

Value of Time Savings as a Factor in Deciding on Route Choice

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Abstract The paper deals with the definition of time savings as a factor in deciding on route choice of a carrier whether to use toll road network. The first part of the paper describes a history of road infrastructure charging in the EU Member States and the USA. Next part analyses the factors affecting decision-making process of a carrier when considering which road infrastructure to use – toll or non-tolled roads. The paper also identifies the value of time savings as a significant factor in route choice.

Keywords transport, toll, financing, factor, impact, decision-making

JEL R48, H40

1. Introduction

Method of road charging is significantly changing in Europe in recent years. Most states have substituted the method of road charging in the form of vignettes for the performance-based method of road charging. In the case of performance-based method of road charging, the fee amount does not depend on time validity of vignettes but it depends on actual distance travelled within toll road infrastructure (Poliak, 2012). Under such a changed method of road infrastructure charging, the approach of carriers to route choice has also changed, particularly in relation to the amount of fees for the use of road network which represents a considerable proportion of the total costs especially in the EU. Deciding on route choice is also more important depending on the extent of the performance-based road charging. Since 2005, the method of road network charging has been changed, for example, in Germany, Austria, the Czech Republic, the Slovak Republic, and Hungary. Changes in the system of road charging can be also observed in non-EU states (e.g. Belarus). Under performance-based method of road charging, the road transport operator – the carrier usually bears higher costs for using road network, and he can also consider a possibility to use non-tolled road infrastructure when planning transportation or to use roads with lower fees (Poliak and Konečný, 2008). Amount of fees for using road infrastructure is regulated by Directive 1999/62/EC in the European Union. The Directive provides a methodology for calculating the fee for using road infrastructure without consideration of the possibility of using the parallel non-tolled roads by the carrier (Poliak, 2008). When charging road infrastructure, there are also approaches that take into account a decision-making process from the position of the carrier. Such approaches are addressed by

several authors, for example, Vadali et al. (2007). The objective of this paper is to express the value of time savings as a factor influencing the carriers when deciding on route choices during transport realization.

2. Development of Road Infrastructure Charging

Road charging has a long history. Many existing roads in the EU were originally built for the purpose of collecting toll fees in return for their use. Already in the 12th century, toll was collected for using roads, in particular bridges, in England (Albert, 1972). In 1830, the toll road network in England was comprised of 35,000 km of roads between London and other centres of regions. In the 19th century, between 2,500 and 3,200 companies financed, built and operated their toll roads successfully in the USA (Klein et al., 2008). Building of private roads was very widespread in the USA during that period of time. During 1850's, a considerable proportion of road infrastructure was operated by private turnpike companies in most states of the USA (Heminger, 2005). By the 1920's, construction of motorways in the USA began to take place with the help of the federal government. Noble (1941) described the feasibility and benefits of using toll roads. Based on estimation in 1937, there were estimated \$3.7 million needed for construction and maintenance of the state road system in the USA. To meet the shortfalls in motorway budgets and also relieve the intense motorway congestion, the first government-owned toll motorways opened in several states of the USA, such as Pennsylvania and Massachusetts, between 1930's and 1950's (McNichol, 2006 and Aronott et al., 2005). In Europe, the first state-built motorway was charged in Italy in 1924. Subsequently, motorways were charged in Greece (1927), France, Spain, and Portugal (Jordi, Ph. 2008).

In the 1950's, the Federal-Aid Highway Act provided funding to construct the interstate system in the USA by running a fuel tax-based financing mechanism (Heminger, 2005). During the 1980's, states began to establish facility-based toll authorities to supplement their interstate motorway capacity. In the 1990's, toll-based congestion pricing and high occupancy toll lanes (HOT) were authorized and introduced in several states such as Texas, California and Minnesota. System of HOT charges motorists in single-occupant vehicles for the use of high occupancy lanes.

When determining fees for using road infrastructure in the USA, the impact of possible diversion of vehicles from toll roads to non-tolled road infrastructure is taken into account. The adequacy of the fee for using road infrastructure is assessed particularly in relation to time savings of transport for the carrier who uses toll infrastructure (Zhou et al., 2009).

