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A micro founded approach to the valuation of benefits of freight travel time savings

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A R T I C L E I N F O

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A B S T R A C T

This article investigates how freight travel time savings should be taken into account in cost–benefit analysis. The general setting of this article is to suppose that transport operators face a constraint on minimum travel time and to examine, in a comparative static framework, what is occurring when this minimum travel time is altered. The analysis takes into account three aspects of freight travel time savings that deserve specific attention and have been, to our knowledge, neglected in existing approaches: the distinction between make to order and make to stock production contexts, the distinction between travel time and transportation time and finally the impact of transport time savings on wider logistics organisation. In this context, the present contribution analyses how this change in the minimum travel time affects the different economic agents' tradeoffs between the duration and cost of the various operations used in production and transport activities. Our findings show that the benefits of travel time savings are at least equal to the sum of travel operating costs reduction, decrease of generalised immobilisation costs of the good (depreciation, financial immobilisation costs, and costs of damage insofar as are related to transport duration). We also draw the implications of this analysis for the valuation of projects that save travel time for freight.

Introduction

This article investigates the value that should be placed on freight travel time savings in cost–benefit analysis. While passenger travel time savings have received a lot of attention from the community of transport economists, the value of time savings for freight lies far behind. This is testified both by the absence of a widely recognised micro founded paradigm and by the limited number of empirical results available. This situation may be explained by the fact that the value of freight time savings usually only ranks second among the benefits of transport related projects, after the value of time for passengers: it is not infrequent, in typical transport projects, that passenger time saving values represent 3–4 times the corresponding freight value. However, the lag in the research for freight value of time clearly exceeds what this ratio may justify. Additionally, some questions did not receive a widely accepted answer among transport economists: this relates to the issue of the so called shippers value of time and whether it should or not be added to the hauliers value of time.

Thus, a research is necessary on how the welfare effects of freight transportation time savings should be accounted for in cost–benefit analysis. The present paper aims at partially filling in this gap. It is based on the acknowledgement of basic features of freight operations that until now have only be partially considered in the economic analysis of freight travel time savings. The first aspect relates to the distinction between make to order and make to stock production process. While this distinction is somewhat traditional in the realm of logistics, its implication for the valuation of time savings has been neglected. The second distinction relates to the difference between transportation time and travel time, where the sooner refers to the total time that elapses between departure of the good from the origin and arrival to destination, and the latest refers only the duration spent on motion. Typically, transportation time will include intermediate logistic operations (cross docking, stocking, custom operations) while travel time will not. While transport projects usually impact on travel time, what matters for most of the stakeholders of the transportation chain is the wider concept of transport time. Thus a micro-founded analysis of the value of travel time savings should clearly incorporate the distinction between these two notions.

Interestingly, our contribution addresses the gap between two fields of research that have been considered in isolation. First, the

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research on freight value of time, second the research on time-cost tradeoffs in project management. This later area of research, illustrated by the seminal work of Parikh and Jewell (1965), considers how project management implies tradeoffs between time and costs, and provides analytical tools that do not need to be kept separated from the research on value of time.

In order to fulfil our objectives, the present paper proceeds as follow. In the first section, we present the current paradigm that is in use in evaluation practice in industrialised countries, and underline the limits of this paradigm. In the second section, we derive a microeconomic model that describes how different agents have to deal with the duration of transport operations. In particular, we analyse how firms make trade-offs between time and cost for different operations, including transportation of outputs. In the third section, we illustrate how travel time savings affect the cost–duration trade off of firms and investigate how such effects should be taken into consideration in cost–benefit analysis. In the forth section, we derive the conclusions of our approach.

1. The current approaches and their limits

In this section, we give a brief overview of the current approaches used for the valuation of freight travel time savings. We also show the limits of these procedures and propose a number of improvements.

1.1. Current approaches to value freight travel time savings

The current approach in use in industrialised countries are summarised in Commission Européenne (1994), Bruzelius (2001), Massiani (2005) and, more recently, Feo-Valero, Leandro, and Rodrigo (2011) and Vierth (2012). It suggests that the dominating approach is based on factor cost approach, while other approaches are quite marginal. We review in turn these different approaches.

