Equitable Financial Evaluation Method for Public-Private Partnership Projects

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Abstract: The feasibility study of a public-private partnership (PPP) project is regarded as one of the critical factors for successful implementation, but unfortunately the common financial evaluation methods currently used only represent the benefits of the private sector. There is, therefore, an urgent need to develop an equitable financial evaluation method for PPP projects. This paper presents a comprehensive literature review that examines international practices. An equitable financial evaluation method was then developed taking into account the inherent characteristics of PPP projects using six separate indicators and Monte Carlo simulations. The result for a bridge project in Romania shows that the method combines the viewpoints of all the relevant stakeholders to achieve an equitable financial evaluation of PPP projects.

Key words: financial evaluation; risk analysis; public-private partnership (PPP)

Introduction

A public-private partnership (PPP) is a collaboration between the public and private sectors for the purpose of delivering a project or a service traditionally provided by the public sector. Recent years have seen an increasing market for PPPs for the development and operation of infrastructure projects. However, in China for example, only a few PPP projects have been successfully completed[1]. One reason is that the commonly used financial evaluation methods only consider the benefits of the private sector. With the fast pace of market-oriented transformations in infrastructure, a delicate balance has to exist among the private sector capacity, government regulatory function, and public satisfaction. This study develops an equitable financial evaluation method incorporating risk analysis for the delivery of PPP projects, taking into account all the viewpoints of the relevant stakeholders including the government, sponsors, and lenders.

1 Method Development

1.1 PPP project characteristics

Governments worldwide are seeking to increase involvement of the private sector in the delivery of public services with overwhelming numbers and types of PPPs. The general characteristics of PPP projects can be easily identified as follows.

(1) The partnership involves several participants in a long-term, stable relationship with at least one as a public entity and another from the private sector.

(2) Each participant needs to be able to negotiate and contract on its own behalf. Thus, transactions imply real continuity of behavior[2].

(3) Most PPP projects include risks that are difficult to control and analyze due to a PPP project’s scale, long concession period, and complexity[3].

(4) Since PPPs seek to draw on the best available...
skills, knowledge, and resources, each participant should bring its value to the partnership. Therefore, each has to transfer some resources to the project\textsuperscript{[2]}.

(5) Responsibilities and risks in a PPP project are allocated to the party best able to manage them\textsuperscript{[4]}.

1.2 Current financial evaluation methods

The most common methods for assessing financial viability are the average accounting rate of return, payback period, net present value (NPV), and internal rate of return (IRR) methods. These methods are based on cash flow forecasts. However, forecasts for PPP projects are more difficult because of the high capital outlays, long lead times, and long concession periods. These require financial evaluation methods that also adequately reflect the characteristics and risks involved\textsuperscript{[5]}. Thus, Ho and Liu\textsuperscript{[6]} presented a build-operate-transfer (BOT) option valuation model to evaluate the financial viability of a privatized infrastructure project. Ranasinghe\textsuperscript{[7]} outlined a methodology based on financial and risk analyses that a government or a government utility can use to analyze the viability of private sector participation in new infrastructure projects. Ye and Tiong\textsuperscript{[5]} systematically classified the existing evaluation methods and proposed an NPV-at-risk method that combines the weighted average cost of capital and the dual risk-return method, which has been vigorously validated and is, therefore, used in this study. Although these earlier studies included various suggestions to improve evaluations, few have considered the different viewpoints for all the project participators.

This study also examines the international experience of financial assessments for PPP projects. UNIDO declared that the key difference between the appraisal of a privatized project and that of a more traditional public sector scheme is that the private sector tends to focus more on risk. Thus the project’s financial viability is more important than for a scheme financed entirely by the public sector\textsuperscript{[8]}. In the UK, the PPP model should only be pursued if it delivers value for money (VFM), where the VFM is the optimum combination of whole life cost and quality (or fitness for purpose) to meet the user requirements, which does not always mean choosing the lowest cost bid\textsuperscript{[9]}. Australia\textsuperscript{[10]} and the European Commission\textsuperscript{[11]} use similar criteria. In addition, the Taiwan government has adopted a self-liquidation ratio (SLR) to measure the budgetary cost to the government by the project\textsuperscript{[12]}.