In the EU, a system of determining fees for using road infrastructure is regulated by Directive 1999/62/EC which sets out the main principles for toll calculation. Toll level in the EU is determined based on:

1. Infrastructure costs – which include:

a) Investment costs – construction cost (including financing costs) and costs of infrastructure development. Investment costs also include costs of land acquisition, planning, designing, supervision of construction contracts and project management, costs of archaeological and ground investigations, as well as other relevant ancillary costs.

b) Annual costs of maintenance and costs of construction repairs – these are annual costs of network maintenance and recurrent costs associated with repairing, firming and restoring of surface in order to ensure the operational functionality of network.

2. Costs of operation, management and collection of toll – these are particularly the costs of construction and maintenance of toll plazas and other payment systems, daily costs of operation, management and maintenance of the toll collection system, administrative fees and charges relating to concession contracts, costs of management, administration and services related to infrastructure operation.

A Member State is entitled not to include all costs into toll level. However, the possibility of using parallel non-tolled infrastructure or the factors affecting a routing decision of the carrier is not taken into account when determining fees for using road infrastructure.

3. Factors Affecting Carriers' Decisions When Planning Route of Transportation

A route choice in road freight transport is the result of various factors that were addressed by several authors. These factors include, for example, route attributes, level of

congestion, toll fees, fuel costs, time of carriage (travel time), speed, and vehicle operating costs. Table 1 summarises the results of studies which deal with the factors affecting a route choice.

Table 1. Factors Affecting a Route Choice Made by Transport Companies

Authors of studies	Knorr et al (2005)	Golob and Regan (2001)	Bain (2002)	Yalcin et al (2005)	Zyl and Raza (2006)	Vadali et al (2007)
Region	USA	Los Angeles (USA)	International experience	Japan	India, South Africa	USA
Driver's decision				✓	✓	
Manager's decision					✓	
Driver wage / income			✓			
Route attributes	✓				✓	
Congestion		✓			✓	✓
Toll					✓	✓
Fuel costs		✓			✓	✓
Speed	✓	✓				
Travel time (reliability /uncertainty)		✓		✓	✓	✓
Vehicle operating costs			✓			

Source: Korring et al. (2005), Golob and Regan (2001), Bain (2002), Yalcin et al. (2005), Zyl and Raza (2006), Vadali et al. (2007)

Based on the results of processed studies, it can be stated that the most important factors are:

- Travel time – congestion and maximum speed for individual roads are also related to the travel time
- Fuel costs
- Toll

These results can be confirmed by the survey outcomes that were published by Vadali et al. (2007). The survey was focused on a route choice while deciding between toll and non-tolled road infrastructure. Carriers quantified individual factors. Factors were ranked from 1 (most important) to 5 (least important) according to their importance to the carriers. The survey outcomes are shown in Figure 1. Based on the survey, travel time, fuel costs and toll achieved the highest rating.

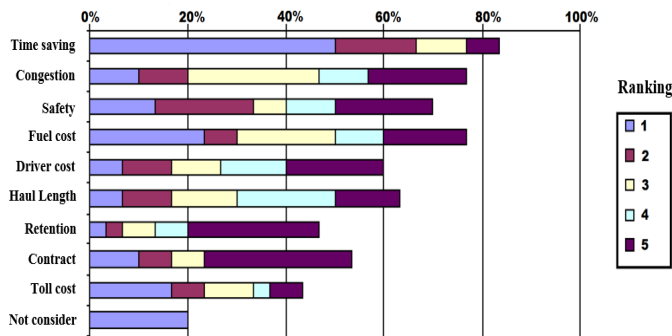


Figure 1 Importance of Factors Affecting the Use of Toll Road; *Source: Vadali et al. (2007)*

Travel time is the most important factor while deciding on transport route, particularly because legislation stipulates the maximum driving time of drivers within a given period. Table 2 provides a comparison of the stipulated working hours of drivers in individual countries. Maximum daily driving time in individual countries is regulated in the interval from 9 hours in the EU to 15 hours in Canada (northern part of the country, maximum daily driving time in southern part of the country is 13 hours). Similarly, maximum weekly driving time or maximum driving time within two consecutive weeks is also regulated. Moreover, minimum daily and weekly rest period are stipulated in the analysed countries. Drivers cannot drive during mentioned rest periods and vehicle must be stationary if a driver draws the rest period in the vehicle.

