Assessing the Value of Delay to Short-Haul Carriers

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ABSTRACT
This paper aims at examining the commercial vehicle operators' value of delay (VOD) due to highway congestion in urban area. The VOD is a fundamental parameter that influences the private sector's response to public freight projects and policies. This paper adopts two methods to estimate the VOD; one being the stated preference (SP) survey and the other being simulation of a carrier's fleet operations. The former applies a Logit model and estimates a driver perceived VOD as $56.48 per vehicle per hour for the regular short-haul delivers. The latter gauges the economic impact of delay on carrier's fleet operations in the Houston highway network. The operations essentially reflect more of a just-in-time system due to the rather stringent time window constraints. The simulation is conducted on a rolling time horizon with a heuristic algorithm for dispatching trucks. The major findings include, but are not limited to as follows. The drivers paid by miles perceive a significantly higher VOD than the others; the drivers are more willing to pay for a faster trip when the toll charges do not come out of their own pockets; VOD increases with uncertainty and demand for capacity. The comparison between the survey and the simulation results also indicates that the interviewed drivers perceive a significantly lower VOD than they may actually experience as a fleet, an indicator of myopic vision.

Keywords: Value of Time; Value of Delay; Short-Haul Carrier; Stated Preference; Logit Model; Simulation.

1. Introduction

The freight delay has a direct and significantly impact on vehicle working hours, fleet efficiency, and the scheduling of warehousing activities, all having a cost implication to the national economy. Unfortunately, with the rapid growth of trucking demand (Federal highway Administration, 2006) and a lagging improvement in the road capacity in the United States, the freight delay due to highway congestion is expected to exacerbate. In the process of developing strategies and policies to mitigate freight delay, the evaluation of the value of freight delay often appears to be a fundamental issue. One example for this is congestion pricing, which is originally designed to divert partial traffic to alternative routes by imposing tolls (Sullivan, 2000, 2002; Supemak et al., 2001; Swenson et al., 2001). An underlying assumption is that the driver's diversion behavior onto alternative routes depends largely on how they value the time savings from avoiding highway congestion.

Another example is prioritizing roadway capacity improvement projects: which bottleneck has the most cost to carriers or truckers? Thus, an accurate understanding of the value of freight delay will enable planners and managers to make informed decisions, leading to improved satisfactions from stakeholders.

2. Literature review

Value of time (VOT) or value of time savings can be viewed as the opportunity cost of travel time. It is typically measured by the maximum amount of money travelers are willing to pay for saving a certain amount of travel time. Since the 1950s, due to traffic congestion in urban areas, there have been numerous studies on the VOT for commuters. These studies primarily aim at the effect of reducing peak hour traffic congestion. Some recent studies can be seen from the work of

Hensher and Goodwin (2003), Small et al. (2005), and Fosgerau and Engelson (2011).

However, the commercial value of freight time savings is quite different from that of the commuters. The benefit of freight travel time reduction includes not only the directly reduction in vehicle operating cost but also the improvement in inventory cost due to lesser freight holding and transit time variation, especially for the just–in–time (JIT) system where a strong consideration on delivery time window is imposed. Therefore, the commercial value of time is inherently related to relevant logistics strategies. The Hague Consulting Group (1992, 1995, 1996) conducts a series of early studies to measure the value of freight reliability and delay. In Wigan et al. (2000), commercial VOT is estimated as 1.40 Australian dollars per hour per pallet for metropolitan multi-drop freight services in Australia. Further study (Wigan et al., 2003) shows that the value of freight delay for urban less than full truck load (LTL) services is significantly higher than that of other segments. Among these studies, stated preference (SP) and revealed preference are prevailing methods (Fowkes and Shinghal, 2002). Kawamura (2000) applies a switch point method in which truck drivers are asked a choice between an existing freeway versus a toll facility with different combinations of travel time and toll, which is actually a willingness–to–pay study. Together with the survey data at the University of California, Irvine, from the year 1998 to 1999, Kawamura successfully identifies switch points of choosing between different road facilities. The average VOT for truck drivers is found to be $26.8 per hour with a standard deviation of $43.7 per hour. Through grouping, it is also found that hourly waged drivers have higher value than the monthly paid. Overall, there are very limited survey–based studies have been conducted in the United States due to the difficulty in collecting data from truck drivers. Figliozzi (2007) explores the efficiency of urban commercial vehicle operations by disaggregating routing characteristics. Suggestions on data collections and policy implications are made. In his later work (Figliozzi, 2010), numerical experiments are conducted to examine the impact of congestion in terms of tour changes due to time windows. Although the problem is simplified to the extent where the vehicles are assumed to experience the same level of congestion at all points, no quantified results on the value of time/delay are derived.

If direct fuel cost and labor cost (e.g., driver wages) are the only considerations, an existing report suggests an average of $20.23 per hour (American Association of State Highway and Transportation Officials, 2003). Other sources, however, indicate different practical values. For example, Highway Economic Requirements System (HERS) indicates a varying truck VOT from $28.50 to $41.25 per vehicle per hour (Federal highway Administration, 2006). It is also worth to mention that the VOT is estimated significantly higher when considering total logistics costs in the work of ICF Consulting (2002), where the savings in transit time ranges from $144 to $192 and non-scheduled delay is estimated to cost $341 per hour.

This paper aims at developing better methodology to assess the VOT to commercial vehicles due to highway congestion, which we define as value of delay (VOD). This goal is achieved by stated preference technique and simulation to carrier's fleet operation. The stated preference technique includes survey design and data processing, which is based on conditional logit model with the conventional utility function. The original intention of the survey is to examine both time–sensitive delivers (such as JIT) and regular delivers. However, the truck drivers are not likely to be interviewed when they are carrying time-sensitive load (for example, they may refuse to take survey when they are approached at truck stops because they are short of time). The result is that the majority of the data collected comes from the drivers who are running regular delivers. To compensate this effect, the survey is modified to ask the drivers for their perceived time values by introducing two scenarios. The first scenario assumes regular delivers while the second scenario assumes time-sensitive delivers. To compare with the results obtained from survey, a carrier simulation is conducted. It envisions a fleet of vehicles operating within an urban area providing truckload services to customers. Demands with time windows are continuously generated for pickups and delivers. The parameters being considered are demand location, size and pattern, congestion segment and time window. According to Federal Highway