1.3 Selection of indicators

In light of these characteristics and international practices, the indicators selected for the financial evaluation method are described from the perspectives of the various stakeholders.

1.3.1 Government’s perspective

For the government, the financial appraisal allows it to determine whether the project cash flows alone are likely to give a sufficient financial return to a private sector sponsor or whether a contribution is required from the public sector. The government also needs a financial model to evaluate the bids in a competitive tender.

The VFM criteria has been used to measure whether the government has obtained the maximum benefit within the available resources. VFM not only measures the cost, but also takes into account the quality and fitness for purpose to determine whether goods and services represent good value. Based on these, the government thus selects a preferred proponent to obtain the maximum VFM. In assessing the VFM, the public sector comparator (PSC) is first identified, probably based on similar projects. The difference between the PSC and the bidding price is the VFM of the potential project, as shown in Fig. 1.

![Assessing VFM and PSC](image)

The SLR is another indicator used to evaluate whether project cash flows give a rational financial return to the sponsors as a measure of the budgetary pressure to the government. The SLR is the ratio of the total revenue to the total cost at the end of the concession period. The government needs to provide subsidies to promote private investment in the project if the
SLR is less than 1.

1.3.2 Lenders’ perspective

For lenders, the nature of non-recourse or limited-recourse funding clearly carries a rather different credit assessment than a conventional full recourse loan. The key difference between the lenders and the sponsors is that holding debt rather than equity never has a potential upside gain in the project, only a downside risk\[13\]. In this case, lenders want to be satisfied that the indicators can measure whether the project can service its debt with a sufficient allowance to cover any contingencies. This study uses the debt service coverage ratio (DSCR) to represent the principal payment ability, where DSCR is the ratio of the net operating income to the annual debt service. The DSCR is typically acceptable if it is more than 1.05. The time interest earned (TIE) is also a widely used benchmark to measure the borrower’s ability to cover the interest payments during the operating period. The TIE is calculated by taking the earnings before interest and taxes and dividing by the total interest. Lenders commonly require a TIE of more than 2.

1.3.3 Sponsors’ perspective

The primary objective of the private sector is to maximize profits, and their decisions are mainly based on the financial viability of PPP projects. Thus, they look at the operational and financial cash flows to check the project’s financial viability and to assess whether they are able to meet all their financial obligations, including debt service, which is quite similar to non-PPP projects. The only differences are that the accounting period in a PPP project is the contract period and the income may include government subsidies or may be limited by the concession agreement. The NPV and IRR instruments were, therefore, selected for this method.

1.4 Method framework

The literature review of the current financial evaluation methods in Sections 1.2 shows that value-at-risk systems provide decision criteria with a confidence level. However, they were first developed for analyzing market risks and then extended to analyze other risks such as credit, liquidity, and cash flow\[14\]. Ye and Tiong\[5\] defined the NPV-at-risk based on the value-at-risk systems as a particular NPV generated for a project at some specific confidence level. Their definition of NPV-at-risk can be used to derive the decision rule: the project is acceptable with a confidence level of $1 - \alpha$ if the NPV-at-risk at given confidence is greater than zero. The NPV-at-risk method takes into account all possible returns resulting from uncertainty, the time value of money, the impact of financing methods, and the various risks associated with PPP projects. Therefore, the theoretical framework for an equitable financial evaluation incorporating risk analysis shown in Fig. 2 was developed based on the NPV-at-risk method. The purpose of the financial evaluation is mainly to analyze the economic feasibility of a proposed project and to provide a basis for decision-making\[15\]. As such, this evaluation framework also gives an effective basis for the contract negotiations among participants.

![Fig. 2 Framework of the method](image1)

Taking SLR-at-risk for instance, the indicator is a particular SLR generated for the project at a specific confidence level. Figure 3 presents the cumulative probability for the SLR of a PPP project with high risks. If the given confidence is 10%, the SLR-at-risk is the SLR shown in Fig. 3, which is less than 1. This indicates that the government would probably need to
provide additional contributions to make the project attractive to the private sector.

