Cross-cultural contrasts of preferences for Bus Rapid Transit and Light Rail Transit

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ABSTRACT

Bus rapid transit (BRT) appears to be relatively unpopular in developed economies despite its appeal in delivering high quality services, usually at a fraction of light rail transit (LRT) costs. This is often linked to an emotional bias towards rail-based solutions and an image perception that clouds the potential merits of a bus-based system. This paper builds on published research from Australia, extended by the results of a stated choice experiment conducted in five developed economies − including the US, France, Portugal, the UK, and Australia − with an aim to verify whether modal preferences are culture-specific and if so what are the drivers of community preferences for BRT and LRT in different geographical settings. We identify the nature of the preference differences to show how citizens/voters could be targeted to buy-in to BRT or LRT systems. Potential gains in public support for BRT are shown through scenario analysis on attributes assessed in a series of choice scenarios, together with voter experience with specific modes and socioeconomic profiles. Willingness to pay estimates are obtained for each of the attributes defining the preferences for and against BRT/LRT.

1. Introduction

"….to sell something surprising, make it familiar; and to sell something familiar, make it surprising." Raymond Loewy[1]

There is much discussion as to why cities appear to prefer rail over bus solutions for new infrastructure. Even when service levels of bus-based systems are as good as or better than rail-based services (including greater coverage and lower construction costs), there is still strong emotion favouring rail (see Hensher 2007, Hensher and Waters 1994). Using a stated choice experiment, Hensher *et al*. (2015c) investigated differences in support for bus rapid transit (BRT) over light rail transit (LRT) in all Australian capital cities. The study concluded that there is a considerable increase in preference for BRT when a real possibility exists for BRT solutions to deliver high frequency services, to cover a larger population, or to operate on a dedicated corridor for a sizeable amount of its length at a fraction of LRT construction cost. Voters' experience with BRT was also shown to enhance BRT's appeal and support. This paper builds on the research from Australia, implementing the exact same stated choice experiment in four other developed countries − USA, France, Portugal, and UK − to investigate the drivers of community preferences for BRT and LRT in different cultural and modal settings. The main aim is to understand which of the drivers of community preferences are common and also different across countries, and what impact these may have in identifying community preferences for BRT in the presence of LRT.

Studies investigating modal preferences between LRT and BRT often ignore the cost/budget component associated with each system. Specifically, these studies often ask which mode is preferred without accounting for differences in infrastructure provision costs. This issue is addressed in the current paper which employs a stated choice experiment in which respondents were asked to choose which modal investment options they prefer given the same route length but with different costs and service levels.

The rest of the paper is structured as follows. Following a short discussion on the literature context, the paper describes the stated choice experiment conducted in a number of cities over five countries. This is followed by some discussion of the samples and their sources before turning to the model specification to obtain evidence on relative preferences for bus and rail options, accounting for attribute attendance by respondents. Willingness to pay estimate for each attribute is then presented to identify cross cultural differences and transferability of preference content between countries. The results are presented in a novel way using a community preference decision support system (DSS), complementing to benefit-cost analysis. We then highlight how resident preferences are linked to potential gains in public support for BRT over LRT and discuss where potential gains in community support for BRT may come from and how this might vary in spatial settings between countries.

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[1] In the 1960s, the psychologist Robert Zajonc conducted a series of experiments where he showed subjects nonsense words, random shapes, and Chinese-like characters and asked them which they preferred. In study after study, people reliably gravitated toward the words and shapes they'd seen the most. Their preference was for familiarity. (URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3008563/)

2. Literature Review

The literature on key drivers of preferences for bus- and rail-based public transport has been summarised in a number of sources (see Hensher et al. (2015) for a recent review). A review of the academic, technical and grey literature was initially undertaken, and a long list of potential attributes were selected for a best-worst experiment (Hensher et al. 2015, Hensher et al 2015c, Hensher and Mulley 2015, Mulley et al. 2014) as a way of synthesis and creating a short list of the most important quality attributes for use in this current choice experiment. The best-worst experiment identified attributes affecting the design and service characteristics of the mode, with the same statements being used in the context of being in favour of a rail-based mode and a bus-based mode. The literature underpinning this work is documented in the above papers and came from peer reviewed papers by Hensher (1991), Swanson et al. (1997), Cirillo et al (2011), dell'Olio et al. (2010a,b), Eboli and Mazzulla (2010, 2008a,b), and Marcucci and Gatta (2007), and more strategic and the grey literature including Hass-Klau and Crampton (2002), Hensher and Waters (1994), Hensher (1999), Mackett and Edwards (1996a,b), Canadian Urban Transit Association (2004), Cornwell and Cracknell (1990), Kain (1988), Pickrell (1992), Sislak (2000), Currie and Wallis (2008), Currie and Delbrosc (2013), and Hensher et al. (2015).

The literature described above, together with our previous empirical work in exactly the same setting, underpinned the inclusion of attributes in a choice experiment to capture differences in cost and coverage between rail and bus based modes (population serviced, % dedicated right of way, operating and maintenance costs and route length (given a fixed budget between two options), service levels which are critical in capturing patronage (service capacity, peak and off-peak headways, travel time and public transport fare), features of the system described by fare payment (on or off vehicle, integrated fare or not), interchange penalty, safety and security and ease of boarding and other general factors shown to be important in personal preferences and voting between transport systems (the assurance of a minimum period of operation and risk of being closed down after this period, value uplift around stations, mode switch from cars and environmental friendliness of the system).

However, while the travel behaviour literature is rich in examples about the drivers of mode choice, the focus has been on perceptions and objective measurements (for example Vos et al 2016). In the quality of service literature, preference drivers are well established and included in many of the papers cited above irrespective of their different emphases. What is general lacking in the literature is the impact of cultural (country) context on travel behaviour and preferences although this has been highlighted by Bueler (2011) in terms of a comparison between Germany and USA for mode choice. This paper directly addresses this shortfall in the literature by looking at cross cultural impacts on preferences for BRT and LRT systems.

2. The Choice Experiment

The centrepiece of this study is a stated choice experiment in which sampled respondents from 19 cities in five countries were interviewed to obtain their preferences for BRT and LRT as a way to understand how a government might spend money on new infrastructure. From the community perspective, the experiment was designed to elicit voter's preferences for an investment option, be it a BRT system or a LRT system, together with their service attributes that are important to the community. The service attributes are classified into four groups, shown in Table 1, together with attribute levels and attribute names. The stated choice experiment is designed with the same route length for BRT and LRT systems which are referred to as *System A* and *System B* in each choice scenario. Subsequent to the respondent indicating their preference for a bundle of attributes defining two unlabelled alternatives, the modal label (BRT or LRT) is revealed (being assigned randomly to the left and right alternatives), and the respondent is asked to review, and possibly revise, their choice. This is designed to reveal whether images about bus-based and rail-based systems are relevant in preference revelation. The focus in this paper is on the labelled choice, noting that the responses did not differ noticeably in the absence and presence of the modal labels which is encouraging evidence of the role of the service and costs levels play in preference revelation.

Table 1. Predefined attributes and attribute levels for the choice experiment

Note: The attributes and attribute levels are exactly the same across all cities. We only change the cost unit ($AU - $US – EU) and length unit (kms – miles)[2]

Attributes	Attribute level	# levels
Route length (same for both systems in each choice scenario)	10,20,30 kms or miles	3
Description of investment		
Construction cost of project	0.5, 1, 3, 6 bn$	4
Construction time	1,2,5,10	4
% metropolitan population serviced	5,10,15,20	4
% route dedicated to this system only and no other means of transport	25,50,75,100	4
Operating and maintenance cost per year (millions)	2,5,10,15 m$	4
Service Levels:		
Service capacity in one direction (passengers/hour)	5k, 15k, 30k	3
Peak headway of service, every...	5,10,15 mins	3
Off-peak headway of service, every...	5,10,15,20 mins	4
Travel time (door-to-door) compared to car	-10,10, 15, 25 %	4
Fare per trip compared to car-related costs (fuel, tolls, parking)	±20, ±10%	4
Features of the system:		
Off-vehicle prepaid ticket required	Yes , No	2
Integrated fare	Yes, No	2
Waiting time incurred when transferring	1, 5,10,15 mins	4
On-board staff for passenger safety and security	present, absent	2
Ease of boarding public transport vehicle	level boarding, steps	2
General characteristics of investment:		
Operation is assured for a minimum of	10,20,30,40,50,60 years	6
Risk of it being closed down after the assured minimum period	0,25,50,100%	4
Attracting business around stations/stops	low, medium, high	3
% car trips switching to this option within first 3 years of opening	0,5,10,20 %	4
Overall environmental friendliness compared to car	±25, -10,±5, 0 %	6
The two systems described above are actually " "	BRT, LRT	2

Each respondent is asked to answer two choice tasks with the same route length, except for respondents in Australia who were asked, in addition, to complete two further choice tasks where the budget is held constant and the route length varied, reflecting different modal costs in a different way[3]. Given the number of levels for each attribute and the desire to maintain attribute level balance, the survey was designed using *Ngene*[4] (Choice Metrics 2012) with 24 rows (i.e., choice tasks) and blocked into 12 blocks so that each respondent is assigned a

