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## OPTIMAL TRANSPORT PROVISION TO A TOURIST DESTINATION: A MECHANISM DESIGN APPROACH

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# OPTIMAL TRANSPORT PROVISION TO A TOURIST DESTINATION: A MECHANISM DESIGN APPROACH<sup>1</sup>

by Amitrajeet A. Batabyal<sup>2</sup> and Hamid Beladi<sup>3</sup>

## Abstract

How to provide transport infrastructure to a tourist destination *optimally* is a salient question in tourism economics. Even so, this question has received no theoretical attention in the literature. Hence, we use contract theory to provide the *first* theoretical analysis of the optimal provision of transport infrastructure by an asymmetrically informed tourist agency (TA) interested in promoting a particular destination to tourists. Specifically, we first delineate our model and then solve for the first-best contract describing the interaction between the TA and a transport infrastructure providing firm. Second, we study the optimal second-best contract with asymmetric information when the above firm can be of two possible types. Finally, we conclude and then discuss extensions of the research described in this paper.

**Keywords:** Asymmetric Information, Contract, Destination, Tourist, Transport Infrastructure

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## INTRODUCTION

For any destination to be attractive to tourists, the infrastructure associated with this destination must be adequately developed. A key aspect of this infrastructure is *transport* infrastructure. An otherwise attractive tourist destination will experience a suboptimal number of visitors if it is difficult to reach. These points are well understood in the tourism literature and hence there is now a substantial empirical and case study based literature that has studied the connections between transport provision and the desirability of tourist destinations.

For instance, Prideaux (2000) focused on Cairns, Australia and pointed to the salient role played by transport infrastructure in developing this tourist destination. Saayman *et al.* (2000) contend that a long term strategy for encouraging tourism in South Africa must involve investment in transport infrastructure. Khadaroo and Seetanah (2007) note that tourists are very sensitive to the transport infrastructure in Mauritius. Rasul and Manandhar (2009) point out that South Asia would be even more attractive to tourists if the problems stemming from complicated travel procedures and inadequate infrastructure could be addressed. Seetanah and Khadaroo (2009) point to the importance of “transport capital” in adding to the value of tourism services in Mauritius. Finally, Das and Ray (2012) note that the success of “rural tourism” in Kamarpukur, West Bengal is dependent on the provision of general tourism infrastructure.

The studies discussed in the previous paragraph have advanced our understanding of the role played by transport infrastructure in promoting the desirability of tourist destinations. However, these studies are based either on case studies or on econometric estimation with specific data sets. The question of how to *optimally* provide transport infrastructure and thereby promote a tourist destination has *not* been analyzed previously. Hence, we use a mechanism design (contract theory)

approach to provide the *first* theoretical analysis of the optimal provision of transport infrastructure by a tourist agency (TA) interested in promoting a destination to tourists. This TA contracts with alternate types of firms to provide transport infrastructure to a tourist destination. The contracting problem is interesting because although the firm knows the cost at which it can provide transport, the TA does not. Therefore, the interaction between the firm and the TA is characterized by *asymmetrically* held information.

The rest of this note is organized as follows. The “Preliminaries” sub-section explains the theoretical framework. “The first-best contract” sub-section discusses the contract between the TA and the transport providing firm when there is no asymmetric information. “The second-best contract” sub-section studies the optimal contract with asymmetric information when the firm can either be a high or a low cost provider of transport infrastructure. Section 3 concludes and discusses extensions of this note’s research.

## THE THEORETICAL FRAMEWORK

### *Preliminaries*

We shall think of the provision of transport infrastructure as the provision of miles of roads. Consider a TA that writes a contract with a firm to deliver  $r > 0$  miles of roads. This firm has constant marginal cost  $c > 0$  and hence its profit function is  $\Pi = P - cr$  where  $P$  denotes the payment made by the TA to the firm for the transaction. The firm’s actual marginal cost is private information to this firm and this marginal cost can either be low ( $c_L$ ) or high ( $c_H$ ) and  $c_H > c_L > 0$ . The TA’s prior belief about the firm’s cost is  $Pr\{c = c_L\} = \omega > 0$  and hence  $Pr\{c = c_H\} = 1 - \omega > 0$ . The concave function  $B(r)$  denotes the benefit to the TA from procuring  $r$  miles of roads. This TA makes a take-it-or-leave-it

offer to the firm.

