DRAFT Technical Background Document on the Impacts of Road User Pricing Based on a Review of the Empirical Literature

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Study Selection

Wherever possible, studies included in this review were those that included empirical findings from actual road pricing programs. For link pricing, numerous studies exist that calculate elasticities of demand based on traffic counts before and after toll implementation or after changes in toll level. Only studies that comprehensively controlled for other potential effects on traffic volumes were considered in this review. This includes employment and population levels, motor vehicle registrations, fuel prices, transit fares and service level, seasonal variations, parking charges, and income levels. Preference was also given to longitudinal studies that included changing toll levels over several years.

For cordon tolls, both pilot and operational programs are becoming more common worldwide. In order to examine the real-world effectiveness of these programs, studies were chosen that examined changes in travel behavior before and after implementation. These studies mostly take the form of case studies. The difficulty in interpreting studies of this type is that the effects being examined are typically local reductions in traffic volume, not vehicle miles traveled (VMT). Also, because the situation under consideration is a change from zero to some non-zero cordon toll, elasticities cannot be derived. The exception is Olszewski's (2007) study of Singapore's Area Licensing Scheme (ALS), which used a time series partial-adjust model that included average income, parking fees, and license costs. Because the Singapore ALS has been in effect since the early 1970s and the charge has changed over the years, elasticities of demand for private vehicle travel into the charging zone can be evaluated. An alternative approach to evaluating the impact of cordon charging is to simulate impacts through travel demand models. Rodier (2008) evaluates such model results in her analysis of congestion, cordon, and VMT charges, and the results are mentioned in the review.

In the case of VMT charges, no operational programs currently exist for passenger vehicles. Therefore, studies selected for this analysis were those that used comprehensive travel demand models to examine potential impacts on VMT. The one exception is Oregon DOT's pilot VMT charging program (Rudolfo and Kimpel, 2008), which was carried out in the Portland area. This program had several methodological shortcomings, including small sample size, high attrition rate for the control group, and data collection problems. Despite these drawbacks, it was included both because it represented the results of a real-world trial in the United States, and because the study results generally agree with those derived through simulation (for example see Rodier's (2008) review). In the Portland pilot program, the distance charging group reduced their daily VMT by an average of 2.9 miles (95% confidence interval: -4.9 to -0.9 miles) in response to a 1.2 cent per mile charge. A second experimental group was charged a congestion premium of 10 cents per mile within the Portland growth boundary during peak hours. This group received a discounted rate of 0.43 cents per mile on non-peak miles and miles outside of the Portland area. The peak charge group reduced their daily mileage by an average of 5.1 miles (95% CI: -7.4 to -2.8 miles). These equated to 9 and 19 percent VMT reductions respectively. Rudolfo and Kimpel analyzed the data to get these results using a pre-post test with control to examine VMT changes, in conjunction with a multiple regression model that included demographic and attitudinal predictor variables.

Additional studies considered in this assessment involve a variety of methods. Hirschman et al. (1995) used a log-transformed multiple regression model to calculate bridge elasticities in New York. Odeck and Bråthen used a time series model with a lagged dependent variable to determine elasticities for toll facilities in Norway. The CURACAO (2009a,b) and Eliasson et al. (2009) studies used pre and post implementation traffic counts at cordon boundaries to determine traffic reductions in London and Stockholm. Estimates of traffic volume reductions in Glaister and Graham (2005) were obtained from econometric models that included driving costs, time costs, taxes, and other relevant factors

Effect Size, Methodology and Applicability Issues

Although road user pricing is an attractive alternative from the standpoint of congestion management and revenue generation, several issues exist related to its effectiveness as a VMT reduction measure. First, cordon and link charging are essentially local policies designed to mitigate pollution and/or congestion. Their effect on regional VMT is difficult to ascertain for several reasons. First, in all of the real-world cases where cordon charging has been employed, the charging area is quite small. For example, the London charging zone is only 8 square miles – less than 1.5 percent of the area of Greater London. At 18 square miles Stockholm's charging zone is somewhat larger, but Singapore's is only 2 square miles. In addition, each of the areas in which congestion charges have been implemented are generally mono-centric. This means they have a single strong central business district that is the dominant employment center of their region. The major urbanized areas of California (and the US) have numerous employment centers distributed throughout the region. The VMT reduction from a single cordon charge in California could be affected by this poly-centric form. In the long run, changes in employer location could further alter commuting travel patterns, though the impact on VMT is somewhat uncertain. For example, the PROPOLIS modeling study of European cities (Lautso et al. 2004), found that cordon tolls resulted in a net movement of employment outside of the cordon zone. However, results for residential movement out of the cordon zone were mixed, with some central zones gaining and others losing population over the long run.

Likewise, VMT impacts from link charging are likely to vary significantly depending on context. The variation in elasticities can be attributed to a number of factors, including predominant trip purpose, trip frequency, and the presence of viable untolled alternatives. Generally, toll increases should result in larger traffic reductions on segments that carry more non-essential trips, those with little congestion, and those that offer parallel routes with similar travel times. Because of the importance of context, it is difficult to narrow the range of elasticities for such facilities.

It should also be noted that traffic reductions on a roadway segment may not result in a corresponding change in regional VMT. Reductions in VMT are dependent on the number of trips that are either not taken or those taken by another mode. In cases where alternative modes are lacking, drivers may choose to avoid link tolls by diversion to another route, which could lead to no change or even increases in VMT and travel time.

Of the studies presented here, those that examine distance charging are most likely to provide accurate assessments of potential VMT reductions at the regional level. There are two reasons for this. First, the variable of interest in distance charging studies is VMT, which is directly related to regional greenhouse gas emissions. Second, the problems of toll avoidance reduced or eliminated. These factors explain why the expected VMT reduction from distance charging fall within a relatively narrow range (10 to 15 percent) compared to cordon and link pricing. However, issues related to alternative availability still remain – at least in the short run. It is possible that this problem could be reduced by using revenue collected from VMT charging to increase the attractiveness of alternative modes through infrastructure and service improvements.

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