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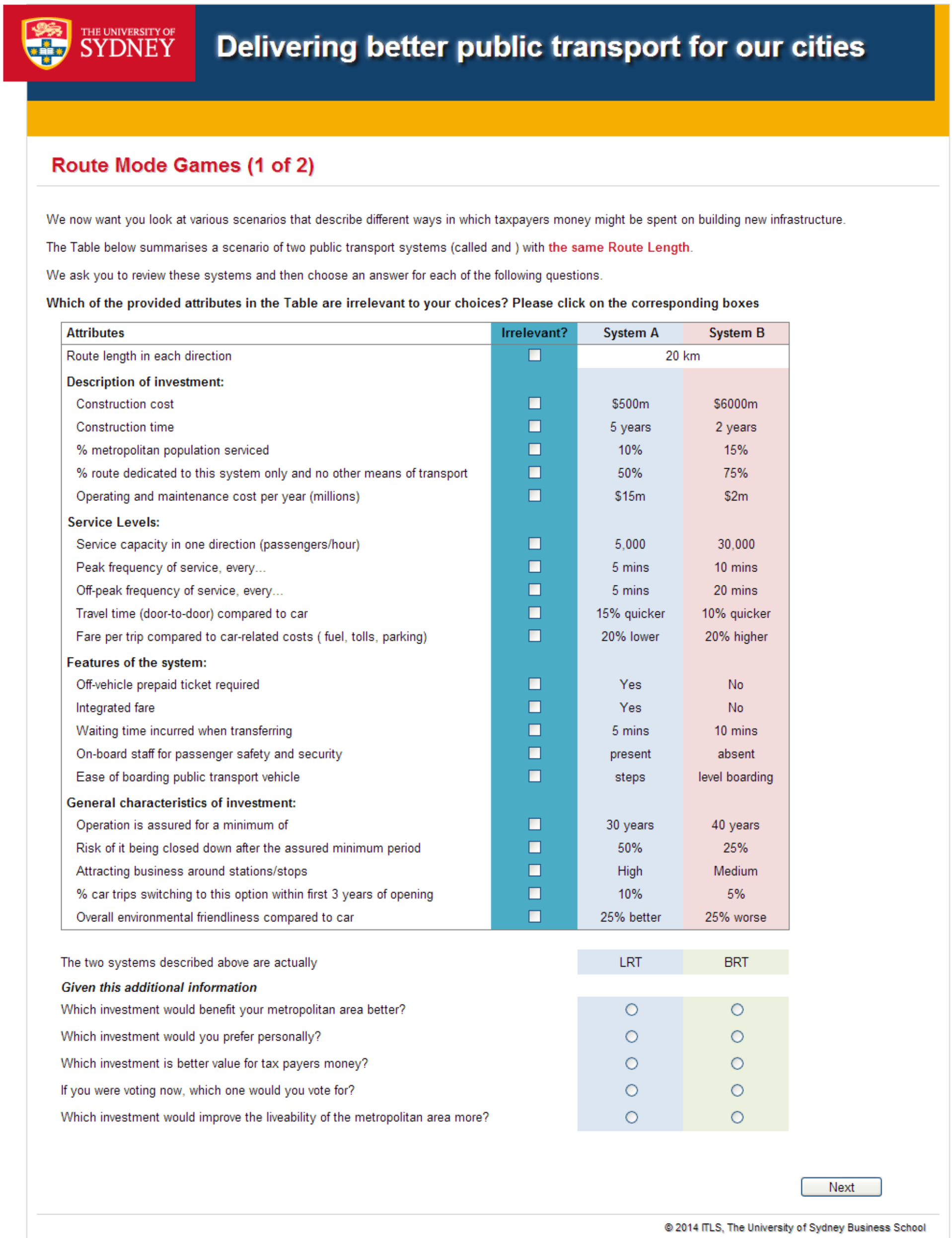
[2] Regarding costs, Australia and UK presented the levels shown in AUD$, Portugal and France in EUR$, and US in US$. In the case of the length, US presented the route length as miles and the rest of the countries in kilometres.

[3] The Australian survey with these additional choice tasks is presented in Hensher *et al* (2015).

[4] Full details of the Ngene syntax, and efficiency outputs for this application, is given in Hensher *et al.* (2015a, Ch 6.6.3 Design 3: D-Efficient Choice Design).

block with 2 choice tasks. A set of conditions were employed to ensure that peak-hour level of service is no worse than the off-peak level of service, so if the level of peak-hour headway of *System A* is 10 (minutes), then the allowed levels of off-peak headway of *System A* are 10, 15 and 20 (minutes). When the level of peak headway is 5 minutes, the off-peak headway can be any of the predefined levels, and thus no condition is required. This condition provided the only large correlation between design attributes (r = 0.46) with all other correlations being small (-0.2 < r < 0.2). At the end of the experiment, respondents were asked to indicate which attributes they consider as irrelevant (i.e., those they did not attend to).

This survey is designed for estimating multinomial logit (MNL) and Mixed (Random Parameter) Logit (ML) models defined by the utility functions of the labelled alternatives (*BRT and LRT*) (see Hensher *et al*. 2015a for details of mixed logit models). How prior values were determined for generating the efficient design is described in Hensher *et al*. (2015). These same designs were implemented subsequently in the other four countries. Figure 1 shows an illustrative choice experiment. In this study we focus on the response to the question “which investment would you personally prefer?” when showing labelled alternatives (BRT and LRT).


THE UNIVERSITY OF SYDNEY

Delivering better public transport for our cities

Route Mode Games (1 of 2)

We now want you look at various scenarios that describe different ways in which taxpayers money might be spent on building new infrastructure.

The Table below summarises a scenario of two public transport systems (called and) with **the same Route Length**.

We ask you to review these systems and then choose an answer for each of the following questions.

Which of the provided attributes in the Table are irrelevant to your choices? Please click on the corresponding boxes

Attributes	Irrelevant?	System A	System B
Route length in each direction	☐	20 km	
Description of investment:			
Construction cost	☐	$500m	$6000m
Construction time	☐	5 years	2 years
% metropolitan population serviced	☐	10%	15%
% route dedicated to this system only and no other means of transport	☐	50%	75%
Operating and maintenance cost per year (millions)	☐	$15m	$2m
Service Levels:			
Service capacity in one direction (passengers/hour)	☐	5,000	30,000
Peak frequency of service, every...	☐	5 mins	10 mins
Off-peak frequency of service, every...	☐	5 mins	20 mins
Travel time (door-to-door) compared to car	☐	15% quicker	10% quicker
Fare per trip compared to car-related costs (fuel, tolls, parking)	☐	20% lower	20% higher
Features of the system:			
Off-vehicle prepaid ticket required	☐	Yes	No
Integrated fare	☐	Yes	No
Waiting time incurred when transferring	☐	5 mins	10 mins
On-board staff for passenger safety and security	☐	present	absent
Ease of boarding public transport vehicle	☐	steps	level boarding
General characteristics of investment:			
Operation is assured for a minimum of	☐	30 years	40 years
Risk of it being closed down after the assured minimum period	☐	50%	25%
Attracting business around stations/stops	☐	High	Medium
% car trips switching to this option within first 3 years of opening	☐	10%	5%
Overall environmental friendliness compared to car	☐	25% better	25% worse

The two systems described above are actually	LRT	BRT
Given this additional information		
Which investment would benefit your metropolitan area better?	○	○
Which investment would you prefer personally?	○	○
Which investment is better value for tax payers money?	○	○
If you were voting now, which one would you vote for?	○	○
Which investment would improve the liveability of the metropolitan area more?	○	○

Next

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Figure 1. An Illustrative choice screen

4. The Samples and Sources

A number of different consumer panels were used to obtain the target sample for each of the studied cities whose quotas were set to reflect their relative populations, given the total sample sizes assigned for each country. Table 2 shows the consumer panels used by country, together with the valid sample sizes and the survey periods. All field surveys were completed within a month, except for the survey in Australia which was live for two months because two consumer panels were used (one after another) to separately evaluate if there are differences between the two panels. In total, 509 of the Australian surveys were collected through SSI and the balance through PureProfile, with a comparative analysis showing no significant difference between the panels' data. 'All other capital cities' in Australia included respondents residing in Adelaide (80), Perth (70), Darwin (21) and Hobart (34).