Table 2. Regulation of Driving Time and Rest Period in Individual Analysed Countries

Requirement	EU	USA	Canada ¹	Australia	New Zealand
Continuous driving time	4.5 h	8 h	13/15 h	5.25 h	5.5 h
Break	45 min	30 min	-	15 min	30 min
Daily driving time	9 h	11 h	13/15 h	12 h	13 h
Daily rest period	11 h	10 h	10/8 h	7 h	10 h
Weekly driving time	56 h	70 h	70/80 h	72 h	70 h
Weekly rest period	45 h	34 h	36 h	24 h	24 h
Fortnightly driving time	90 h	148 h	147 h	144 h	166 h

Source: Authors based on: ², ³, ⁴, ⁵, ⁶

¹ Southern part of Canada / Northern part of Canada

² Ministry of Transport of the USA: <https://cms.fmcsa.dot.gov/regulations/hours-service/summary-hours-service-regulations> (12.10.2013)

³ Ministry of Transport of Canada: <http://laws-lois.justice.gc.ca/eng/regulations/SOR-2005-313/> (12.10.2013)

⁴ Ministry of Transport of New Zealand: <http://www.nzta.govt.nz/resources/rules/work-time-and-logbooks-2007-index.html> (15.10.2013)

⁵ Ministry of Transport of Australia: http://www.ntc.gov.au/filemedia/Publications/HVDF_Basic_July08.pdf (16.10.2013)

When taking into account the mentioned restrictions, the carrier prefers the shortest travel time due to possibility to deliver the greatest number of shipments within limited period of time, and from the reason of realization of maximum vehicle performance that is possible within limited period of time. The mentioned statement was also stated by Vadali et al. (2007) and Geiselbrecht et al. (2008). This means that the carrier will prefer a superior road infrastructure (toll roads) in terms of higher vehicle utilization and he will be willing to pay the fees for its use unless the amount of fees is higher than benefits associated with faster transport performed on that infrastructure.

4. Value of Time Savings from the Perspective of Carrier

Main factors that affect the decision of the carrier to use toll roads were identified in the previous chapter. Travel time is one of the most important factors. Value of time savings plays a key role related to the use of toll roads by the carrier. When considering the construction of toll infrastructure, public authorities should estimate how the carriers value their time savings associated with the use of toll infrastructure in terms of money. Only then it is possible to make a proper and efficient pricing policy.

Knorrning and Kornhauser (2005) dealt with the value of time savings from the perspective of carriers. They concluded that value of time savings is a key factor in decision-making process of the carriers. They stated that the carriers, or drivers, do not just make a decision on which route to take when facing parallel routes, but every single transport route is planned with regard to the factor of time savings.

Several authors tried to estimate the value of time savings. Kawamura (2000) estimated this value based on preference data collected in California. Firstly, he summarized that value of time savings ranged from \$14.50/hour to \$35.60/hour according to the results of previous studies. Then, he estimated the mean value of time savings as \$26.8/hour based on own collected preference data. He also defined dependence of the likelihood of using a particular infrastructure on the value of time savings when using alternative transport route (Figure 2). Likelihood of using a particular route is increasing with increasing value of time. At value of time savings of \$100/h, only low percentage of the carriers would not use a given infrastructure.