*The first-best contract*

First-best means that the TA is perfectly informed about the firm's true marginal cost of providing miles of roads. Therefore, the TA treats each type of firm separately and offers it a contract for each cost type  $c_i$  where  $i=L, H$ . Formally, our TA maximizes its net benefit ( $NB$ ) from the procurement of road miles. It solves

$$\max_{\{r_i, P_i\}} NB = B(r_i) - P_i \quad (1)$$

subject to the firm participation constraint

$$P_i - c_i r_i \geq 0. \quad (2)$$

Given that there is no asymmetric information in this environment, the participation constraint (2) binds at the optimum (holds with equality). This means that the first-best payment from the TA to the firm equals the cost of providing the first-best number of road miles or  $P_i^{FB} = c_i r_i^{FB}$ . Put differently, our TA leaves no informational rents for the firm. Also, in the first-best contract, the marginal benefit to the TA from procuring the optimal number of road miles is equal to the marginal cost of providing these same road miles or  $B'(r_i^{FB}) = c_i$ . This first-best contract represents the benchmark case.

*The second-best contract with two possible types of firms*

There is asymmetric information now and our TA does not know whether the firm's true marginal cost is  $c_L$  or  $c_H$ . However, this TA does know the probability that the firm is low (high) cost is  $\omega$  ( $1 - \omega$ ). The specific incentive problem is that the low cost firm will pretend to be the high

cost firm and thereby obtain positive informational rents from the TA. To deal with this problem, we use the revelation principle—see Bolton and Dewatripont (2005, pp. 16-18)—to state the TA's net benefit maximization problem. This TA solves

$$\max_{\{r_L, P_L, r_H, P_H\}} NB = \omega[B(r_L) - P_L] + (1 - \omega)[B(r_H) - P_H] \quad (3)$$

subject to

$$P_L - c_L r_L \geq 0, \quad (4)$$

$$P_H - c_H r_H \geq 0, \quad (5)$$

$$P_L - c_L r_L \geq P_H - c_L r_H \quad (6)$$

and

$$P_H - c_H r_H \geq P_L - c_H r_L. \quad (7)$$

The constraints (4) and (5) denote the two participation constraints and the constraints (6) and (7) are the two incentive compatibility constraints.

From Bolton and Dewatripont (2005, pp. 52-56), it follows that of the four constraints (4)-(7), only (5) and (6) will bind (hold with equality) at the optimum. Therefore, we can disregard constraints (4) and (7) because these constraints will hold as strict inequalities at the optimum. Substituting (5) and (6) into (3), we get an unconstrained maximization problem. The TA now solves

$$\max_{\{r_L, r_H\}} NB = \omega[B(r_L) - c_L r_L - (c_H - c_L)r_H] + (1 - \omega)[B(r_H) - c_H r_H]. \quad (8)$$

Differentiating (8) with respect to the control variables  $r_L$  and  $r_H$  gives us the two first order necessary conditions for an optimum. We get

$$B'(r_L^{SB}) = c_L \text{ and } B'(r_H^{SB}) = c_H + \{\omega/(1 - \omega)\}(c_H - c_L), \quad (9)$$

where the superscript **SB** denotes second-best. Comparing (9) with the optimal number of road miles  $r^{FB}$  procured by our TA from the firm in the first-best contract, we see that

$$r_L^{FB} = r_L^{SB} \text{ and } r_H^{FB} > r_H^{SB} \quad (10)$$

and

$$P_H^{FB} > c_H r_H^{SB} = P_H^{SB} \text{ and } P_L^{SB} = c_L r_L^{SB} + (c_H - c_L) r_H^{SB} > P_L^{FB}. \quad (11)$$

In words, (10) says that the efficient (low cost) firm provides miles of roads at the first-best level but the inefficient (high cost) firm provides fewer miles of roads than in the first-best level. This happens because of the tradeoff between the informational rents that are given to the efficient firm and the distortion in the provision of miles of roads. Although this distortion *increases* when the provision of miles of roads is less than the first-best level, the informational rent going to the efficient firm also *decreases*. Only the efficient firm earns informational rents that are greater than its actual cost in the equilibrium.

## CONCLUSIONS

We used a mechanism design approach to provide the first formal analysis of the optimal provision of miles of roads by an asymmetrically informed TA interested in promoting a particular destination to tourists. We solved for the first-best contract between the TA and the transport infrastructure providing firm. Next, we studied the optimal second-best contract with asymmetric information when the above firm could be of two possible types. Two practical recommendations for a TA follow from our analysis. First, the TA should always attempt to learn as much as possible about the cost structure of the firms it is interacting with. Second, because a TA will typically never have all the information it needs to design a first-best contract, it will face a tradeoff between

making sure that the right quantity of road miles are provided and the need to make extra payments (informational rents) to the efficient or the lowest cost firm.

It would be useful to conduct a mechanism design analysis of this note's problem in a dynamic setting. It would also be helpful to study the ways in which repeated interactions between a TA and a transport providing firm affect the underlying contract design problem. Studies that incorporate these features of the problem into the analysis will shed valuable light on the properties of optimal contracts governing the interactions between tourist agencies and transport providing firms.



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