Table 2. Studied cities, sample sizes and consumer panels used

Country	City	Quota	Sample	Consumer Panel used	Survey period
Australia	Sydney	270	271	PureProfile (www.pureprofile.com) SSI (www.surveysampling.com)	10/04/2014 – 10/06/2014
	Melbourne	240	241		
	Canberra	100	100		
	Brisbane	200	201		
	All other capital cities	200	205		
US	Boston	180	181	Affordable Samples (www.affordablesamples.com)	24/02/2015 – 19/03/2015
	Los Angeles-Long Beach	300	300		
	Seattle-Bellevue-Everett	100	100		
	Minneapolis – St Paul	100	100		
	Dallas – Fort Worth	150	150		
	Philadelphia	170	170		
Portugal	Lisbon	405	425	Light Speed GMI (www.lightspeedresearch.com)	04/05/2015 – 21/05/2015
Britain	Birmingham	280	274	Light Speed GMI	01/06/2015 – 21/06/2015
	Newcastle	150	153		
France	Lyon	185	128	Light Speed GMI	01/06/2015 – 21/06/2015
	Toulouse	173	137		

5. Descriptive Profile of Sample

The sample profile is summarised in Table 3. There are similarities in the socioeconomic profiles across the countries (although there are the obvious difficulties in comparing income), but there are differences as well. Specifically, household car ownership is much lower in the UK and France, compared to the other countries. Respondents from Portugal and France have longer working hours due to the higher incidence of full time workers compared to part time workers in our sample.

The trip profile is informative with marked differences in use of BRT and LRT. Specifically, Portugal shows greater use of Bus/BRT compared to the other countries (with Australia the lowest incidence); likewise the Portugal sample has the highest incidence of train/metro use with the US being the lowest. Overall, the US respondents showed a low level of public transport use – for example, the lowest use of light rail/tram together with Australia (reflecting the lack of such modal infrastructure compared to France and Portugal). The UK is interesting, showing a low use of rail-based modes compared to the other four countries, but high use of bus-based modes. The potential role of experience in using a mode may impact on the preferences for BRT and LRT, which is explored below.

Table 3. Country-specific socioeconomic profiles and experience

Location	***Australia***	***U.S.***	***Portugal***	***France***	***U.K.***
Socioeconomic Profile					
Average (std dev) of respondent age in year	44.32 (14.9)	44.42 (16.11)	40.75 (11.45)	42.83 (14.41)	47.52 (15.35)
% female respondent	54%	61%	52%	53%	50%
Average (std dev) of personal income in AUD$1000	$61.24 (43.50)	$80.57 (60.79)	$30.36 (26.11)	$50.63 (35.26)	$39.12 (31.53)
% Full time employed	41%	43%	72%	63%	44%
% Part time employed	20%	16%	6%	7%	16%
% Students	6%	7%	7%	4%	4%
Average (std dev) working hours per week	20.75 (17.00)	21.9 (17.42)	31.79 (14.36)	27.13 (15.55)	20.16 (17.32)
Average (std dev) household adults	2.11 (0.89)	2.02 (0.94)	2.18 (1.04)	1.85 (0.68)	2.08 (0.89)
Average (std dev) household children	0.66 (1.03)	0.6 (0.98)	0.68 (0.91)	0.68 (0.92)	0.57 (0.95)
Average (std dev) household cars	1.66 (0.98)	1.76 (1.02)	1.86 (1.37)	1.50 (1.00)	1.25 (0.89)
Member of PT association *(%)*[5]	9%	7%	3%	2%	7%
Member of environment association *(%)*	7%	12%	6%	4%	7%
Trip profile					
Times using Bus/BRT in last month	5.85 (9.13)	7.46 (9.63)	11.46 (14.26)	7.13 (10.19)	7.27 (9.45)
Use Bus/BRT at least once last month (%)	45%	39%	49%	49%	62%
Times using LRT last month	1.73 (4.35)	2.14 (4.34)	2.48 (5.69)	3.91 (6.23)	0.53 (1.76)
Used LRT at least once last month (%)	19%	19%	22%	37%	14%
Times using Train/Metro last month	6.49 (9.92)	4.29 (7.9)	13.94 (13.88)	9.27 (11.58)	3.55 (6.57)
Used Train/Metro at least once last month (%)	46%	31%	66%	56%	50%
Travel time of the last bus trip	28.62 (18.11)	33.28 (21.51)	25.77 (17.1)	23.44 (17)	28.36 (18.24)
Travel time of the last Train/Metro trip	35.87 (21.93)	36.3 (23.21)	24.1 (14.66)	24.15 (20.52)	33.8 (25.26)

[5] The US survey asked "Are you active in any public transit advocacy groups or organizations?"

Not all attributes presented in the choice experiment are relevant to each respondent and Figure 2 summarises the incidence of each attribute being ignored (attribute non-attendance or ANA)[6]. There is an extensive literature suggesting that respondents use a range of heuristics (or rules) when evaluating choice scenarios. ANA is one such rule that has demonstrated behavioural relevance (Hensher *et al*. 2015a and Hensher 2014 provide details). The incidence of ANA is remarkably similar between the countries, with the average incidence of an attribute being ignored by the respondent ranging from 12% to 22%. Also, the range of ANA across countries all fall within two standard deviations. Given that identical choice experiments were used across the countries, this is a very important result, suggesting some cultural commonality in the attendance given to each attribute.

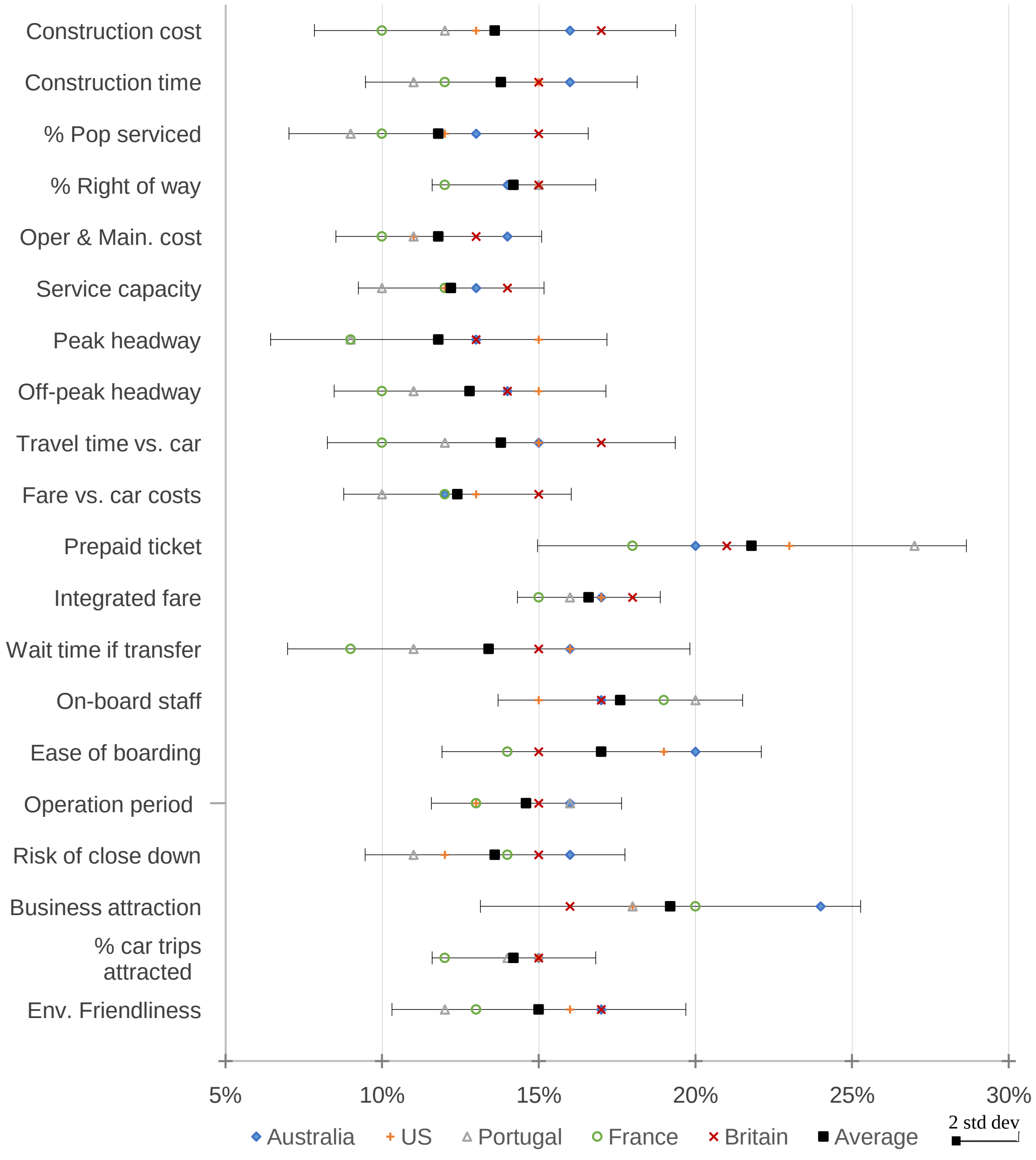

Figure 2. Incidence of each attribute being not attended to by country

[6] Note that ANA only applies to the attributes of the alternatives and not socioeconomics and experience.

In addition to ANA, this study examines the effect of voter's experience with BRT and LRT on their support for these systems. To this end, Table 4 shows respondent's experience with BRT and LRT through day-to-day travel at their home city. Of course, experience with different transport modes could be obtained outside their residential area, but it is argued that local (overt) experiences are more relevant in revealing respondent's support for a particular public transport system.