1.1.1. Factor cost approach

Factor cost approach is in use in countries with well consolidated traditions in evaluation like France[1] and the UK. Besides their differences, the commonalities among the different approaches referred to as "factor cost approach", are that they rely on a relationship between the duration and the cost of transport operations. In other words, the reduction of travel time affects the cost of transportation because it modifies the quantity of consumed inputs (vehicles.hours, drivers.hours, fuel and other Vehicle Operating Costs). A more detailed framework, as is exemplified by the COBA Manual in England (DETR, 1996), considers that operating costs of the vehicles vary with speed (as is common knowledge about fuel consumption).

A general formulation of the transport production cost, taking into account the effect of duration (speed), can be proposed under the form:

$$ct(d_\mu;k) = w \cdot d_\mu + v \cdot d_\mu + k \cdot g(k/d_\mu), \quad \text{with} \tag{1}$$

$ct(d_\mu; k)$ travel cost
d_μ travel duration
k travel distance
w hourly cost of the driver
v hourly cost of the vehicle
$g(k/d_\mu)$ vehicle operating costs per kilometre as a function of speed.
μ is an index for travel as opposed to non-travel operations (stands from the Greek μετακινηση, meaning movement)

The last component of the function, $g(k/d_\mu)$ is U shaped. In the most general case one can suppose that $ct()$ will also be U shaped, unless the linear component of $ct()$ dominates on the effect of $g()$. Empirically, basing ourselves on the parameters in use in cost–benefit in the UK (Transport Economic Notes, DETR, 2001), we can represent the function $ct()$ as in Fig. 1.

The aspect of the curve suggests that generally a travel time reduction (speed increase) will reduce costs when the duration is large (speed is low), this reflects the cumulative effect of increased engine efficiency and reduced cost of driver and vehicle immobilisation. However, when duration is further reduced, engine consumption may increase and this can counteract the reduction in driver and vehicle immobilisation costs. This can result in a cost increase providing the U shape aspect of the cost curve. Interestingly, this representation is also valid for other modes than road transport, this is for instance the case for rail transportation, where costs can increase sharply with speed (Thompson, 1990). One could however consider that, for certain transport situations, the interval of duration (speeds) for which cost decreases with duration may not be relevant as it would correspond to speeds that are unrealistic for the mode considered. Then, the approach should also allow for the situation where curves, displayed in Fig. 1, would be truncated for low values of duration, and would then appear monotonically increasing (and convex).

Whatever the mode considered, the emerging feature of the factor costs approach currently in use in industrialised countries is that they rely on the relationship between transport costs and transport duration. What about other cost–benefit approaches?

1.1.2. Other approaches to valuation of travel time savings

While the factor cost approach focuses on the cost of the resources used to produce the transport services, other approaches have tried to integrate other components in the valuation of freight travel time savings.

For completeness, we can cite an approach linked to the interest on the goods in transit: these later appear as immobilised good on which an opportunity cost can be applied. It has however appeared that, theoretically, this could represent only a fraction of the costs corresponding to transport duration while, empirically, it has been showed that this approach could represent only a small fraction of shipper benefits for faster transportation. Although these

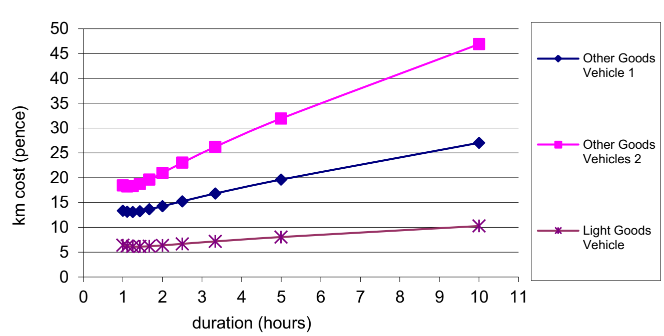

Fig. 1. Travel cost as a function of travel duration (100 km trip).

[1] Note as well that the latest release of the cost–benefit analysis guidelines for France (Direction des routes, 2004) also includes a valuation of the time savings for the owner of the goods. Three figures: 0.45 € t/h, 0,15 € t/h and 0.01 € t/h are used based on the value of the good. The guidelines however recognises that the inclusion of a value for the good is experimental and that the numerical values are subject to improvement.