

An Empirical Analysis of the Determinants of Passenger Rail Demand in Melbourne, Australia

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Abstract: Considerable yet largely unexpected growth in passenger rail demand has occurred recently in Australian capital cities. This article uses historical data, together with modern time series methods, to examine empirically the factors that might have contributed to growth in passenger rail demand in Melbourne, Australia, and to gain greater insight into the relationships between the various explanatory variables. A cointegration approach is used to estimate the long-run rail elasticities, while an error correction model is used to estimate short-run elasticities. The study finds that the short – run rail elasticity is twice as low as the long-run elasticity, although both are highly inelastic. The inelastic nature of the demand suggests that a fare increase would not lead to a significant drop in boardings, and hence results in a rise in total revenue. In addition to the fare, city population, petrol price and passenger income exert a positive impact on passenger rail demand.

I. INTRODUCTION

Unexpected growth in passenger rail demand has occurred recently in Australian capital cities. For example, Sydney, Australia's largest city, experienced an increase of 5.1 million annual rail passenger journeys from the year 2001/02 to 2006/07 (Brooker and Moore 2008), while Perth, the capital of Western Australia, experienced an increase in passenger boardings from 35.7 million in 2007 to 42.6 million in 2008 – roughly a 20 percent increase within a

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year. Melbourne, the capital of Victoria and the subject of this study, experienced patronage growth of 47% between 2004/05 and 2008/09 (Gaymer 2010). Since state governments in Australia, which are tasked with funding heavily subsidized urban rail services and associated infrastructure, are being required to do more with less, funding urban rail projects where they are most needed, and providing more services as required, is of critical importance. Hence, it is more critical than ever for transport planners to develop a more informed understanding of the impact of various factors on passenger rail demand. This article uses historical data, together with modern time series methods, to examine empirically the factors that might have contributed to growth in passenger rail demand in Melbourne, and to gain a greater insight into the relationships between the various explanatory variables.

The sequential four-step trip generation model, developed in the United States in the 1950s, has regularly been used for contemporary transport planning. It comprises of i) trip generation, ii) trip distribution, iii) modal choice, and iv) route assignment (Goulias *et al.* 1990, Wardman 1997). With burgeoning private vehicle use driven by inexpensive automobiles, low access pricing and cheap fuel (Mees 2000), the model was subsequently adopted as the main tool for urban transport planning. In recent years, however, it has proved increasingly deficient in terms of predicting the urban rail demand spikes seen in Australian capital cities. In light of the inadequacies of current demand estimation methods, it is important to ascertain the factors that have contributed to the rise in urban rail patronage from other approaches. Here, a demand model estimated by employing time series data will be used to gain greater insight into these matters. This does not mean that traditional techniques should be dispensed with. Instead, there is a need to *supplement* rather than replace them, especially since an approach more directly suited to estimating the rail passenger demand function, rather than transport demand more generally, is required. Since the time series method is regularly employed for forecasting in finance and economics fields, its functionality will be tested, here, in the context of the passenger rail demand of Melbourne.

This study represents a pilot attempt to develop a time series technique that will be efficacious for testing the passenger demand function of Australian urban rail travel. The study therefore represents an addition to the mere handful of existing Australian studies employing a comparable approach (see Douglas and Karpouzis 1999, Odgers and Schijndel 2011). Modern time series techniques will be used to examine the relationship between passenger rail demand and its explanatory variables, especially since previous studies have not utilised these techniques in the estimation of passenger rail demand. In particular, that most time series data is non-stationary is now well known. If this is not taken into account, spurious results and invalid inferences may result (Granger and Newbold 1974). From the literature review, no time series study on urban passenger rail demand in Australia tested for stationarity, which compromises the validity of the techniques developed hitherto. In addition, cointegration and error correction models allow the researcher to separate between the short-run and long-run elasticities (Engle and Granger 1987). This was also largely neglected in previous Australian studies. Without doing this, there is the danger of confusing short-run impacts with those that will occur in the long-run if the relationship between key variables changes.

The article is divided into five main parts. Section II provides a brief synoptic discussion of the relevant theoretical and pertinent empirical literature on the topic. Section III reflects

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