Table 4. Respondent's experience with BRT and LRT services

Country	City	BRT available	LRT available
Australia	Sydney	X	X
	Melbourne	-	X
	Adelaide	X	X
	Brisbane	X	-
	All other capital cities	-	-
US	Boston	X	X
	Los Angeles-Long Beach	X	X
	Seattle-Bellevue-Everett	-	X
	Minneapolis – St Paul	X	X
	Dallas – Fort Worth	-	X
	Philadelphia	X	X
Portugal	Lisbon	-	X
Britain	Birmingham	-	X
	Newcastle	-	X
France	Lyon	-	X
	Toulouse	-	X

6. The Mode Preference Model Form

It is generally accepted that overt experience is likely to influence the extent to which a particular mode is preferred over other alternatives (see Hensher and Ho 2016 for a review and recent application). Including the level of experience as an explanatory variable in a choice model that is linear in the parameters and additive in the attributes is not an appropriate way of recognising the role that experience can play in conditioning all of the attributes that influence preferences. We adopt the method proposed by Hensher and Ho (2016) which conditions the entire utility expression defining each individual's preferences for BRT and LRT. Intuitively, a good experience with an alternative will increase its overall utility relative to another alternative and vice versa for a bad experience, *ceteris paribus*. Consequently, experience will have an influence on the marginal utility of each attribute that contributes to the overall level of utility.

This approach to incorporate experience is analogous to the approach developed by Swait and Adamowizc (2001) to accommodate complexity, in which the theoretical context is aligned with information theory in order to provide a measure of information content or uncertainty. Experience is a source of information quantity. Swait and Adamowizc assume that complexity affects the utilities only through the stochastic component and assume that differences in complexity generate differential consistency levels in preferences across individuals, which will be reflected in the standard utility expression $V_{qj}+\varepsilon_j$ by affecting the variances of the assumed distribution for the disturbances. As shown in Swait and Adamowicz (2001), under the usual distributional assumptions associated with logit model form, the complexity conditioning expression, or in our case, experience conditioning expression, is the scale function μ(E), where μ is inversely related to the variance of the errors. Also, so long as experience/information is a function of object attributes *X* and decision maker characteristics, the resulting model does not have the Independence of Irrelevant Alternatives property (unlike the standard MNL model). This is referred to as the Heteroscedastic MNL model, similar to the idea presented in Hensher and Rose (2012).

Beginning with the standard utility expression associated with the j^{th} alternative contained in a choice set of j=1,…,J alternatives, it is assumed that an index defining overt experience with the j^{th} alternative and q^{th} individual, referred to as E_{qj}, conditions the utility expression. The functional form can be denoted by equation (1):

$$U_{qj}^{*}= \mu_q(E_{qj})U_{qj}=\mu_q(E_{qj})(V_{qj}+\varepsilon_{qj}), \tag{1}$$

where U_{qj}^{*} is the standard utility expression (U_{qj}) conditioned on the overt experience (and other possible influences) with an alternative. This conditioning is a form of heteroscedasticity. E_{qj} recognises that individual-specific experience, proxied by some metric such as frequency of use, conditions the marginal (dis)utility of each and every attribute, observed and unobserved, associated with the j^{th} alternative in a pre-defined choice set.

In equation (1), the random variables $\mu(E_{qj})\varepsilon_j$, for all q and j contained in an individual's choice set, are IID Gumbel but with unit scale factors. Multiplying both the left and right hand sides of (1) by $\mu_{qj}\geq 0$, the probability expression remains unchanged, as shown in (2).

$$\begin{aligned}\Pr[U_{qj}\geq U_{qj'}] &= \Pr[V_{qj}-V_{qj'}\geq \varepsilon_{qj}-\varepsilon_{qj'}]\\ &= \Pr[\mu_{qj}(V_{qj}-V_{qj'})\geq \mu_{qj}(\varepsilon_{qj}-\varepsilon_{qj'})]\end{aligned} \tag{2}$$

Given the IID property of the error difference, it follows that the probability of choosing an alternative is an MNL-like model with the observed sources of utility $\mu_q(E_{qj})V_{qj}$ as given in equation(3).

$$\Pr_{qj}=\frac{\exp\left[\mu(E_{qj}\mid\gamma)\cdot V_{qj}(X_{qj}\mid\beta)\right]}{\sum_{j'\in J_q}\exp\left[\mu(E_{qj'}\mid\gamma)\cdot V_{qj'}(X_{qj'}\mid\beta)\right]} \tag{3}$$

where we have parameters γ and β, and the observed variables *E* and *X* associated with each alternative and each individual. Model (3) is non-linear-in-parameters since the parameters associated with the experience effect interact with the parameters associated with attributes X_{qj}.

Against the background of the theory above, four dummy variables that represent individual experience on BRT and LRT were specified: (1) $dummy_{useBRT\_onlyBRT}$ which equals 1 if the individual had used the bus in the last month and their home city has BRT system only, and 0 otherwise; (2) $dummy_{useLRT\_onlyLRT}$ equals 1 if the individual had used the rail or metro in the last month and only had LRT system available in their city, and 0 otherwise; (3) $dummy_{useBRT\_BRTLRT}$ if the individual had used the bus in the last month and had both BRT and LRT systems available in their city; and (4) $dummy_{useLRT\_BRTLRT}$ if the individual had used the rail or metro in the last month and had both BRT and LRT systems available in their city. These dummy variables were established using the information in Table 4 and the information provided by respondents as to the modes they had used during the previous month.

Dummy variables (1) and (3) were added to condition the BRT utility function, and the other two to condition the LRT utility function. All dummy variables, except for dummy variable (3) were statistically significant. Hence, the BRT utility function was only conditioned by those individuals in the sample that have used the bus in the last month and only have the BRT system available in their city. The only city included in our sample meeting these criteria is Brisbane. Hence, those individuals from Brisbane that used the bus in the last month had a significant influence on conditioning the utility function. This finding aligns with the results found in Hensher *et al*. (2015) that showed a higher preference towards the BRT system in Brisbane than in other cities of Australia.

The specific functional form of heteroscedastic conditioning, implemented herein, is given in equation (4).

$$U_{BRT} = (1+\varphi_{useBRT\_onlyBRT} \cdot dummy_{useBRT\_onlyBRT}) \cdot \left[ASC_{BRT} + \theta_{\cos t} \cdot \text{cost}_{BRT} \ldots\right] \quad (4)$$

$$U_{LRT} = (1+\varphi_{useLRT\_onlyLRT} \cdot dummy_{useLRT\_onlyLRT} + \varphi_{useLRT\_BRTLRT} \cdot dummy_{useLRT\_BRTLRT}) \cdot \left[ASC_{LRT} + \theta_{\cos t} \cdot \text{cost}_{LRT} \ldots\right]$$

7. Model Results

We estimated two final models, one that does not include the stated attribute non-attendance (ANA) and the other which includes it. Different interactions between countries and attributes were tested and the final models included interactions that were statistically significant. The final mixed logit model under attribute non-attendance is summarised in Table 5 (the model that treats all attributes as relevant is provided in the Appendix as Table A1). All monetary items were converted to the June 2014 currency value of $AUD.

This model pooled the data from all five countries which enables us to compare parameter estimates across countries as well as test whether some parameters are generic in contrast to country specific. Many attributes describing BRT and LRT interact with country-specific dummy variables, suggesting that the contribution (as a marginal (dis)utility to the preference for BRT or LRT) varies between the countries.

Several parameters were estimated as random and normally distributed and shown in Table 5 and the Appendix Table A1. Significant socioeconomic effects were found to be limited to gender (as a random parameter in France where this denotes significant preference heterogeneity with females having a positive marginal utility for BRT). Gender as a fixed parameter was significant and positive in Portugal and France for BRT. This evidence may be aligned to the more visible presence of the bus driver compared to the tram driver in a multi-tram set. Travellers often indicate that they feel safer in a bus than on a train. The overall fit of the two models – with and without considering ANA is similar. However, when including ANA, more interactions becomes statistically significant. In general, as a result of the large number of differences in the mean and standard deviation (for random parameters) parameter estimates between countries it suggests a notable presence of preference heterogeneity between countries.

Although discussion of the statistical significant of parameter estimates is informative, a more behaviourally appealing way to identify differences is to obtain willingness to pay estimates for each attribute, which is considered in the next section.

