option Value

The net benefit to the concessionaire by choosing a real option can be computed as the difference in NPVs with and without the real option. The stochastic traffic model was used to calculate the probable net returns to concessionaire using Monte Carlo simulations, with fixed term concession and flexible term concession. The difference in average net returns in both cases was calculated as the value of the real option. The value was also calculated for the option with the provision of government payout. These values are presented in Table 2.

<table>
<thead>
<tr>
<th>Project</th>
<th>Project A</th>
<th>Project B</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPV of net revenues, regular BOT</td>
<td>- INR 989 Million</td>
<td>+ INR 492 Million</td>
</tr>
<tr>
<td>NPV of net revenues, FTC</td>
<td>- INR 644 Million</td>
<td>+ INR 553 Million</td>
</tr>
<tr>
<td>Value of real option without govt payout</td>
<td>+ INR 345 Million</td>
<td>+ INR 30 Million</td>
</tr>
<tr>
<td>Value of real option with govt payout</td>
<td>+ INR 1,345 Million</td>
<td>+INR 220 Million</td>
</tr>
</tbody>
</table>

*Computed at 12% discount rate, with reference point as commencement of concession period

Both options indicate a positive value for the concessionaire, in both projects. The option with guaranteed government payout has higher value, as it eliminates the downside risk entirely. The value at risk plot for net revenues is presented in Figures 5 and 6, respectively for projects A and B. The plot is for the option without government payout, to demonstrate how the flexible concession duration alone can impact the project performance.
Figure 5. Probability of NPV of net revenues from project A

Figure 6. Probability of NPV of net revenues from project B

The numbers in Table 2 and curve in Figure 5 indicate how project A is likely to yield negative returns with both fixed and flexible term concessions, indicating how the option without any government pay out can be unattractive to the concessionaire. However, the returns from project B is mostly positive and the variance in returns is much lower with the use of flexible term concession, as seen in Figure 6. The right sided tail of curves in Figure 6 points to high traffic events, and it may be noted how such scenarios result in higher returns from use of a fixed term concession, due to early termination of a flexible term concession.
4.4 Sensitivity with Discount Rate

The entire exercise was modelled at a discount rate of 12%. This choice was in accordance with the Manual for Economical Evaluation of Highway projects in India (IRC SP30) and was acceptable to the lead firm of the consortia. Since FTC completion (when FTC range is not capped at 25 years) is marked by attainment of NPV of revenues, change in discount rate can create variations in results. This is demonstrated in Table 3, where the median flexible term concession durations for the projects are presented at various discount rates. Note that project A featured lower traffic turnout and hence require a very long concession duration to meet revenue target, hence the sensitivity of FTC duration w.r.t discount rate was higher in comparison to project B due to multiple years of compounding.

Table 3. Sensitivity of discount rate on FTC completion

<table>
<thead>
<tr>
<th>Discount Rate</th>
<th>8%</th>
<th>10%</th>
<th>12%*</th>
<th>13%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median FTC duration for project A</td>
<td>34</td>
<td>38</td>
<td>45</td>
<td>56</td>
</tr>
<tr>
<td>Median FTC duration for project B</td>
<td>22</td>
<td>22</td>
<td>22</td>
<td>22</td>
</tr>
</tbody>
</table>

*Discount rate used for modelling

5. DISCUSSIONS

5.1 Feasibility of FTC Based Options in BOT Projects

The results from the valuation of real options, presented in Table 2 indicate positive values for FTC based real options, with and without government pay-out. The results were presented to the representatives of the lead member in the consortia for both the projects and later to the government executives from the department of finance.

The interactions identified that for project A, the real options without government pay-out was not attractive enough for the private sector as the net returns remained negative, despite the flexibility. The option with government pay-out of deficit revenues was however found attractive as it fully indemnified the concessionaire from downside risks. The government representatives opposed the idea of pay-out of deficit revenues on FTC completion, as the huge deficit computed at a 12% discount rate will be a large value by end of concession period. For project A, the average pay-out required at end of 25th year was ~ INR 23 Billion, because of the compounding effect of the discount factor used. Private sector requires a high discount rate such as 12%, as lower discount rate will not ensure favourable returns to concessionaire.

