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Optimal transport provision to a tourist destination: A contract theory perspective☆

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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. Third, we generalize the previous analysis by analyzing the case in which the firm can be of infinitely many types. Finally, we note that policy makers can reduce the negative effects of asymmetric information in practical settings by engaging in underwriting or obtaining additional information, by asking the firm to provide references, and by inspecting past transport infrastructure projects completed by the firm.

1. Introduction

For any tourist destination to actually be attractive to tourists, it is essential that the infrastructure associated with this destination be adequately developed. A key aspect of this infrastructure is *transport* infrastructure. Put differently, an otherwise attractive tourist destination will generally 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 alternate aspects of the connections between transport provision and the desirability of specific tourist destinations.[1]

More than a decade ago, Prideaux (2000) focused on Cairns, Australia and pointed to the salient role played by the transport infrastructure in developing this particular tourist destination.

Studying tourism in South Africa, Saayman et al. (2000) contend that a long-term strategy for encouraging tourism in this nation must involve investment in transport infrastructure. Madsen and Jensen-Butler (2004) concentrate on Denmark and study the ways in which changes in transport costs and bridge tolls have impacted economic activity at what they call the "sub-regional" level. Khadaroo and Seetanah (2007, 2008) focus on Mauritius and note that tourists from Asia, Europe, and the United States are all very sensitive to the transport infrastructure present on this island.

Although there has been progress in promoting tourism in South Asia, Rasul and Manandhar (2009) point out that this part of the world would be even more attractive to potential tourists if the problems stemming from complicated travel procedures and inadequate infrastructure could be dealt with. On the basis of their econometric analysis, Seetanah and Khadaroo (2009) point to the importance of what they call "transport capital" in adding to the value of both tourism services and experiences in Mauritius. Aguilo et al. (2012) concentrate on the Balearic Islands and show that road transport is vital to the success of tourism in these islands. Das and Ray (2012) point out that the success of "rural tourism" in Kamarpukur, West Bengal is dependent significantly on the provision of general tourism infrastructure. Finally, Che (2013) obtains the counterintuitive result that when selecting destination countries, outbound tourists in Taiwan are not deterred by rising prices in these same countries.

The papers discussed in the previous two paragraphs have advanced our understanding of the important role played by transport infrastructure in promoting the desirability of alternate tourist destinations. However, it is important to understand that these papers are typically based either on case studies or on econometric estimation that utilizes specific data sets. The link between this body of research and our paper is that the topic of study is the provision of transport infrastructure in the context of tourism. However, there are two points of departure. First, in contrast with this existing literature, our method of analysis involves using contract theory to first construct and then analyze theoretical models. Second and also in contrast with the extant literature, we

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[1] See Karlsson et al. (2007), Mun and Nakagawa (2008), Eriksen and Jensen (2010), Seetanah (2011), and Meunier and Quinet (2012) for more information on the optimal provision of transport infrastructure in general.

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focus on the microeconomics of the contractual interaction between a "demander" of transport infrastructure and a "supplier" of this same infrastructure that can be of several possible types.

In other words, our paper connects with and therefore contributes to the body of work discussed above because it studies the same topic as this body of work but it develops an alternate, contract-theoretic mode of inquiry that is able to shed considerable light on the details of the interaction between a "demander" and a "supplier" of transport infrastructure.

Because the salient question of how to *optimally* provide transport infrastructure and thereby promote a particular tourist destination has *not* been analyzed previously in the tourism literature, we use contract theory[2] to provide what we believe is the *first* theoretical analysis of the optimal provision of transport infrastructure by a tourist agency (TA) interested in promoting a particular destination to tourists.[3] This TA (the preceding paragraph's "demander") contracts with a firm that can be of two possible types (the previous paragraph's "supplier") to provide transport infrastructure to a particular tourist destination. This contracting problem is both interesting and challenging because although the firm knows the cost at which it can provide transport, the TA does not. Put differently, the interaction between the firm and the TA is characterized by the presence of *asymmetrically* held information.[4]

Given the discussion in the preceding paragraph, the reader should note that the real contribution of our paper to the field of tourism economics is twofold. First, in a literature dominated by empirical and case studies, the present paper is the first to show how contract theory can be used to rigorously model and thereby shed light on the optimal provision of transport infrastructure.

Second, given that the actual provision of transport infrastructure is affected by uncertainty,[5] our paper clearly shows how the presence of uncertainty about the cost at which transport can be provided influences the terms of the contract that governs the interaction between the TA and a transport providing firm.