Table 5. Summary of Model (Mixed Logit with ANA) Results

500 Halton draws, with panel structure accommodated
Random parameters are unconstrained normal distributions

	Australia		US		Portugal		France		U.K.	
	BRT	LRT	BRT	LRT	BRT	LRT	BRT	LRT	BRT	LRT
System Characteristics										
Constant	-0.243 (2.88)	-	-0.243 (2.88)	-	-0.243 (2.88)	-	-0.243 (2.88)	-	-0.243 (2.88)	-
Travel time compared to car (% quicker/slower)	0.007 (2.85)	0.007 (2.85)	-	-	-	-	-	-	-	-
Travel cost compared to car (% cheaper/dearer)	-0.004 (3.63)	-0.004 (3.63)	-0.004 (3.63)	-0.004 (3.63)	-0.004 (3.63)	-0.004 (3.63)	-0.004 (3.63)	-0.004 (3.63)	-0.004 (3.63)	-0.004 (3.63)
Construction cost ($m), **mean**	-0.017 (1.22)	-0.071 (3.75)	-0.017 (1.22)	-0.106 (4.36)	-0.017 (1.22)	-0.071 (3.75)	-0.074 (1.83)	-0.071 (3.75)	-0.017 (1.22)	-0.071 (3.75)
Construction cost ($m), **std. dev**	0.097 (2.21)	0.161 (4.14)	0.097 (2.21)	0.140 (2.16)	0.097 (2.21)	0.161 (4.14)	0.304 (1.83)	0.161 (4.14)	0.097 (2.21)	0.161 (4.14)
Waiting time if transfer (mins), **mean**	-	-	-0.020 (1.96)	-0.046 (3.69)	-	-0.039 (2.57)	-	-0.046 (2.13)	-	-0.038 (2.93)
Waiting time if transfer (mins), **std. dev**	-	-	0.065 (1.96)	-	-	-	-	-	-	-
Construction time (year), **mean**	-0.030 (3.45)	-0.035 (2.47)	-0.030 (3.45)	-	-0.030 (3.45)	-	-0.030 (3.45)	-	-0.030 (3.45)	-0.065 (2.76)
Construction time (year), **std. dev**	-	-	-	-	-	-	-	-	-	0.164 (3.22)
Percent metro population serviced (%)	0.016 (2.23)	-	-	-	-	-	-	0.059 (3.65)	-	-
Annual operating and maintenance cost ($m)	-0.008 (1.47)	-	-0.008 (1.47)	-	-0.030 (3.28)	-	-0.008 (1.47)	-	-0.008 (1.47)	-
One-way service capacity ('1000 passengers)	0.010 (2.33)	-	-	-	-	-	0.029 (3.41)	-	-	-
Peak-hour headway (mins)	-	-	-	-	-0.037 (2.57)	-	-	-	-	-
Off-peak headway (mins)	-0.028 (4.00)	-	-	-	-	-	-	-	-	-
Prepaid ticket required (1/0)	-	-	-	-	-	-	-0.504 (2.05)	0.447 (1.62)	-	-
Integrated fare availability (1/0)	0.185 (1.62)	-	-	-	-	-	-	-	-	-
Level boarding (vs. step boarding)	0.206 (2.01)	-	-	-	-	-	-	-	-	-
Operation period assured (year)	0.003 (2.27)	-	0.003 (2.27)	-	0.003 (2.27)	-	0.003 (2.27)	-	0.003 (2.27)	-

Environmental friendliness (% better/worse vs. car)	-	0.012 (4.78)	-	0.012 (4.78)	0.012 (2.18)	0.012 (4.78)	-	0.012 (4.78)	-	0.012 (4.78)
Percent car switched to this mode (%)	-	-	-	-	-	-	0.023 (1.97)	-	-	-
Staff presence on board (1/0)	-	0.203 (3.18)	-	0.203 (3.18)	-	0.203 (3.18)	-	0.203 (3.18)	-	0.203 (3.18)
Risk of being closed after assured period (%)	-	-	-	-	-	-0.008 (3.16)	-	-	-	-
Medium level of business attracted to station/stop (1/0)	-	0.153 (1.93)	-	0.153 (1.93)	-	0.153 (1.93)	-	0.153 (1.93)	-	0.153 (1.93)
High level of business attracted to station/stop (1/0)	-	0.234 (1.91)	-	0.360 (2.63)	-	-	-	-	-	0.452 (2.91)
Socioeconomic Characteristics										
Female (1/0), **mean**	-	-	-	-	0.447 (3.24)	-	0.535 (2.51)	-	-	-
Female (1/0), **std. dev.**	-	-	-	-	-	-	1.680 (2.51)	-	-	-
Experience										
Dummy (use BRT_onlyBRT)	-1.210 (2.09)	-	-1.210 (2.09)	-	-1.210 (2.09)	-	-1.210 (2.09)	-	-1.210 (2.09)	-
Dummy (use LRT_onlyLRT)	-	-0.213 (1.83)	-	-0.213 (1.83)	-	-0.213 (1.83)	-	-0.213 (1.83)	-	-0.213 (1.83)
Dummy (use LRT_BRTLRT)	-	-0.328 (2.08)	-	-0.328 (2.08)	-	-0.328 (2.08)	-	-0.328 (2.08)	-	-0.328 (2.08)
Summary Statistics										
Log-likelihood at zero	-5104.34									
Log-likelihood at convergence	-4931.52									
McFadden Pseudo R^2	0.034									
Info. Criterion AIC	-1.342									
Sample Size (number of observations)	7420									

8. Willingness to Pay

The willingness to pay (WTP) estimates for each attribute are calculated relative to the construction cost. However, in the models that did not include ANA (Appendix), the construction costs for BRT were not statistically significant for every country, only for Australia, and France. For those countries where the construction cost attribute is not significant, suggesting that any difference between BRT and LRT on construction cost (over the range investigated) is not a driver of relative preference, it is not possible to calculate the WTP for the Model under ANA.

Table 6 presents the WTP estimates where ANA is implemented. The WTP estimates under all attributes being relevant are provided in the Appendix Table A2.The findings between the two models are directly comparable because they are calculated as ratios of parameter estimates. The non-ANA model (in the Appendix Table A1) obtained a statistically significant estimate of construction cost for BRT and LRT for all countries, so it was possible to obtain an estimate of WTP for all the attributes that were statistically significant.

The first column in Table 6 provides the interpretation given to each WTP estimate. In interpreting the findings, it is important to recognise that some estimates of mean WTP are dependent on a dummy variable (i.e., the presence vs. absence of a particular attribute). For example, the WTP estimates associated with level boarding and availability of integrated fares are high in dollar values because they represent a single value under presence vs. absence of that attribute through the use of a dummy variable. In contrast, many of the other WTP estimates are related to a unit change such as a 1 minute change of service headway.

Table 6 shows that the community in Australia is willing to spend an additional $0.96m for the construction of BRT in order to increase the served population by 1%, or an extra $9.6m for a 10% increase. This is similar to the WTP of the community in France for LRT for an increase in the served population of $7.3m for a 10% increase. Although some of the WTP estimates are very similar across countries (after a statistical test of differences), for example, travel cost compared to the car (in percentages, except for BRT in France which is significantly lower), there are some notable differences such as waiting time if transfer, environmental friendliness compared to the car and level of business attracted to a station/stop (high), with the latter showing a big difference between the UK ($6.36m) compared to Australia ($3.29m) and the USA ($3.40m).

Table 6 and Appendix Table A2 show that differences between countries are sufficient to suggest that there are cultural differences between countries with individuals in each country exhibiting different willingness to pay for specific service attributes. The differences also suggest that transferability of evidence on preferences between the countries is of questionable merit, and while there are some common attribute influences on preferences for BRT and LRT, their role varies quite noticeably.

The findings suggest that we should not just focus on the very narrow traditional sources of user benefit (e.g., travel time and fare) in a benefit-cost analysis where bus-based and rail-based projects are being evaluated. Instead, we should recognise and incorporate the larger set of relative benefits, many of which would demonstrate increased support for BRT, or at least change the comparative analysis in a way that gives greater credibility as to the provision of a level playing field assessment of the relative merits of BRT and LRT.

Table 6. Willingness to pay estimates (with ANA)

WTP higher construction cost (AUD$m)[7] to…	Australia		US		France		Portugal		U.K.	
	BRT	LRT	BRT	LRT	BRT	LRT	BRT	LRT	BRT	LRT
Reduce the construction time in one year	$1.81	$0.50	$1.81	-	$0.41	-	$1.81	-	$1.81	$0.92
Increase the population serviced in 1%	$0.96	-	-	-	-	$0.73	-	-	-	-
Reduce the annual operating costs in million $	$0.47	-	$0.47	-	$0.11	-	$1.84	-	$0.47	-
Increase the service capacity in 1,000 passengers	$0.63	-	-	-	$0.39	-	-	-	-	-
Reduce the headway in peak hours by 1 minute	-	-	-	-	-	-	$2.22	-	-	-
Reduce the headway in off-peak hours by 1 minute	$1.72	-	-	-	-	-	-	-	-	-
Increase the travel time compared to the car in 1% quicker	$0.40	$0.00	-	-	-	-	-	-	-	-
Reduce the travel cost compared to the car in 1%	$0.23	$0.05	$0.23	$0.04	$0.05	$0.05	$0.23	$0.05	$0.23	$0.05
Require prepaid ticket in the service	-	-	-	-	-$6.86	$6.29	-	-	-	-
Integrate fare availability	$11.21	-	-	-	-	-	-	-	-	-
Reduce the waiting time if transfer in 1 minute	-	-	$1.19	$0.44	-	$0.65	-	$0.54	-	$0.53
Have staff presence on-board	-	$2.86	-	$1.92	-	$2.86	-	$2.86	-	$2.86
Have level boarding	$12.48	-	-	-	-	-	-	-	-	-
Increase the operation period assured in 1 year	$0.20	-	$0.20	-	$0.05	-	$0.20	-	$0.20	-
Decrease in 1% the risk of being closed after assured period	-	-	-	-	-	-	-	$0.11	-	-
Have a medium level of business attracted to the station/stop	-	$2.15	-	$1.44	-	$2.15	-	$2.15	-	$2.15
Have a high level of business attracted to the station/stop	-	$3.29	-	$3.40	-	-	-	-	-	$6.36
Increase the environmental friendliness in 1% compared to car	-	$0.17	-	$0.12	-	$0.17	$0.73	$0.17	-	$0.17
Increase in 1% the cars switched to this mode	-	-	-	-	$0.32	-	-	-	-	-

[7] WTP are presented as AUD$ June 2014.