For project B, the private sector demonstrated confidence in continuing the project in fixed term concession-based BOT and was concerned of losing the possible upside opportunity by introducing FTC into the project model. The right end of the VAR curves in Figure 6 represents events with high traffic turnout, and the FTC does not allow the concessionaire to benefit from such events. However, a risk neutral valuation indicated a positive value for using FTC in project B, as indicated in table 2. This demonstrate risk seeking behaviour from the concessionaire for the project.

5.2 Increasing Competitiveness

A major challenge faced by Indian PPP highway projects is the limited competition and overoptimistic bids. Under-performing projects are likely to demand for renegotiations and with low competition, the government will be forced to agree to demands of the few players in the market. The culture of renegotiations is however detrimental to competition, incentivizing
existing players to bid aggressively hoping for renegotiations, and thereby keeping new entrants outside the sector (Vassallo, 2006; 2010b). The low competitiveness in Indian highway sector was demonstrated by the government efforts to absorb most risks and was also mentioned as a key challenge during the interactions with government executives. The government officials mentioned their apprehension to implement any flexibilities that can alienate the few private players in the Highway sector.

As mentioned in section 5.1, the concessionaire did not find the real option offered in project B attractive enough, indicating a risk seeking behavior. And fixed term BOTs are relatively high-risk projects, hence mostly unattractive to risk averse bidders. Therefore, FTCs based BOTs can make the sector attractive to such players. Hence offering FTC as a real option will result in projects that offer a ‘high-risk high-return’ profile for risk seeking bidders and a ‘low-risk low-return’ profile for risk averse bidders. Thus, the use of real options can make individual projects attractive to more participants and thereby increase the competition in the overall sector.

5.3 Sensitivity with Discount Rate

The duration of FTCs and valuation of the real option is sensitive on the discount rate chosen. The importance of using the right discount rate in FTCs was demonstrated in detail by Vassallo (2010a). The risk-free return rates are likely to vary over years and the cost of financing project for concessionaire is likely to drop in future due to refinancing opportunities, therefore use of a variable discount rate seems to be a more practical approach in real options valuations in projects with long concession durations. However, estimation of the variable rate itself will have uncertainties and can add more complexities to the real options analysis.

5.4 Pricing the Option

Offering FTC based real options to fixed term BOT projects can improve the project value as represented in table 2. Offering such flexibility at the time of bidding can reduce the project risk and reflect in lower bids, thereby adding value to the public. This article models FTC based real option on operational BOT projects, however offering such flexibility, post project award is not favourable to the competition in the sector, as it is unfair to the unsuccessful bidders. This dilemma can be solved by effectively pricing the option. With availability of the value of the options, it is possible to price the option as a percentage of this value. Since the reliability of forecasts will improve with availability of more years of operation data, the pricing can be set at a higher percentage of real options value, with delay in choosing the option.

The private sector opposed the idea of pricing the real option offered, as the option will only be attractive to projects that are underperforming and additionally imposing an expenditure in the form of cost of option on an underperforming project, can further deteriorate its cash flows. Hence, an effective pricing strategy for offering real options post project award need to be developed so as to aid underperforming BOT projects and reduce the demand for renegotiations.

5.5 Organizational Barriers to real Options

The valuation of FTC based real options demonstrated positive value, however the private and public sector were not really attracted by the flexibility offered. The government officials while impressed by the improvement flexibilities can impart to projects, was opposed to the idea of
implementing the same in a developing nation like India, due to the low competition and limited capacity in addressing the added complexities with real option analysis.

