Optimal Incentive Strategies for PPP Transport Projects: A Conceptual Approach*

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Abstract: Incentives given by governments in a Public-Private-Partnership can be costly, that it is important to properly structure an incentive package to achieve minimal financial exposure. This study presents an analytical framework of an optimal incentive strategy by considering the "risk-averse" tendencies of an investor.

1. Introduction

In the present era of tight government budgetary constraints and macroscopic policies of cutting down on sovereign loans, governments are finding it difficult to fund large-scale transport projects to ease its growing infrastructure backlog. This is especially true in developing countries. The only alternative in a lot of times is to tap the private sector in the form of Public-Private Partnerships (PPP); wherein, the private sector assumes the risks and costs of the project in return for the right to gain profit through user charges.

However, oftentimes the economic efficiency of a transport project does not necessarily translate to financial viability. This leads to the necessity of "incentives" from the government in the form of risk sharing, subsidies, etc. But these "incentives" can be costly, as recent experiences in Philippines have shown. Government agencies are thus faced with a problem of minimizing their financial exposure while packaging a financially attractive project.

2. Perception of Contingent Gains and Losses by a Risk-Averse Investor

To properly design incentive policies, knowledge of the mechanism of how an investor behaves is of paramount importance in order to design policies pro-actively and with deliberation leading to more efficient outcomes.

It is a consensus that investors are typically "risk-averse". A risk averse investor does not perceive a real or actual contingent monetary gain or loss (or a contingent change of wealth) by its real value, but rather a risk-averse investor "filters" or adjusts real contingent values to a perceived value, taking account its distaste for risk. A contingent loss/gain is defined as, the loss or gain multiplied by its probability of occurrence.

The following are assumptions on the mechanism of risk perception.

- Gains and losses are perceived monotonically
- Gains are never perceived as loss; and, losses are never perceived as gains
- Decision-makers are consistently risk-averse
- Perception proceeds in a smooth function

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Thus, the mechanism of perception can then be defined by a *perception filter* as follows:

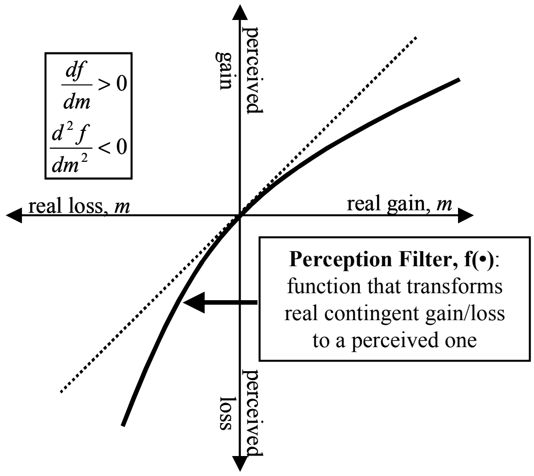

Fig. 2.1 Perception Filter

Review of the empirical results of Swalm (1966) and Carr (1977) indicates that the form of the developed perception filter is reasonable.

3. Measuring the "Utility" Level of a Project

The next step is to define an index of the "utility" of a project to gauge if the investment is viable enough to attract investors. The index must explicitly account the risk and reward balance of the project to be functional for this study.

The convention is to define the project as a bundle of attributes, and these attributes may be a "risk"/undesirable attribute (e.g. market risks, currency risks) or a "reward"/desirable attribute (e.g. potential for profits). Attributes measure the probability of loss/gain and the extent of the loss/gain due to some key element in the project. Moreover, attributes (A) can be represented as a contingent monetary equivalent and is defined by a certain function, *m(A)*.

$$A = prob(occur) \times extent$$
$$m(A) = p^{PS} \times A$$

Where, p^{PS} denotes the unit price attached by the private sector and p^{G} is that of the government to the same attribute, recognizing that the private sector and the government may price an attribute differently.

The perceived overall contingent change of wealth may then be used as an index of the project's utility level (Steil, 1993).

$$C(\mathbf{A}) = \sum_{1}^{N} f\left[m_i(A_i)\right]$$

Where, $C(\mathbf{A})$ is the utility level of the project, a function of its attribute vector.

Defining a substitution function between two attributes, A_i and A_j, as $A_i = S(A_j,K)$, the mechanism of attribute-wise compensation while retaining a certain project "utility level", K, has the following properties.

