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Špeciálne vydanie

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MEDZINÁRODNÝ VEDECKÝ ČASOPIS MLADÁ VEDA / YOUNG SCIENCE

Číslo 1 (špeciálne vydanie), ročník 6., vydané v januári 2018

ISSN 1339-3189

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Fotografia na obálke: Floriánova brána v Prešove. © Branislav A. Švorc, foto.branisko.at

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Javorinská 26, 080 01 Prešov

Slovenská republika

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VALUE OF TRAVEL TIME

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Abstract

This study deals with the value of travel time. It starts with a literature search for the topic and after that the contribution introduces the basic methodology of the value of travel time calculation on the base of the discrete choice model according to Becker and Evans. The issue public policy and the value of travel time is also dealt with. The value of travel time is documented on an example of a high-speed railway in China and the dime saving related to it. Key words: value, travel time, transportation, transportation economics, marginal utility

Introduction

Value of travel time has a long history in the microeconomic theory, this history dates from about 1965, when Becker published a key work about the optimum time allocation. In Becker's conception time is an unused input to the preparation of final products. Johnson is another representative that started to deal with the value of time in 1966. He placed time and free time against each other (the question of preferences) as two independent arguments of a utility function. He proved that the value of travel time equals the sum of two values, namely the wage level and money value of the marginal dis-utility of work in time. Johnson came to a conclusion that a wage contains an upwards deviated estimation of the value of travel time. Oort (1969) came to the same opinion after Johnson. He claimed that travel time itself should be added to the consumer utility function. DeSherpa (1971) was another one who made a step

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forward towards the formal integration of time in the standard microeconomic theory of demand. He clearly divides time to the time spent on necessities and the time spent according to everybody's choice. (Becker, 1965), (Mackie & kol., 2003), (Evans, 1971).

Methodology of the calculation of the value of travel time (VOT)

As mentioned above, the knowledge of the value of travel time is necessary for calculations in cost and revenue analyses in various public projects related to the transport infrastructure. The methodologies of various elaborated analyses differ. They are however always base on the basic framework defined by Becker (1965) and Evans (1971), namely the discrete choice model: (Becker, 1965)

$$VOTT = MRS = \frac{\delta V \div \delta T}{\delta V \div \delta C}$$

VOTT (Value of Travel Time) expresses the relation of the Marginal Rate of Substitution of the partially derived value (V) of time (T) and the partially derived value (V) of travel cost (C). By plotting these values to a linear utility function, we get the ratio between the marginal utilities of the saved time (β_t) and the saved travel costs (β_c): (Becker, 1965)

$$VOTT = MRS = \frac{\beta_t}{\beta_c}$$

The calculation model defined this way is a part of all studies of the value of travel time, the model can be modified by means of various parameters. After substituting particular parameters, a sophisticated model should emerge, which reflects the economic reality as exactly as possible. The most frequently used parameters are: age, sex, the purpose of travelling, the incomes or the number of working members of a family. The parameters (attributes) chosen by the author are collected from respondents together with the values of travel time and are included in the utility function: (Becker, 1965)

$$\beta_c \times \text{price}_1 + \beta_t \times \text{time}_1 + \beta_x \times \text{value}_x + \beta_y \times \text{value}_y + \dots$$

$$\beta_c \times \text{price}_2 + \beta_t \times \text{time}_2 + \beta_x \times \text{value}_{x+1} + \beta_y \times \text{value}_{y+1} + \dots$$

Concrete values from the individual respondents are substituted for the variables price_1 , time_1 and price_2 , time_2 , while further parameters have to be defined (in this case β_x a β_y), for example $\beta_x = \text{age}$, $\beta_y = \text{sex}$, and they also have to acquire numeric values. (Becker, 1965)

Public policy and the value of travel time

Each government is concerned with the issue of the value of travel time nowadays, this issue is crucial for the public administration, particularly in relation to the quality, the infrastructure development and the transport systems. In the practice politicians rely on cost analyses carried out in each particular project. The improvement of the transport infrastructure is always the goal. Two important elements are usually dealt with, the value of travel time (VOT) and the value of journey time – reliability (VOR). If public servants face a problem of a choice between two mutually incompatible public transport infrastructure projects (e.g. a construction of a new high-speed railway = significant time saving, or a construction of a bypass = transport capacity increase), a study theoretically derivable from the monetary

measures VOT and VOR can help them (Wardman, Chintakayala, & Jong, 2016), (Mackie & kol., 2003)

As mentioned above, the value of travel time is one of the most important parameters in transport planning in all countries. Some international organizations have official values available, so that transport projects, programmes and policies are evaluated on a solid base. So called national studies were carried out in Denmark, Germany, in the Netherlands, in New Zealand, Norway, Sweden, Switzerland and Great Britain. A wide range of time linked variables in various contexts can be examined on the base of these studies of evidence. For example, in the issue of high-speed railways, new toll roads/highways, transit modes, charged concessions, improvement of a local bus transport, services of intercity trains, improvement of the infrastructure for pedestrians and cyclists. (Wardman, Chintakayala, & Jong, 2016)