Herder et al. (2011) had identified the following barriers for implementing real options:

1) Reputalion
2) Applicability
3) Lock-in Nature
4) Lacking Capacity
5) Decisive nature of planning
6) Compound Uncertainty

Exercising a real option is a deviation from the status quo or default mode of running the project and is done at the discretion of the concessionaire. Such a decision can be naively perceived as an untoward favor to concessionaire from the public sector and result in allegations. This concern was made by the public participants and is well founded due to the extreme media scrutiny for corruption in large projects. Ensuring a fair pricing mechanism however can address this issue, as it will eliminate the impression of ‘untoward’ benefits. Possibilities of allegation also calls for careful implementation and publicity strategies from the government while introducing such flexibilities.

The issue of applicability is of major concern and was demonstrated by both private and public agencies, by the lack of interest in options despite its positive valuation. Cardin et al. (2007) had developed a methodology to systematically identify multiple real options. The real option without government pay-out was not attractive to the concessionaire, despite its positive valuation in project A. The notion of government pay-out was not welcomed by the government’s stakeholders, due to the high volume of payment involved. Hence identifying real options with features that are attractive to both public and private sector is necessary for successful implementation.

The issue of capacity was of concern to the public sector. However, sufficient competition in the sector can be expected to force private players with lacking capacity to quickly adapt, to benefit from the advantages offered.

The issues of lock-in, decisiveness and compound uncertainty were not mentioned during the interactions with practitioners. Herder et al. (2011) explains the issue of ‘Lock-In’ as the tendency of firms involved in project conceptualization to follow the conventional way of thinking and not actively seek out flexibilities. Cardin et al. (2007) presents a systematic method to identify and model real options into projects which can be used to overcome the challenges of ‘Lock-In’.

PPPs feature complex projects and real options will further complicate the contract and revenue sharing structure. The escalated levels of complexity in project structure due to real options can pose difficulty in project management for both public and private stakeholders. Adoption of real options will therefore require changes in decision making process at organizational level (Herder et al., 2011).

6. CONCLUSION

FTCs offer an asymmetric risk profile, which can only be partially addressed by limiting the flexibility in concession duration. While a government payout of deficit revenues at the end of maximum allowable concession duration, made the option attractive to private sector, the compounding of discount rate over many years made the government oppose use of such guarantees. Hence flexible term highway concessions cannot benefit all underperforming projects. Offering FTCs as a real option allows the concessionaire to delay the decision to
switch to an FTC, and make an informed decision, using more years of traffic data. Hence, offering FTCs as real options can benefit underperforming projects and reduce the risk in highway projects.

FTCs are usually used in projects through LPVR based auctions, the methodology used in this article presents a way to introduce FTCs as real options to ongoing BOT projects. However, if the option is presented after project award, the option needs to be priced effectively so as to maintain the competitiveness and fairness in the industry. Offering such real options over ongoing BOT projects with an effective pricing strategy can therefore improve the project performance and reduce the demand for renegotiations, however this strategy alone may not offer fairness, as this information was not available to every bidder at the time of bidding. An alternative is to offer the option at the time of bidding without pricing, expecting the value of flexibility to result in lower bids. However, this approach fails to use the actual traffic data, and hence result in less reliable valuation. Also, the true value of flexibility may not be perceived during bidding due to ignorance to uncertainty. Therefore, it seems advantageous to offer the option such that the availability of the option and the pricing strategy is communicated to all the bidders at the time of bidding, and the exercise of the option can be made at the discretion of the concessionaire during operations with payment as per the pricing strategy. This can ensure fairness in pricing and information availability while depending on actual data for valuation. The analysis presents a theoretical case for use of ROs but is not sufficient for adoption to practice. Modifying contractual structure post award can be limited by the legal system and is not considered in this analysis. Further, the pricing strategy is key for actual adoption, as it ensures fairness while retaining the attractiveness of option to the concessionaire, and developing such strategies require deeper analysis.

The real option presented, despite its positive valuation was not attractive enough for the private sector in a project where the actual traffic turnout was comparable to initial forecasts. This behavior demonstrated the risk seeking nature of the stakeholder considered. A risk averse bidder might however identify a superior value with the same real option. The risk preference of the bidders and attitude towards flexible project structures needs to be studied in detail and can serve more insights into strategies for implementing and pricing the real options.

REFERENCES


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