The analysis also uses the discounted cash flow (DCF) techniques based on the time value of money. The DCF technique is used to calculate all the indicators based on a discount rate (DR) that measures the risks associated with a particular cash flow. For PPP projects, a DR is determined for each project that reflects the risk transferred to each stakeholder. Thus, the DR includes a risk-free rate (to reflect the time value of money) and a premium for the systematic risks borne by the participant. For instance, when more systematic risks are transferred to the private sector, the DR should be higher for evaluating the NPV-at-risk or the IRR-at-risk.

2  Application of the Method

2.1  Project information

The method has been applied to a bridge project in Romania. The project was procured under a PPP contract with a concession period of 30 years. The base-case cash flow for the project was derived as follows. The building of the bridge requires US$300 million over 6 years. The tolls during the operating period are listed in Table 1 with the expected traffic flow in Table 2. The operation and maintenance (O&M) costs are about US$0.8 million. The debt-equity ratio is 7:3, with an annual debt interest rate of 2.5%. The income tax rate is 16%.

<table>
<thead>
<tr>
<th>Year</th>
<th>Bridge toll (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007-2010</td>
<td>7.0</td>
</tr>
<tr>
<td>2011-2020</td>
<td>8.5</td>
</tr>
<tr>
<td>2020-</td>
<td>10.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Car</th>
<th>Heavy vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>1 467 750</td>
<td>489 250</td>
</tr>
<tr>
<td>2010</td>
<td>1 767 750</td>
<td>589 250</td>
</tr>
<tr>
<td>2015</td>
<td>2 533 875</td>
<td>844 625</td>
</tr>
<tr>
<td>2020</td>
<td>3 513 000</td>
<td>1 171 000</td>
</tr>
<tr>
<td>2025</td>
<td>4 266 750</td>
<td>1 422 250</td>
</tr>
<tr>
<td>2030</td>
<td>4 986 750</td>
<td>1 662 250</td>
</tr>
</tbody>
</table>

Thus, the estimated base-case NPV and IRR are US$83.34 million and 15.6% with a 10% DR, which shows that the project is financially feasible. However, these values are uncertain. For Romania, the construction costs, traffic flows, and O&M costs are key factors for the success of the PPP project. Therefore, only the construction cost, O&M cost, and traffic increase ratio were treated as stochastic variables in this study to simplify the financial model. The three variables are assumed to have distributions as shown in Figs. 4 and 5 and in Table 3.

<table>
<thead>
<tr>
<th>Increase ratio (%)</th>
<th>2007-2020</th>
<th>2021-2035</th>
<th>2036-2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>8</td>
<td>0</td>
<td>-8</td>
</tr>
<tr>
<td>Maximum</td>
<td>16</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Expected value</td>
<td>12</td>
<td>4</td>
<td>-4</td>
</tr>
</tbody>
</table>

2.2  Simulation results

A Monte Carlo simulation using 5000 iterations was carried out on a simulation model to obtain the distributions of the selected indicators for the evaluation. The results generated in Table 4 were then used to compute the project’s finances for various confidence
levels listed in Table 5. In the first few years, the lenders would bear much higher risks than during the operating period and the DSCR and TIE typically vary for the lender every year; however, this analysis only used the values of the DSCR-at-risk and the TIE-at-risk in the first year. In addition, the analysis requires a PSC determined before the evaluation by the government, so the VFM is not evaluated.