9. Community Preference Model: Simulated Scenarios

To illustrate how the preference model can be used in promoting BRT in the presence of LRT, a community preference model (CPM) has been developed which provides a number of interesting scenarios. This model offers an appealing way of identifying the gains in user or voter support which is potentially available under various planning opportunities, and could usefully be used as a screening process when deriving the options for appraisal as well as providing an intuitive comparison across cultures. Scenarios that can be assessed by the CPM emphasise some key issues that are often raised about BRT, as compared to LRT. These include construction cost, the catchment of the population served, the extent of dedicated right of way, waiting time if transfer, and a general bias against BRT compared to LRT linked to modal experience (i.e., familiarity). It can in principle be extended to all attributes of the choice experiment.

Given that the relative utilities are conditioned by the level of experience that individuals have of BRT and LRT if available in their cities, the cities that have different systems available have to be differentiated. That is, Australian cities will be separated into four categories: (1) cities that have only BRT available (i.e., Brisbane), (2) cities that have LRT available (i.e., Melbourne), (3) cities that have both systems available (i.e., Sydney and Adelaide), and (4) those cities that do not have BRT or LRT (i.e., Canberra, Perth, Darwin and Hobart). Equivalently, and as can be deduced from Table 4, U.S. cities will be separated into two categories: ones that have only LRT and the ones that have both systems. France, Portugal and U.K. cities only have the LRT system available, so they will be part of only one category. Table 7 show the percentage of use of BRT and/or LRT in each of the categories[8].

Table 7. Percentage of use of the BRT and LRT systems (considering city availability)

Description	% of use in those cities[9]	% of use in whole country (given availability)[10]
Australia		
Only BRT	49%	10%
Only LRT	70%	17%
Both BRT and LRT	57%	20%
U.S.		
Only LRT	23%	6%
Both BRT and LRT	42%	31%
Portugal		
Only LRT	68%	68%
France		
Only LRT	61%	61%
U.K.		
Only LRT	51%	51%

[8] We are not able to identify residents of a particular city/country who have experienced LRT and/or BRT in other jurisdictions, which should, ceteris paribus, increase the percentage who have experienced that mode.

[9] For example: 49% of the people that live in cities with only BRT have used the bus in the last month; 70% of the people that live in cities with only LRT have used the metro or rail in the last month, and; 57% of the people that live in cities with both LRT and BRT have used the bus, metro or rail in the last month.

[10] For example: 10% of the total sample in Australia have only BRT system available and have used the bus in the last month; 17% have only LRT system and have used metro or rail in the last month; and 20% have both systems available and have used bus, metro or rail in the last month.

Figure 3, using the ANA Model illustrates the extent of a (percentage) change in preference towards or away from BRT associated with a number of individual scenarios, with an illustration of how a combination of these scenarios might affect the preference for BRT. All attribute levels for the non-scenario attributes are initially set equal between BRT and LRT at the means shown in Table 8, and in Table 3 and Table 7 for those other variables that are not attributes of the modes.

Table 8. Mean levels of each significant attribute used in the scenarios[11]

Description	Mean (Std deviation)
Construction cost in AUD$ million	
Australia	2.632 (2.17)
US	3.331 (2.74)
Portugal	3.637 (3.00)
France	3.752 (3.08)
UK	2.593 (2.13)
Construction time in years	4.496 (3.50)
Percent metro population serviced	12.498 (5.59)
Percent right of way	62.500 (27.95)
Annual operating and maintenance cost in AUD$ million	
Australia	7.996 (4.93)
US	10.151 (6.28)
Portugal	11.075 (6.87)
France	11.482 (7.10)
UK	7.982 (4.92)
Service capacity in one way in 000 passengers	16.667 (10.27)
Service headway in peak hours (mins)	9.163 (4.00)
Service headway in off-peak hours (mins)	14.071 (5.07)
Travel time compared to car in % (% quicker or slower)	10.003 (12.75)
Travel cost compared to car in %	0.000 (15.83)
Prepaid ticket required (1,0)	0.500 (0.50)
Integrated fare availability (1,0)	0.500 (0.50)
Waiting time if transfer in minutes	7.749 (5.27)
On-board staff presence (1,0)	0.500 (0.50)
Level boarding (1,0)	0.500 (0.50)
Operation period assured in years	35.000 (17.11)
Risk of being closed after assured period	43.758 (37.00)
Level of business attracted to station/stop – Medium (1,0)	0.333 (0.47)
Level of business attracted to station/stop – High (1,0)	0.334 (0.47)
Environmental friendliness compared to car (%)	-1.666 (15.18)
% car switched to this mode	8.749 (7.39)

[11] The mean estimates are almost identical (some small amount of rounding error) across countries given the same choice design was used and hence we report the overall sample mean. The only attributes with differences across countries are those related with the costs, since the currencies used for each country varied across them. The cost attribute levels are converted to $AUD for June 2014.

The support levels towards BRT and LRT in the base scenarios (i.e., with the current characteristics of the systems) for each country are presented in Table 9. To illustrate some of the evidence, we see in Figure 3 that increasing BRT off-peak frequency by 50% in Australia increases on average voter support for BRT by 4.4%, which is a significant gain when voting outcomes are often close to 50%. In the USA, we see a large increase in support for LRT (5.1% drop in BRT support) when it is 50% less expensive to construct than BRT and considering that 80% of voters have used bus in the last month.

Table 9. Level of support towards BRT in base scenarios for each country

Country – Systems availability	Using Model without ANA	Using Model with ANA
Australia		
Only BRT	49.38%	50.40%
Only LRT	47.77%	48.21%
Both BRT and LRT	47.76%	48.14%
None	48.08%	48.46%
All cities together	48.15%	48.67%
U.S.		
Only LRT	46.98%	47.29%
Both BRT and LRT	46.07%	46.29%
All cities together	46.30%	46.54%
Portugal		
Only LRT	44.16%	42.62%
France		
Only LRT	48.08%	47.54%
U.K.		
Only LRT	50.54%	51.72%