The value of travel time in Europe has been analysed on the base of an allegedly largest revision of validation of the individual attributes related to travel time (meta-analysis). The revision covers the European values for travelling in a vehicle, the time spent on walking, waiting time, progresses, the time necessary for looking for a suitable parking space, timetable changes, the time spent in complicated travel conditions and travel time variability. (Wardman, Chintakayala, & Jong, 2016), (Mackie & kol., 2003)

Meta-analysis

Meta-analysis is a statistical method that generally analyses data from multiple partial mutually independent studies. The aim is to identify and quantify the prevailing trends or to ascertain the causes of different conclusions of papers. The meta-analysis elaboration procedure: (Wardman, Chintakayala, & Jong, 2016)

1. search of literature (including unpublished works),
2. selection of all compliant studies,
3. data extraction,
4. data homogeneity assessment, efforts for its improvement,
5. the analysis itself. (Wardman, Chintakayala, & Jong, 2016)

The meta-analysis (VOT) carried out within the European circle, if correctly performed, provided much more exact and objective data than the individually carried out studies. It reduced the occurrence of false results, it ascertained the causes of different conclusions of some works and enables hypotheses to be tested. The carried out study is based on 389 studies, which cover 26 European countries in 1960-2011. (Wardman, Chintakayala, & Jong, 2016)

The individual value of travel time

The willingness to pay for travelling is individual and depends on the particular socioeconomic level of each individual, it also depends on the purpose of travel and on various situational factors like time pressure. The analysis of the value of travel time only used to deal with the first two above mentioned factors (socioeconomic level and the purpose of travel), but did not pay due attention to various situational factors. It is however generally assumed (at least in most cases) that an employee is willing to pay more in the time before work than in the time after work. This results from the fact that each employee has to come to

work on time or in time. After leaving the work everybody's schedule is freer, which is why the willingness to pay for the time spent on travelling decreases. The time pressure an employee faces before the work starts makes the time more valuable, which increases the value of travel time. If however an employee does not have a flexible plan after work and is for example limited by concert tickets bought in advance (where he/she has to be at a specific time), the situation is different and the value of travel time increases again with regard to further time pressure (Paleti, Vovsha, Givon, & Birotker, 2015)

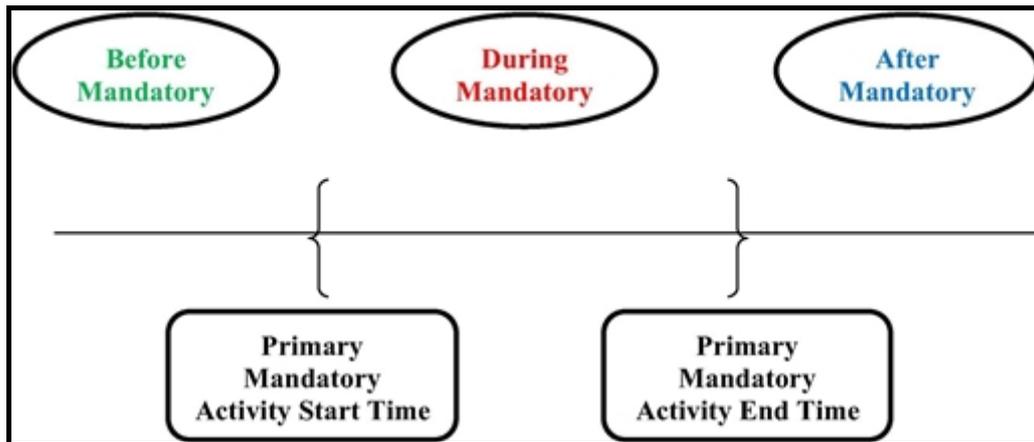


Fig. 1: The value of travel time during a working day
Source: Paleti, R., Vovsha, P., Givon, D., & Birotker, Y. (2015).
Impact of individual daily travel pattern on value of time.