The rest of this paper is organized as follows. Section 2.1 discusses the theoretical framework in detail. Section 2.2 sheds light on the first-best or full information contract between the TA and the transport providing firm when there is no asymmetric information. Section 2.3 studies the optimal second-best contract with asymmetric information when the firm can either be a high cost or a low cost provider of transport infrastructure. Section 2.4 generalizes the analysis in Section 2.3 by studying the contract design problem for the case in which the firm can be of infinitely many types. Finally, Section 3 concludes and then discusses extensions of the research described in this paper.

2. The theoretical framework

2.1. Preliminaries

In the remainder of this paper, we shall think of the provision of transport infrastructure concretely as the provision of miles of roads.[6] As such, consider a TA that enters into 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 we suppose that $c_H > c_L > 0$. The TA's prior belief about the firm's cost is $Pr\{c = c_L\} = \omega > 0$ and this tells us that $Pr\{c = c_H\} = 1 - \omega > 0$. 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.[7]

The model that we analyze is intended to capture the contractual interaction between a TA that is interested in promoting a particular tourist destination and a road transport providing firm. Consistent with some of the studies cited in the Introduction section, we assume that the key factor that limits our TA's promotion of this destination is the lack of quality roads. That is why the most important control variable for the TA in our model is r or the miles of roads provided. Also, because a key objective of ours is to study the contractual aspects of the underlying problem, we have specific representations for the road providing costs of the potential road transport providing firm. This is why we contend that our model is tourism specific. Were we to analyze a general transport infrastructure provision problem then our present model would be incomplete. In particular, the benefit function $B(\cdot)$ would need to have more arguments in it and hence the profit function $\Pi(\cdot)$ would also have to be more general. Given this background, our task now is to describe the first-best or full information contract between our TA and the transport infrastructure providing firm.

2.2. The first-best contract

First-best or full information 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 and hence it solves

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

subject to the firm participation or individual rationality constraint

[2] Contract theory is also known as mechanism design theory and as the Principal–Agent paradigm.

[3] Since we provide what we believe is the first contract-theoretic analysis of a TA's road infrastructure provision problem, our approach is very new and, as a result, it is not the dominant approach. The dominant approach thus far to this kind of problem has been either case study based or empirical in nature. Having said this, we would like to point out that there are alternate theoretical ways of analyzing the problem that we address in this paper. For instance, we could analyze the road infrastructure provision problem from the perspective of the TA alone and cast the resulting mathematical problem as a single-agent optimization problem. We could also cast the road infrastructure provision problem as a Cournot game between the TA and the infrastructure providing firm. However, to the best of our knowledge, these last two approaches have not been adopted in the extant literature. Hence, it is not possible to explicitly consider and then compare these alternate theoretical approaches with the contract-theoretic approach that we adopt in this paper.

[4] We reiterate that the primary objective of this paper is to provide a contract-theoretic analysis of the optimal provision of transport infrastructure by a TA. It is *not* to provide a calibration analysis of the model that we work with. Having said this, following Romer (2012, pp. 219–220), we would like to emphasize two points about calibration. First, because the theoretical model that we work with has not been tested against alternative models (also see the previous footnote), we do not yet know whether there are other theoretical models of the provision of transport infrastructure that would fit any available data better than the present model. Second, even if the model that we work with did match the moments of any available data, it is unclear whether this would be a good thing. On account of all of these reasons, we contend that a calibration exercise is beyond the scope of this paper.

[5] See Kramberger and Curin (2011) and Fayard et al. (2012) for a more detailed corroboration of this claim.

[6] From the perspective of the TA, the *general* problem of attracting visitors to a specific tourist destination can be split up into two parts. The first part involves the provision of adequate transport infrastructure—such as road infrastructure—so that visitors find it easy to get to the destination in question. Once visitors have arrived at the tourist destination, then comes the second part of the problem. In this second part, the TA is concerned about optimizing the stay of the visitors or, put differently, the TA focuses on making the stay of the visitors in the tourist destination as enjoyable as possible. This is where the provision of other forms of tourist infrastructure such as hotel and cultural services comes into the question. Our paper focuses on the first part of this two-part problem that we have just described. This is why we focus on the provision of road infrastructure in this paper. This focus of ours is *not* intended to imply that the provision of these other forms of tourist infrastructure is unimportant. Note that contract theory can also be used to analyze the second part of the overall problem. Such an analysis would be more involved with different objective functions and constraints but it should still be possible to obtain results of the sort that we obtain in this paper.

[7] If one wanted to extend the analysis in this paper to include the provision of, for instance, airport infrastructure, then this can be done. To see how, let $a > 0$ denote square feet of airport infrastructure. Then, in a more general model, the benefit function would not be $B(r)$ but instead $B(r,a)$. This more general benefit function explicitly accounts for the fact that instead of a single control variable (r or miles of roads) there now would be two control variables (r and a or square feet of airport infrastructure) for the TA.