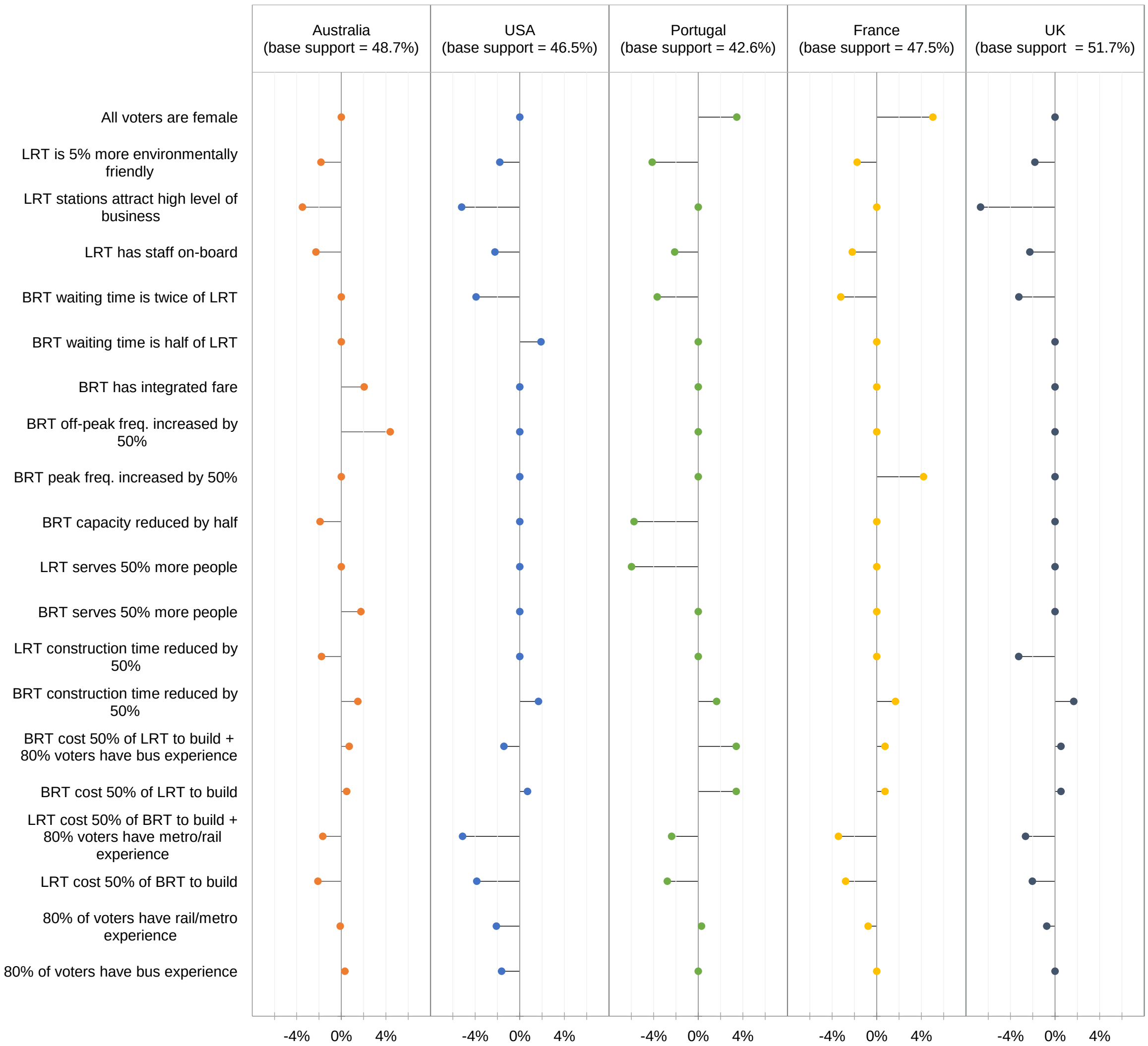

Figure 3. Simulated potential gains in voter support for BRT

Figure 4 highlights the role that experience plays in modifying the percentage change in voter support for the same scenarios presented in Figure 3. Only Australian and American cities were used in this exercise since BRT is not available in other surveyed countries. Assuming a high level of business attraction for LRT (3rd line from the top of Figure 4), we could expect that support for BRT will drop by around 3.9% in Australian cities with BRT (i.e., Brisbane), by around 3.3% for cities with LRT only (i.e., Melbourne), 3.2% in cities with both systems (i.e., Adelaide and Sydney), and close to 3.9% in cities with no BRT/LRT system (i.e., Canberra, Perth, Darwin and Hobart). What this tell us is that experience, be it positive or negative, results in a change in voter support, albeit small in this example. Another example that highlights the general perception of BRT is BRT off peak frequency increasing by 50%. In Figure 3, we have on average for all Australian cites, a 4.4% increase in voter support; however when this is segmented by cities with various modal experiences, we see that this gain drops to 2.0% in cities with BRT only (which is Brisbane – see Table 5) whilst increases to 5.0% in other cities. That is, when the BRT off-peak frequency is improved, support towards it increases at a higher rate in cities that have LRT relative to cities that do not. This is an interesting (if not curious) finding – which might suggest that LRT is not so great and hence the support for BRT where there is experience with LRT actually grows. The message is that experience is both good and bad, and hence there are opportunities for BRT to be given a better light where LRT has resulted in possibly a more negative outcome when experienced than when not.

Importantly, this community preference model offers a platform to show the relative merits, in terms of preference, which can be associated with voter or general community support of a project specification that is of interest to planners. In our example, a planning agency might be assessing BRT and LRT project proposals and have identified the construction cost, the amount of dedicated right of way and the catchment area served. This information can be fed into the CPM as assumptions of the project alternatives to obtain predictions of gains in support, as illustrated in Figures 3 and 4.

Overall, the evidence shows that there are significant differences between the five countries in the potential gain in voter support for BRT, both in respect of the attribute level associated with BRT and LRT and also with the role that experience with various public transport modes plays in modal preferencing (or what may be seen by some as modal bias).

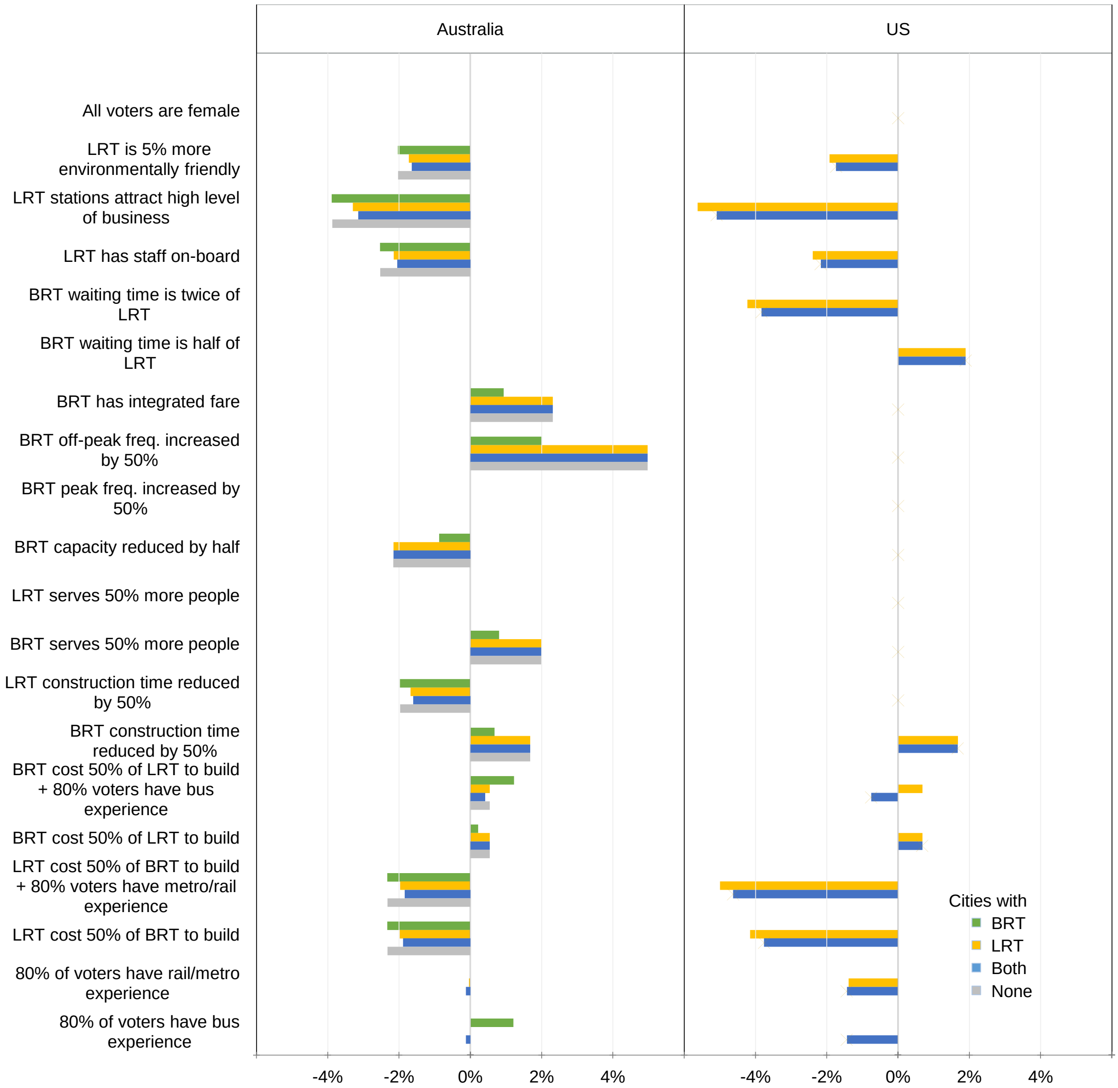

Figure 4. Potential gains in voter's support for BRT: influence of the existing system (experience)

10. Conclusions

This paper has presented evidence on the key drivers of community preferences for BRT and LRT across five developed countries. Although there are demonstrations of cultural commonality in attribute attendance and non-attendance, there are different drivers (with different WTP estimates) of relative support for bus over rail between the countries studied. In turn, these differences suggest that country-specific promotion of bus-based systems must draw on different attribute sets (with a very few common attributes of relevance (mainly construction cost, fare, and waiting time).

An important result is the influence of experience with a specific mode on modal support, something that has been known in the broader literature on preferences for some time (see for example Hensher and Ho 2016 for a review of the literature). 'We learn by our experiences' is a catch cry that resonates in many situations of real life (see Hoeffler and Ariely 1999).

The community preference scenario-based simulation model presented shows how to assess likely potential gains in supporting BRT over LRT in each country as a consequence of specific changes in service and cost levels, as well as familiarity (proxied by overt experience) in using bus and rail-based modes. The findings reinforce the need to focus in on specific features of BRT that make it an attractive alternative to LRT in building support for BRT.

