Regulatory structures and their impact on the sustainability performance of public transport in world cities

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ABSTRACT

This paper describes a new measure of the sustainability performance of public transport in 88 world cities adopting 15 indicators including Environmental, Social, Economic and System Effectiveness sustainability. Sustainability performance is then explored for cities with only “Public” operations or others with some degree of commercial operation (“Non-Public”). Results show no significant difference in aggregate total sustainability indicator scores between world cities with “Public”/“Non-Public” operations. However Social Sustainability indicators are significantly different with “Public” operations having better Social Sustainability performance than “Non-Public”.

For individual component indicators, three of the four Social Sustainability component indicators have average normalised scores suggesting statistically significant differences between “Public” and “Non-Public” city scores with “Public” cities performing better than “Non-Public”. The indicators and their relative positive sustainability scores for “Public” cities compared to ‘Non-Public’ cities are; Trip distance (24%), Affordability (34%) and PT related deaths (29%). However results also show that operating costs per passenger km are lower and cost recovery are higher in “Non-Public” cities suggesting higher elements of Economic Sustainability in “Non-Public” based Public Transport cities.

The paper concludes with a summary and discussion of the results including implications for regulatory practices and areas for future research.

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1. Introduction

Cities play a leading global economic, social and environmental role in human existence on planet Earth. From 2007, for the first time in history, more than half of the world’s population lives in cities (United Nations Population Fund, 2007). Between 2000 and 2030, the world’s urban population is expected to double. The 21st century is said to be the ‘Urban Millennium’ where the functioning of cities has a principal influence on the future of human kind (United Nations Population Fund, 2007).

Transport is a major economic, social and environmental challenge to the functioning of world cities. Travel in developed cities is dominated by the private car (Cosgrove, Gargett, & Mitchell, 2009) which has generated the global problem of urban traffic congestion (Arnott & Small, 1994; Cervero, 1991) imposing significant and growing environmental and economic costs on world cities. In Australian major cities congestion is estimated to cost $Aust 9.4 B p.a. (2005) and is expected to rise to $Aust 20.4 B by 2020 (Bureau of Transport and Regional Economics, 2007). Urban liveability is at risk as a result of environmental damage caused by the private car (Vuchic, 1999) while the segregation of urban communities by growing ‘traffic sewers’ imposes social costs on disadvantaged communities (Rosenbloom, 2007). Transport, mainly private car travel, is the only sector of the UK economy for which environmental emissions in 2007 are higher than in 1990 (Woodcock, Banister, Edwards, Prentice, & Roberts, 2007).

Improving existing and developing new urban public transport (PT) systems has been widely seen as part of a global solution to the economic, social and environmental challenges faced by world cities (Beimborn, Horowitz, Schuetz, & Zejun, 1993; Bunting, 2004; Larwin, 1999, pp. 427—498; Vuchic, 1981). Indeed it is a commonly held view amongst the planning and transport community that public transport systems are ‘sustainable’ because they address...
economic, social and environmental transport impacts in an effective way. However the assumption that public transport systems are, by their nature, ‘sustainable’ is rarely tested (De Gruyter, Currie, & Rose, 2017) and deserves scrutiny.

Regulatory reform of urban public transport has also been a major world trend, due to concerns about the economic performance (and economic sustainability) of public transport. Escalating government public transport subsidies have driven many governments to explore private operation or involvement in the management of urban transit systems (Currie, 2016). Major drivers have been to encourage greater market competition and reduce costs. The rationale for encouraging competition in public transport is that public ownership is often thought to create higher cost and less customer focused operations (Currie, 2016).

While much research now demonstrates cost savings and arguably improved ‘economic’ sustainability as a result of private sector involvement in publicly owned public transport services, no research has explored how this has affected its social and environmental sustainability performance.

This research paper is an empirical exploration of public transport sustainability from an environmental, social, economic, and system effectiveness perspective. It aims to explore these dimensions of sustainability for public transport in major world cities which have public sector vs commercial or private sector involvement in public transport. It aims to answer the question; does public sector or more market based involvement act to affect the sustainability performance of public transport in cities (and if so how)?