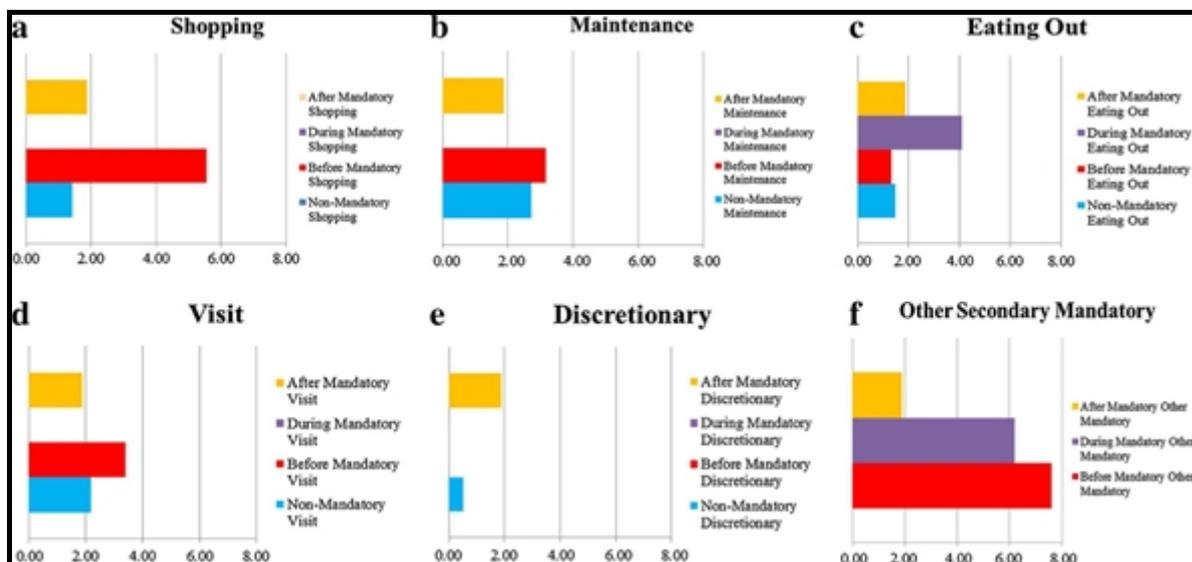


Fig. 1: Individual preferences and the value of travel time
Source: Paleti, R., Vovsha, P., Givon, D., & Birotker, Y. (2015).
Impact of individual daily travel pattern on value of time.

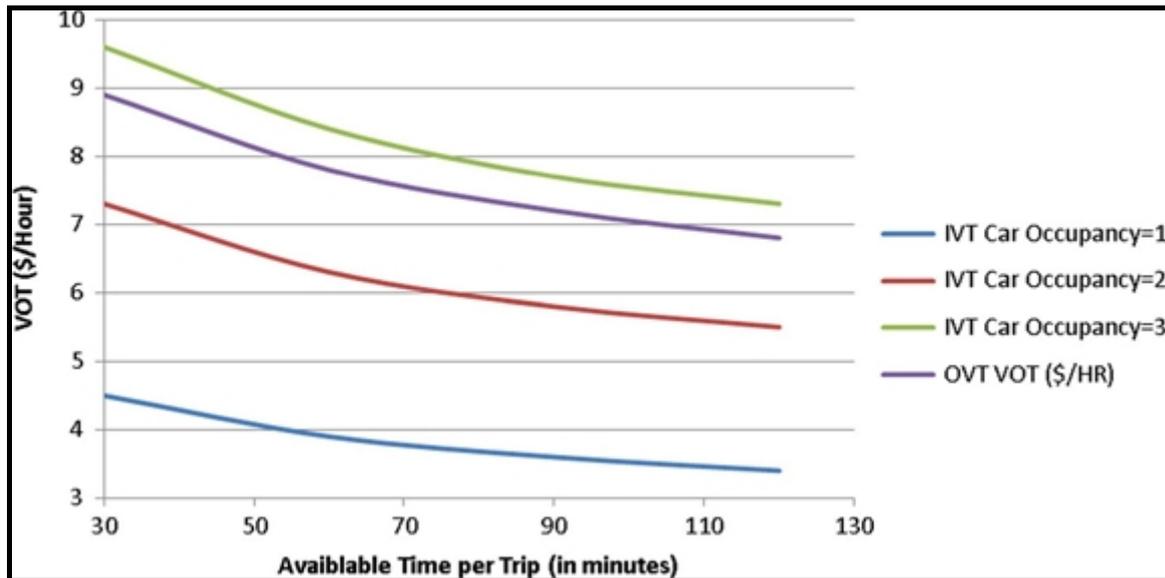


Fig. 2: The value of travel time in terms of car occupancy
 Source: Paleti, R., Vovsha, P., Givon, D., & Birotker, Y. (2015).
 Impact of individual daily travel pattern on value of time.