⁶ Regulation (EC) No 561/2006 of the European Parliament and of the Council of 15 March 2006 on the harmonisation of certain social legislation relating to road transport and amending Council Regulations (EEC) No 3821/85 and (EC) No 2135/98 and repealing Council Regulation (EEC) No 3820/85

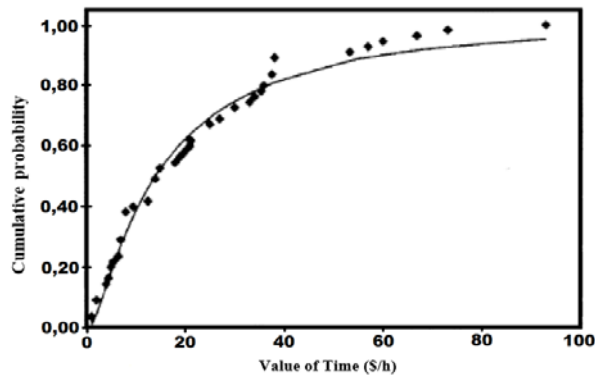


Figure 2 Value of Travel Time Savings for Road Transport Companies in the USA; *Source: Kawamura (2000)*

Before introducing toll in the SR, Poliak and Konečný (2008) addressed an issue of the use of parallel non-tolled road infrastructure in connection with definition of the methodology for determining the extent of road network pricing. In conditions of the SR, they processed dependence of the proportion of carriers willing to avoid toll roads depending on the level of toll; for two values of time savings – 600 SK/hour (€19.92/hour) and 400 SK (€13.28/hour). The dependence of vehicle diversions from toll infrastructure is depicted in Figure 3. About 30 % of vehicles had bypassed toll road infrastructure in 2008 if value of time savings would have been at the level of €19.92 when assuming the toll rate of 21 SK/km (€0.697/km). If value of time savings would have decreased to the level of €13.28 while keeping the same toll rate, about 37 % of vehicles had bypassed toll road infrastructure. Mentioned approach was not reflected in SR in the determination of toll rates and the rates were processed only based on the requirements of EU legislation.

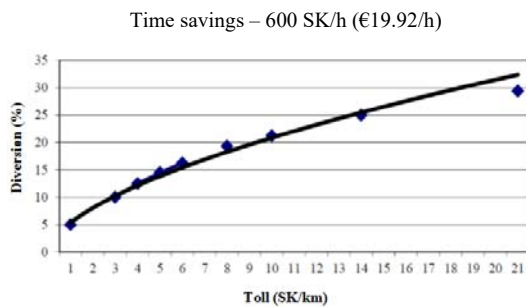


Figure 3 Dependence of Vehicle Diversions from Toll Road Infrastructure in Conditions of the SR; *Source: Poliak and Konečný (2008)*

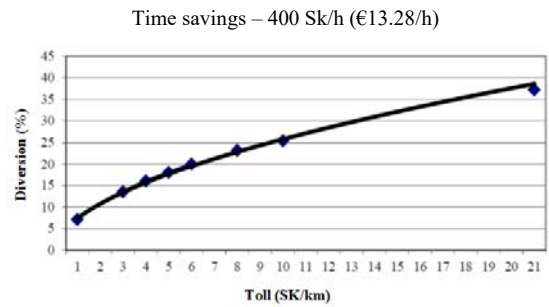


Figure 4 Dependence of Vehicle Diversions from Toll Road Infrastructure in Conditions of the SR; *Source: Poliak and Konečný (2008)*

4. Conclusion

The situation where freight vehicles which bypass toll road infrastructure and use non-tolled infrastructure of lower category still persists in EU countries. However, these non-tolled roads often lead across populated areas such as towns and villages. Operators of road freight transport (carriers) prefer non-tolled road infrastructure in order to reduce their costs related to vehicle operation in the case that costs of fees for using toll infrastructure exceed the effects associated with the use of this infrastructure, e.g. in the form of time savings or savings in fuel costs. Under EU legislation, the level of fee for using road infrastructure is dependent on the costs of its construction and maintenance without assessment of the impact of such determined fee on the demand of operators for the use of toll infrastructure. Public authorities then look for solutions of transit restrictions for road freight transport on parallel non-tolled roads. However, these solutions are often not effective without a thorough inspection. It is also difficult to ensure effective control between transport service of territory and transit of territory.

Therefore, a suitable solution is to set the level of fee for the use of road infrastructure so that carriers can use toll road infrastructure more efficient. This means that the amount of fee must be related to time savings of the carriers and cannot be higher than the value of time savings when using a particular section of toll road network.

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