Table 3.1 Properties of $A_i = S(A_j,K)$

attribute$_{i/j}$ type		$\partial A_i/\partial A_j$	$\partial^2 A_i/\partial A_j^2$
A_i = risk	A_j = risk	<0	>0
A_i = risk	A_j = reward	>0	<0
A_i = reward	A_j = reward	<0	<0

Table 3.2 Boundary Conditions of $A_i = S(A_j,K)$

attribute$_{i/j}$ type		at $A_j = 0$	at $A_i = 0$
A_i	A_j		
risk	risk	$0 < A_i' < -p_j/p_i$	$-\infty < A_i' < -p_j/p_i$
risk	reward	$0 < A_i' \le p_j/p_i$	$0 < A_i' \le p_j/p_i$
reward	reward	$-\infty < A_i' < -p_j/p_i$	$0 < A_i' < -p_j/p_i$

4. Policy Implications

The problem then is how to design an incentive package, $\mathbf{\Delta A}$, that will minimize the financial exposure of the government ($\min[E(\mathbf{\Delta A})]$), under the constraint that the private sector will be attracted to the project (s.t. $C \geq K$); wherein, K is a benchmark utility level that projects with utilities greater than K are considered viable and non-viable otherwise; and, $\mathbf{\Delta A}$ as the vector of attributes the government absorbs or provides as incentives. Assuming that the government takes a "risk-neutral" stance, its financial exposure, $E(\mathbf{\Delta A})$, is equal to $\mathbf{p^G \Delta A}$; and, for a two-attribute project it is formulated as follows.

$$E[\Delta\mathbf{A}] = p_i^G \Delta A_i + p_j^G \Delta A_j$$

$$1 = \frac{p_i^G}{E}\Delta A_i + \frac{p_j^G}{E}\Delta A_j \quad \text{, normalized financial exposure line}$$

Therefore as an example, the optimal incentive strategies[*], assuming $p^{PS} \approx p^G$, for a two-attribute project can be determined as illustrated in Fig. 4.1 and 4.2. The results in Fig. 4.1 indicate that the optimal risk sharing strategy is to diversify and moderate the risk exposure of the government, fundamentally due to the increasing marginal effect of risks to a risk-averse investor.

In Fig. 4.2, it is shown that it is superior to involve in risk sharing strategies than to provide reward incentives (such as subsidies), as the marginal effect of rewards is less than that of risks to a risk-averse investor. Reward incentives should be pursued only if the price of such incentives for the government is less than that for the private sector (e.g. rights for commercial development). Still, the government should not focus on a one-sided reward strategy as it can also be shown that a combination of risk and reward incentives can yield better results.

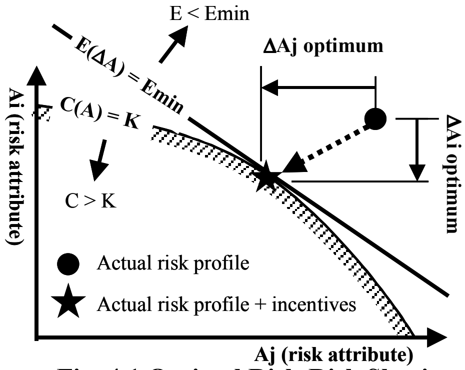

Fig. 4.1 Optimal Risk-Risk Sharing

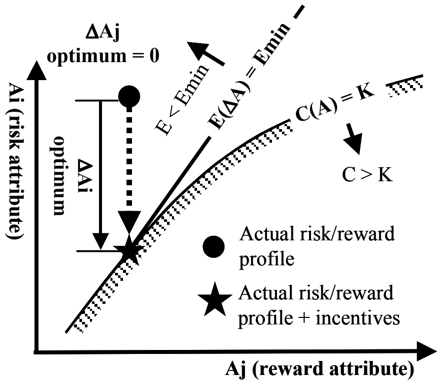

Fig. 4.2 Optimal Risk-Reward Manipulation

5. Conclusion

The primary principle in incentive design in the form of risk sharing is to assign risks to the party who can best price them. However, ambiguity occurs when it is unclear who can price risks the least. Moreover, there are no clear guidelines on how to deal with reward incentives and incentive packages in a comprehensive manner. To deal with these concerns, this study presented a general analytical perspective that can shed light on these issues and takes the present risk-sharing strategy as a special case (i.e. p^{PS} >> or << p^G).

Reference

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[*] Since it would be too lengthy to itemize all possible combination of p^{PS}, p^G, and initial risk and/or reward profile, it is left to the reader to induct from the results in Fig. 4.1 and 4.3. The reader can also induct the results for a reward-reward strategy, where practicable.