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Abstract

The Swedish government has commissioned VTI to summarize state-of-the-art principles for estimating the marginal costs of infrastructure use and to update cost estimates as well as develop new knowledge if and when feasible. The wear and tear of cars and trucks using road infrastructure is one component of the project. Costs include the amount spent on day-to-day operations and maintenance as well as periodic renewal and reinvestment. Economic analysis of renewal costs, i.e. expenditure during one year which will benefit users during several subsequent years, is based on some specific propositions (Small et al 1989):The renewal activity is triggered by quality reaching a critical level. Road quality deteriorates due to both weather and use. It is use by heavy vehicles in particular which makes road quality decline. Even more specific, wear increases very fast with weight per axle; this is often handled through the fourth power rule-of-thumb. The fundamental theorem of road user charges establishes circumstances under which the average cost (per vehicle etc.) can be used as a first approximation of marginal costs of road wear (Newbery 1988).Not only costs for renewal but also spending on operations(including winter activities) and day-to-day maintenance can be affected by traffic, thereby by definition being relevant for the calculation of marginal costs. This is done by regressing this cost components against information about traffic. The purpose of this paper is to present the results of estimations of marginal costs in the above dimensions. A platform for the analysis is that all reconstruction and maintenance activities in Sweden are being competitively tendered. For day-to-day operations and maintenance, the database comprises the 2005 – 2012period with annual invoicing from some 120 contracts, each defining the responsibility for a geographical district. In the same way as in Haraldsson(2007), information is available about the infrastructure in each district, i.e. kilometers of roads of different width. Traffic data is represented in a more disaggregate way than in the previous analysis. This will make it feasible to empirically analyze whether it is traffic at large or heavy traffic which affects the extent of maintenance activities. Also reinvestment is tendered. A separate database comprises some 15 000 contracts for different types of expenditure for new roads, for fixing pot-holes and cracks as well as for renewal and rehabilitation. Information about spending on the latter two activities will be used in the analysis. Contracts have been tendered during the 2002 – 2012 period. This will be used for providing information about costs per square meter for different types of pavement. Based on Svensson (2014) a hazard rate approach will be used for estimating the lifespan of each type of pavement. This is then transformed to the annual number of vehicles, thus generating an estimate of average cost. Finally, this information is used to account for time, weather and (possibly) traffic growth in the way suggested by Small et al (1987).A major shortcoming of available data is that information about traffic only reports vehicle movements at large (Average Annual Daily Traffic) and how many of these vehicles that are heavier than 3.5 tons; the latter number is based on the registered distance between vehicle axles. It is therefore not possible to test directly the significance of vehicles of different weight per axle for road deterioration. The hazard rate model will however be developed in

order to include the possibility of randomness in basic observations. This will make it feasible to address the relevance of weather-related quality deterioration in a climate with freeze-thaw cycles, warm but wet summers and cold winters.   Finally, a brief review of a separate test of the fourth power rule-of-thumb will be given. Using a Heavy Vehicle Simulator (HVS), atrial is currently under way where three types of road constructions –good/modern, less good and old roads with respect to substructure – are worn down until rutting has reached a target level using three different axle weights. While the number of observations is not sufficient for admitting systematic statistical testing, the results will provide some intuition for the relevance of subsequent analyses of these matters. References Haraldsson, M. (2007). Essays on Transport Economics. Dissertation, Economic studies 104, Dpt. of Economics, Uppsala University. Newbery, D. (1988). Road Damage Externalities and Road User Charges. Econometrica Vol. 56, No. 2(Mar., 1988), pp. 295-316Small, K., C. Winston, C. Evans (1989). Road Work. A new highway pricing and investment policy. The Brookings institution. Svensson, K. (2014). Estimated Lifetimes of Road Pavements in Sweden Using Time-To-Event Analysis. Working Paper.