Table 4 Generated financial results

<table>
<thead>
<tr>
<th>Perspective</th>
<th>Variable</th>
<th>Mean value</th>
<th>SD</th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government</td>
<td>SLR</td>
<td>1.53</td>
<td>0.08</td>
<td>1.77</td>
<td>1.30</td>
</tr>
<tr>
<td>Lenders</td>
<td>DSCR</td>
<td>1.06</td>
<td>0.03</td>
<td>1.14</td>
<td>0.98</td>
</tr>
<tr>
<td>Lenders</td>
<td>TIE</td>
<td>2.68</td>
<td>0.02</td>
<td>2.71</td>
<td>2.63</td>
</tr>
<tr>
<td>Sponsors</td>
<td>NPV (US$, million)</td>
<td>72.61</td>
<td>8.86</td>
<td>102.04</td>
<td>43.55</td>
</tr>
<tr>
<td>Sponsors</td>
<td>IRR (%)</td>
<td>15.00</td>
<td>0.007</td>
<td>13.10</td>
<td>16.90</td>
</tr>
</tbody>
</table>

Table 5 Financial results for various confidence levels

<table>
<thead>
<tr>
<th>Perspective</th>
<th>Variable</th>
<th>99% confidence</th>
<th>90% confidence</th>
<th>50% confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government</td>
<td>SLR-at-risk</td>
<td>1.36</td>
<td>1.43</td>
<td>1.53</td>
</tr>
<tr>
<td>Lenders</td>
<td>DSCR-at-risk</td>
<td>1.00</td>
<td>1.02</td>
<td>1.06</td>
</tr>
<tr>
<td>Lenders</td>
<td>TIE-at-risk</td>
<td>2.64</td>
<td>2.66</td>
<td>2.68</td>
</tr>
<tr>
<td>Sponsors</td>
<td>NPV-at-risk (US$, million)</td>
<td>51.99</td>
<td>61.08</td>
<td>72.67</td>
</tr>
<tr>
<td>Sponsors</td>
<td>IRR-at-risk (%)</td>
<td>13.50</td>
<td>14.10</td>
<td>15.00</td>
</tr>
</tbody>
</table>

2.3 Evaluation analysis

2.3.1 Government’s perspective
As explained above, the government is required to identify a PSC to assess the VFM of a project. In this case, the VFM is not evaluated; however, the NPV-at-risk and IRR-at-risk can provide a basis to estimate a reasonable PSC.

The minimum SLR for the project is 1.30 with values of 1.36 at a 99% confidence level and 1.43 at a 90% confidence level, which indicates that the project’s economic viability is adequate and should attract private investments. In this project, the Ministry of Transportation of Romania borrowed the money for this project with no financial return. That is the major reason for the special financial package, and is regarded as an innovative solution to attract private investment in a project with poor economic viability. Another advantage of PPP projects seen here is that the Romania government can acquire much cheaper financing than the domestic commercial debts which have interest rates of more than 20%.

2.3.2 Lenders’ perspective
For lenders, a debt service with a high debt-equity ratio of 9 and a low interest rate of 2.5% is quite risky, since the minimum DCSR in Table 4 is 0.98 with a 90% confidence level DCSR close to 1.02 as seen in Table 5.

In actual practice, lenders have to seek guarantees from the Ministry of Finance of Romania, and procure an insurance package from a third-party insurance provider. The debt service in this case also includes some political significance. Lenders should be strongly involved in the project to ensure the project’s feasibility instead of requiring more guarantees from the sponsors which creates more barriers for project implementation when the financial conditions are not very attractive.

2.3.3 Sponsors’ perspective
With government incentives such as in this case, the sponsors initially obtain revenue by operating the US$300 million project with about a US$35 million investment. The minimum calculated NPV of the project is US$43.55 million as seen in Table 4 and the NPV at a 99% confidence is US$51.99 million as shown in Table 5.

3 Conclusions
Compared with other types of infrastructure projects, PPP projects are exposed to more risks and, therefore, require more vigorous financial evaluations. This paper presents a comprehensive review of international practices which shows that appropriate indicators for all the stakeholders and improved financial evaluation methods can be combined to form an equitable method for
evaluating PPP projects. The financial evaluation method is based on the NPV-at-risk method, which incorporates a risk analysis using confidence levels and discount rate concepts, to give more equitable results for all the parties involved in the PPP project. Therefore, the contract negotiations will be easier and thus desired VFM will be more easily reached.

Further studies should focus on the evaluation guidance to make the method more practical and useful, especially how to determine the discount rate based on the transfer of the systematic risks.

References