Empiric approach dominates in the derivation of the value of time and is mostly based on experiments in which respondents are asked to define their travel choice hypothetically. There is a question, what travel costs they are willing to pay from their budget. Scholars have objections against this method of setting the value of travel time, that an individual's hypothetic choice depends on how each individual trusts him/herself. Here we operate with two terms, namely "consumer VOT" and "citizen VOT". The differences between these two terms have not been empirically studied yet. A "Choice Experiment" has confirmed that some incline to the consumer choice and some to the citizen choice. The willingness to pay for travelling from the already collected money (money collected by the government) among individuals is significantly higher than the willingness to pay from the tax incomes to be collected. This implies that the citizen VOT is higher than the consumer VOT. This difference does not result from a higher willingness to spend the money from taxes obtained before in comparison to the expenses of individuals from their own incomes. The difference is in the value of the added travel revenues. A revenue in the form of a travel resulting from a government activity is more valued than a revenue obtained from an own choice of procedure. This and numerous further empirical results are discussed in deep in relation to the conceptual differences between the preference of individuals in the role of a consumer or a citizen. (Paleti, Vovsha, Givon, & Birotker, 2015)

There is no doubt that the value of travel time (VOT) is one of the most important concepts in the transportation economics. The value of travel time is a key component of the Cost-Benefit analysis of transport policies and projects in the infrastructure sphere. (Litman, 2013)

Cost-Benefit analysis

Cost-Benefit analysis, usually abbreviated to CBA, serves for an assessment of projects, particularly from the public sphere, and contains a procedure of dealing with questions related to such projects. The method compares benefits, which formulate any positive effects, with the costs or loss that affect the negative effects of an investment. The method is based on an analysis of the effects of an investment on the involved entities, a quantification of the ascertained effects and then a transfer to a collective numeric (ideally financial) unit. After that we can use criterial indicators of the net present value, the internal revenue percentage from the economic CF, the profit index and the payback period. The method is applied to a criticism of public projects, where we require a wider social profit of a project to be taken into account and we must include non-financial benefit into the financial interpretation. (Litman, 2013)

Travel time saving and the issue of the high-speed railway in China

Reduction of the time spent by citizens in means of transport is a goal of all world economies. China is dealing with the same dilemma. Reduction of the time spent on the way is an important topic of the transport infrastructure. The way how travellers evaluate the travel time savings is a basic determinant in the issue of the demand for the improvement of the transport infrastructure quality. In China, this is crucial in the issue of the construction of high speed railways. The large-scale construction of high speed railways in China started in 2004, namely in more than 10,000 kilometres of high speed lines. The biggest advantage of a high-speed railway is that it saves travellers' time and travellers also appreciate the price of the tickets and the time reliability. (Zhao, Zhao, & Li, 2015)

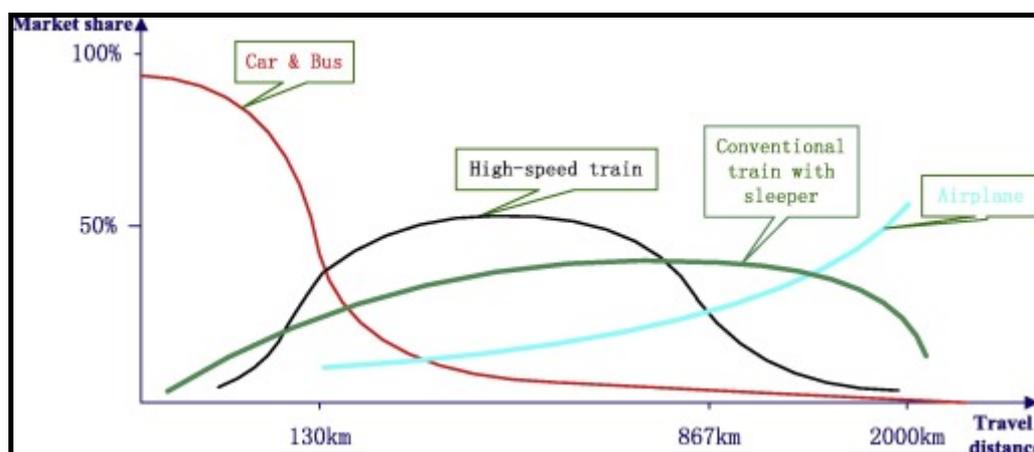


Fig. 3: The relation between the vehicle type and the travel distance in China
 Source: Zhao, J., Zhao, Y., & Li, Y. (2015).

Conclusion and discussion

This study has highlighted the issue of the value of travel time in transportation. The article was designed to cover the value of travel time both from the point of view of the public policy and from the point of view of an individual. It might not be clearly obvious on the first sight that the value of travel time in the public policy (the issue of the transportation infrastructure

and its improvement) and the value of travel time for individual travellers are so closely linked. It is really so, the government has always to take the preferences and opinions of the individuals (inhabitants, travellers) into account when dealing with the transportation infrastructure.

*Tento článok odporúča na publikovanie vo vedeckom časopise Mladá veda:
Ing. Vendula Velková*

*Studie vznikla v rámci vedecké činnosti na Vysoké škole technické a ekonomickej
v Českých Budějovicích.*

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