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Cost structures of public transit systems: a panel data analysis

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Abstract

Results from numerous cost studies have generated conflicting results on public transit production technologies. Because prior studies have employed various sub-samples of public transit properties, the diverse results may either reflect alternative technologies or sampling differences. Based on a panel of nearly all transit systems reporting for Section 15 (US National Transit Data) purposes from 1986 to 1994, this paper explores whether public transit production technology differs by size and operating characteristics of the system. The results indicate that US transit properties are heterogeneous with different production technologies, which implies that transit cost analyses based upon a set of heterogeneous systems will generate incorrect inferences on public transit cost and production structures.

Keywords: Public transit; Cost structures; Translog; System size; Section 15; Cluster analysis

1. Introduction

Characteristics of the underlying production technology of firms in regulated industries have attracted considerable interest in the literature due to the vast array of valuable information provided by such analyses. Policy makers and governmental agencies may be interested in the underlying production technology in order to set pricing policies. Firms on the other hand may be interested in the cost effects of introducing new or discontinuing existing services. Further, the examination of the production structure can shed light on the issue of privatization. While most transit systems in the US are publicly owned and operated, privatization is widely debated with both avid supporters and strong opponents. A finding of diseconomies of scale may imply that,

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for example, a city can have different parts of its system operated by separate companies at a lower unit cost of output. Information on scale economies, input factor and cost elasticities, average and marginal cost, and optimal fleet and fare, can be obtained from the underlying production structure of transit systems.

For reasons that will be examined later in the paper, most of the literature concerned with uncovering the underlying production structure of transit systems has used the cost function approach. While in the 1960s and 1970s most authors employed linear and Cobb–Douglas functional forms to estimate transit system cost functions, in the 1980s and 1990s researchers almost exclusively used flexible functional forms, and most notably translog cost functions. Beginning with Viton (1981) widely cited paper, many authors used parts of the readily available Section 15 US transit systems data as the basis for a wide variety of flexible cost function models (a summary of many of the cost function studies appears in Table 1). Due to differences in empirical specifications of the model, differences in the transit properties analyzed, or different time periods, these studies have often reached *conflicting* conclusions regarding the existence of scale economies, economies of density and input factor elasticities. For example, researchers have reported results on economies of density and scale that vary depending upon the size of the systems in the sample and upon the systems forming the sample (Berechman, 1993, Karlaftis et al., 1999a). The easy availability of Section 15 data has led most researchers to use these data in their estimation of transit system production characteristics. Nevertheless, researchers have generally based their empirical work on different time periods, cross-sections, or both. As a result, the comparability of the results across studies is questionable. Further, in many studies researchers have used cross-section time series data from largely heterogeneous systems, introducing a size related bias in their results (Berechman, 1993).

In this paper, we generalize previous work in two important directions. First, we develop a panel data set composed of transit systems that reported operating data for Section 15 purposes (256 systems) over a 9-year time period (1986–1994). [1, 2] These data allow us to examine both the cross-section and the temporal production characteristics of transit systems of all sizes. Second, as noted above, a drawback in pooling data and analyzing systems of vastly different sizes and operating environments is that the results will likely be skewed towards the most "influential" group of firms (Berechman, 1993; Braeutigam et al., 1984). Further, in pooled models, it is not possible to account for differences in economies of density or scale between subgroups of firms. To avoid these biases and accurately capture the production characteristics of different-sized transit systems, we introduce a grouping scheme that classifies individual properties into homogeneous subsets.

In this paper, we employ a two-step procedure to analyze the production technology of public transit firms. First, based upon size and operating characteristics, we use cluster analysis to classify transit systems into homogeneous groups. Second, we develop separate cost function models for each group of transit systems. This two-step process minimizes the pitfalls of size related biases and enables us to explicitly capture the production characteristics of transit systems

[1] Section 15 data is now called the National Transit Database. We will use the term Section 15, since the data used in the study came from Section 15 publications.

[2] There are approximately 290 systems reporting for Section 15 purposes. The systems excluded did not report operating data over all the years in the sample (for further discussion on the data see Section 3).