Identifying Number MPC-346

Project Title:

Marginal Cost Pricing and Subsidy of Transit in Small Urbanized Areas

University:

North Dakota State University

Principal Investigators:

David Ripplinger
Associate Research Fellow
Phone: (701)231-5265

Jeremy Mattson
Associate Research Fellow
Phone: (701)231-5496

Description of Research Problem:

Recent economic conditions have forced public transportation agencies across the country to make significant, and in some cases draconian, changes to their service and fare structure (APTA 2010). The resulting impacts on system users and social welfare have been considerable. At the same time, the Obama Administration, which will play a leading role in crafting the next federal transportation bill, has established a firm emphasis on the importance of transit and its role in community livability and sustainability.

While many recognize the challenges facing the country as it develops the next transportation bill, the role of transit is relatively clear. Livability, sustainability, mobility, and social welfare are not only compatible, but complementary concepts. Now is the time to revisit and expand the dialogue on the impacts of transit on the community, the environment, and other transportation system users to ensure that discussion of national transit policies under consideration are fully informed. This requires identifying the costs and benefits that result from transit which in turn impacts how the system should be financed including fare structure and level of subsidy.

Optimal pricing of fares and determination of subsidy levels requires a full accounting of externalities. Like other modes of passenger travel, transit operation results in often un-priced external impacts including congestion, noise, air pollution, and accidents. Changes in service frequency impact passenger waiting time, a significant, mode-specific externality (Mohring 1972).

The determination of fares and subsidies for transit gains an added level of complexity when the firm's cost structure and the behavior and market for other users of the transportation network are considered. In the first case, the presence of increasing returns to scale often allow for monopoly pricing with firms charging prices higher than marginal cost, although this practice for transit in small urbanized areas is not known. In the second case, other passenger modes, especially travel by automobile, are not priced at their marginal social cost. Consequently, second-best pricing of transit becomes a policy alternative to achieve a socially optimal outcome.

Public transportation agencies serving small urbanized areas, those with populations between 50,000 and 200,000, face challenges unique from those in major metropolitan areas. Key among these is low population density which makes transit a less viable mode of travel. While in many circumstances, this reduces or eliminates the justification for subsidizing transit to alleviate congestion, it amplifies the impact of passenger waiting times. At the same time, transit agencies that serve small urbanized areas have been found to have different cost structures than their peers (Karlaftis and McCarthy 2002).

Research Objectives

The objective of the study is (1) to quantify the internal and external costs of transit operation in small urbanized areas, (2) to estimate the social impact of recent changes on fare structure and service level on riders, and (3) to determine the optimal transit fare and level of subsidy.

Research Approach / Methods

A full social cost function for transit operations in small urbanized areas, which accounts for economies of scale and externalities, will be estimated. Knowledge of the function will be used to estimate the optimal fare which is equal to marginal social cost of service. The needed subsidy will be calculated as the difference between the revenue generated by the optimal fare and that needed to maintain efficient levels of production. This method expands on Vickrey's (1980) seminal paper beyond a simple mathematical model to a more detailed econometric model with real-world data.

The study will begin with a thorough review of the literature on transit externalities, the impact of subsidies, and the determination of optimal fares.

Next, a survey of transit agencies will be conducted. The target population will be those agencies serving communities between 50,000 and 200,000 as reported in the National Transit Database. The survey will collect information on recent changes in service and fare structure including: the motivation behind changes; the intent of each change; the decision-making process; the changes that were made; and if anticipated goals have been or are expected to be met. The survey will also ask managers about their understanding of the concept of externalities, the types of externalities that exist in transit, the role of externalities in justifying government invention, and the purpose of subsidies.

The full social cost function will account for internal costs, as estimated using traditional economic modeling techniques, as well external costs including congestion, accidents, air and noise pollution, and waiting time.

A short-run cost function for transit agencies serving small urbanized areas will be estimated using data from the National Transit Database. A short-run model will be fit as it is not assumed that transit agencies are operating at their long-run equilibrium point. The method will account for the distortions resulting from existing government intervention using the methodology proposed by Obeng, Golam Azam, and Sakano (1997). A long-run cost function will be found by using the method described by Viton (1981).

As the study focuses on small urbanized areas, the role of congestion for most transit systems is expected to be negligible. However, this issue will be investigated on a community by community basis using the same methodology used by TTI in calculating its Annual Urban Mobility Report (TTI 2009). External costs resulting from congestion will only be calculated for those areas and agencies with moderate congestion, that is with road congestion index values greater than 1.

The impact of air pollution (CO_2, N_2O, CH_4, and HFCs) will be calculated based on the gallons of fuel consumed by each agency as reported in the National Transit Database and the cost of their emission as estimated by the Environmental Protection Agency.

The impact of the externalities resulting from accidents will be calculated using accident data available from the Federal Transit Administration's Safety Management Information System (SAMIS). These costs are external to those already accounted for by liability insurance which is included in the traditional cost function (Edel 2006).

Time spent waiting will be based on average headway data from the National Transit Database. The cost of waiting time will be based on figures available in the literature.

The full social cost function will be used to identify optimal fare by equating marginal social cost to marginal social benefit. This price will be used to determine the level of subsidy, if any, to offset losses not covered by the optimal fare at the efficient level of production. The absence of road pricing in the passenger automobile travel market and the implications of second-best pricing will be considered.

MPC Critical issues Addressed by the Research

13. Improved Pricing Strategies

18. Economic Analysis of Investments and Impacts

Contributions/Potential Applications of the Research

The survey is expected to inform the national policy debate and provide transit agencies with information to be used in decision-making and public education.

Potential Technology Transfer Benefits

Policy makers, administrating agencies, and transit agencies will benefit from improved decision-making and increased public support.

Time Duration:

July 1, 2010 - June 30, 2011

Total Project Costs:

$80,000

MPC Funds Requested:

$40,000

Source of Matching Funds:

NDDOT: $22,600

TRB Keywords: Public Transit, Pricing, Subsidies, Fares

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