The paper adopts a new methodology previously developed by the authors (De Gruyter et al., 2017) to empirically measure the sustainability of public transport in world cities from an economic, social, environmental and system effectiveness perspective. The method adopts data on public transport systems in over 100 cities produced by the International Association for Public Transport (UITP, 2001; UITP, 2015). The original application of the sustainability methodology was to explore patterns of sustainability performance between cities in world regions (De Gruyter et al., 2017). The approach has also been adopted to explore empirical links between land use patterns and their influence on the sustainability of public transport in world cities (Currie & De Gruyter, 2017). This paper seeks to adopt this approach to explore how and if public vs private/market influence on public transport in world cities acts to influence sustainability performance.

The paper is structured as follows; the next section presents a description of the method used to measure sustainability performance. This is followed by an outline of the approach used to apply the method to assess public transport in cities with only public vs private/market influenced operations. Results are then described. The paper concludes with a summary of key findings and discussion of their implications for practice and an outline of areas for future research.

2. Methodology

2.1. Measuring sustainability performance

The methodology developed by the authors (De Gruyter et al., 2017) adapts ‘Miller’s framework’ (Miller, 2014) to assess and compare the sustainability performance of urban public transport systems in world cities. This framework includes measures of economic, social, environmental and system effectiveness sustainability. This includes a range of individual metrics of many types including measures of supply (D5). The adaptation is shown in Table 1 and contains a total of 15 indicators, grouped into the same four headings used by Miller (2014) to reflect key dimensions of public transport sustainability. Indicators for each city use data collated by the International Association for Public Transport (UITP, 2001; UITP, 2015). In practice, high quality data measuring a wide range of aspects of sustainability performance is not available. To some extent the method takes a pragmatic approach by fitting sustainability measures around available data.

Indicators are ‘normalised’ using a distance to reference based approach to give a value of between 0 (lowest performance) and 1 (highest performance) to allow comparison between cities on a comparable basis. Where a lower value for an indicator is seen as more desirable (e.g. pollutants), the following equation is used to normalise the indicator value:

\[ n_i \text{ negative} = \frac{\min (all \ x)}{x_i} \]

where:

Table 1

<table>
<thead>
<tr>
<th>ID</th>
<th>Indicator</th>
<th>Units</th>
<th>Desirability</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Environmental</td>
<td>Quantity of energy consumed</td>
<td>MJ/pkm</td>
</tr>
<tr>
<td>A2</td>
<td>Environmental</td>
<td>Mass of total pollutants emitted (e.g. NOx, VOC, CO2)</td>
<td>kg/ha</td>
</tr>
<tr>
<td>A3</td>
<td>Environmental</td>
<td>Land area consumed by public transport facilities</td>
<td>% of urban area</td>
</tr>
<tr>
<td>B1</td>
<td>Social</td>
<td>Travel participation</td>
<td>pkm/capita</td>
</tr>
<tr>
<td>B2</td>
<td>Social</td>
<td>Average user trip distance</td>
<td>km</td>
</tr>
<tr>
<td>B3</td>
<td>Social</td>
<td>Affordability</td>
<td>10^-4% per capita GDP/trip</td>
</tr>
<tr>
<td>B4</td>
<td>Social</td>
<td>Public transport related deaths</td>
<td>fatalities/billion-pkm</td>
</tr>
<tr>
<td>C1</td>
<td>Economic</td>
<td>Annual operating cost</td>
<td>$US/pkm</td>
</tr>
<tr>
<td>C2</td>
<td>Economic</td>
<td>Cost recovery (proportion of costs recovered)</td>
<td>% of total costs</td>
</tr>
<tr>
<td>C3</td>
<td>Economic</td>
<td>Passenger km travelled per unit GDP</td>
<td>pkm/$US</td>
</tr>
<tr>
<td>C4</td>
<td>Economic</td>
<td>Average time per trip</td>
<td>mins</td>
</tr>
<tr>
<td>D1</td>
<td>System effectiveness</td>
<td>Average occupancy rate of passenger vehicles</td>
<td>% of seated capacity</td>
</tr>
<tr>
<td>D2</td>
<td>System effectiveness</td>
<td>Annual public transport trips per capita</td>
<td>trips/capita</td>
</tr>
<tr>
<td>D3</td>
<td>System effectiveness</td>
<td>Public transport mode split</td>
<td>% of all trips</td>
</tr>
<tr>
<td>D4</td>
<td>System effectiveness</td>
<td>Public transport fleet size</td>
<td>vehicles/million people</td>
</tr>
</tbody>
</table>

Source: De Gruyter et al. (2017).
<table>
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<tr>
<th>متن کامل مقاله</th>
<th>دریافت فوری</th>
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