Overall, the key finding of this study is that it is necessary to identify preferences in each geographical jurisdiction for BRT and LRT and not making (as appropriate) unqualified commentary of the merits of one mode over the other without accounting for the responses of communities that will be impacted by a specific investment. Far too often, it appears, arguments are mounted for support of one mode (typically LRT) over another in ignorance of the level of services and experience that local communities have for specific modes. Importantly, by empirically identifying experience with each mode and estimating models to account for this, experience-conditioned scenario analysis can identify the extent of preference change when more information and familiarity is in place. Ideally, no judgment of modal preferences can be informed by community responses without at least recognising that more relevant information (associated with a circumstance as if a community had been able to experience a specific mode) will offer richer evidence on the potential support for specific modes. In turn this will at least help to neutralise the emotional bias in support of LRT, often driven by a love of trains and an absence of real experience in using high quality dedicated corridor rapid bus transport. The evidence provided by this paper shows that support for BRT or LRT is often influenced by whether an experience of one mode has been good or bad, in a relative sense, and how examples of a poor experience with LRT has helped the support for BRT even where BRT has not been experienced. This is a crucial finding and highlights the way in which comparisons have in the past been made and which need to change in the future along the lines of the approach we have set out in this paper.

We hope, in time, that BRT and LRT are properly assessed on a level playing field (neutralised by differences in experience), otherwise bus based systems will continue to be subject to an ideological and emotionally charged setting where there is a bias in favour of LRT over BRT (reinforcing the 'uninformed' notion that 'trains are sexy and buses are boring' (Hensher 1997, 2007).

Appendix A

Table A1. Summary of Model 1 (Mixed Logit without ANA) Results
500 Halton draws, with panel structure accommodated
Random parameters are unconstrained normal distributions

	Australia		**US**		**Portugal**		**France**		**U.K.**	
	BRT	**LRT**	**BRT**	**LRT**	**BRT**	**LRT**	**BRT**	**LRT**	**BRT**	**LRT**
System Characteristics										
Constant	-0.331 (2.96)	-	-0.331 (2.96)	-	-0.331 (2.96)	-	-0.331 (2.96)	-	-0.331 (2.96)	-
Travel time compared to car (% quicker/slower)	0.008 (3.60)	0.008 (3.60)	-	-	-	-	-	-	-	-
Travel cost compared to car (% cheaper/dearer)	-0.005 (5.80)	-0.005 (5.80)	-0.005 (5.80)	-0.005 (5.80)	-0.005 (5.80)	-0.005 (5.80)	-0.005 (5.80)	-0.005 (5.80)	-0.005 (5.80)	-0.005 (5.80)
Construction cost ($m), **mean**	-0.065 (2.40)	-0.086 (4.13)	-	-0.141 (6.79)	-	-0.086 (4.13)	-0.066 (1.75)	-0.086 (4.13)	-	-0.086 (4.13)
Construction cost ($m), **std. dev**	-	0.192 (5.51)	-	0.192 (5.51)	-	0.192 (5.51)	0.234 (1.75)	0.192 (5.51)	-	0.192 (5.51)
Waiting time if transfer (mins), **mean**	-	-	-0.036 (3.74)	-	-	-	-	-	-	-
Waiting time if transfer (mins), **std. dev**	-	-	0.075 (3.74)	-	-	-	-	-	-	-
Construction time (year), **mean**	-0.067 (3.96)	-0.019 (1.73)	-	-0.019 (1.73)	-	-0.019 (1.73)	-	-0.019 (1.73)	-	-0.099 (4.41)
Construction time (year), **std. dev**	-	-	-	-	-	-	-	-	-	0.153 (3.45)
Percent metro population serviced (%)	0.035 (4.08)	-	-	-	0.020 (1.91)	-	0.068 (3.99)	-	-	-
Annual operating and maintenance cost ($m)	-0.023 (4.50)	-	-0.023 (4.50)	-	-0.048 (4.94)	-	-0.023 (4.50)	-	-0.023 (4.50)	-
One-way service capacity ('1000 passengers)	0.018 (3.64)	-	-	-	-	-	0.014 (1.57)	-	-	-
Peak-hour headway (mins)	-	-	-	-	-0.056 (3.53)	-	-	-	-	-
Off-peak headway (mins)	-0.033 (3.87)	-	-	-	-	-	-	-	-	-
Prepaid ticket required (1/0)	-	-	-	-	-	-	-1.530 (4.44)	1.630 (4.20)	-	-
Integrated fare availability (1/0)	0.347 (3.39)	-	-	-	-	-	-	-	-	-
Level boarding (vs. step boarding)	0.223 (2.23)	-	-	-	-	-	-	-	-	-

Operation period assured (year)	0.006 (3.62)	-	0.006 (3.62)	-	0.006 (3.62)	-	0.006 (3.62)	-	0.006 (3.62)	-
Environmental friendliness (% better/worse vs. car)	-	-	-	-	0.022 (4.73)	-	-	-	-	-
Percent car switched to this mode (%)	-	-	-	-	-	-	0.023 (2.00)	-	-	-
Staff presence on board (1/0)	-	0.298 (2.87)	-	-	-	-	-	-	-	-
Risk of being closed after assured period (%)	-	-	-	-	-	-0.009 (3.61)	-	-	-	-
Medium level of business attracted to station/stop (1/0)	-	-	-	-	-	-	-	-	-	0.270 (1.62)
High level of business attracted to station/stop (1/0)	-	-	-	-	-	-	-	-	-	0.594 (3.83)
Socioeconomic Characteristics										
Female (1/0), **mean**	-	-	-	-	0.400 (2.84)	-	0.428 (2.04)	-	-	-
Female (1/0), **std. dev.**	-	-	-	-	-	-	1.400 (2.04)	-	-	-
Experience										
Dummy (use BRT_onlyBRT)	-0.669 (1.70)	-	-0.669 (1.70)	-	-0.669 (1.70)	-	-0.669 (1.70)	-	-0.669 (1.70)	-
Dummy (use LRT_onlyLRT)	-	-0.215 (2.15)	-	-0.215 (2.15)	-	-0.215 (2.15)	-	-0.215 (2.15)	-	-0.215 (2.15)
Dummy (use LRT_BRTLRT)	-	-0.278 (1.86)	-	-0.278 (1.86)	-	-0.278 (1.86)	-	-0.278 (1.86)	-	-0.278 (1.86)
Summary Statistics										
Log-likelihood at zero					-5104.34					
Log-likelihood at convergence					-4922.79					
McFadden Pseudo R^2					0.036					
Info. Criterion AIC					-1.338					
Sample Size (number of observations)					7420					

Table A2. Willingness to pay estimates Model (without ANA)

WTP higher construction cost (AUD$m)[12] to…	Australia		US	France		Portugal	U.K.
	BRT	LRT	LRT	BRT	LRT	LRT	LRT
Reduce the construction time in one year	$1.03	$0.22	$0.13	-	$0.22	$0.22	$1.16
Increase the population serviced in 1%	$0.54	-	-	$1.03	-	-	-
Reduce the annual operating costs in million $	$0.36	-	-	$0.35	-	-	-
Increase the service capacity in 1,000 passengers	$0.27	-	-	$0.22	-	-	-
Reduce the headway in off-peak hours by 1 minute	$0.51	-	-	-	-	-	-
Increase the travel time compared to the car in 1% quicker	$0.12	$0.09	-	-	-	-	-
Reduce the travel cost compared to the car in 1%	$0.08	$0.06	$0.04	$0.08	$0.06	$0.06	$0.06
Require prepaid ticket in the service	-	-	-	-$23.22	$19.04	-	-
Integrate fare availability	$5.34	-	-	-	-	-	-
Have staff presence on-board	-	$3.48	-	-	-	-	-
Have level boarding	$3.43	-	-	-	-	-	-
Increase the operation period assured in 1 year	$0.09	-	-	$0.09	-	-	-
Decrease in 1% the risk of being closed after assured period	-	-	-	-	-	$0.10	-
Have a medium level of business attracted to the station/stop	-	-	-	-	-	-	$3.15
Have a high level of business attracted to the station/stop	-	-	-	-	-	-	$6.94
Increase in 1% the cars switched to this mode	-	-	-	$0.36	-	-	-

12 WTP are presented as AUD$ June 2014.

Appendix B: Assessing Overall Preference Differences across Countries

This appendix seeks to understand the overall preference differences across countries. To do so, we estimated a utility function for each individual for each of BRT and LRT and ran a linear regression of these utility differences (U_{BRT}-U_{LRT}) as a function of the countries or cities and other socioeconomic characteristics. Gender was the only socioeconomic characteristic that is statistically significant for both models. Given that some parameter estimates are random distributions, we used 15 draws to estimate a utility function for each individual. Table A shows the results for these linear regressions including all the countries or all the cities, plus gender. For the cities model, Newcastle was defined as the base, and for the countries model, the U.K. is the base.

Table B. Linear regression results

	Without ANA		**ANA**	
	Cities	**Countries**	**Cities**	**Countries**
Constant	-0.051 (1.89)	-0.028 (1.65)	-0.063 (2.17)	-0.047 (2.65)
Cities				
Sydney	-0.114 (3.09)		-0.080 (2.29)	
Melbourne	-0.071 (1.91)		-0.036 (1.02)	
Canberra	-0.096 (1.79)		-0.077 (1.60)	
Adelaide	-0.140 (2.33)		-0.112 (2.38)	
Brisbane	0.008 (0.22)		0.015 (0.42)	
Perth	0.069 (1.12)		0.040 (0.81)	
Darwin	-0.196 (2.30)		-0.090 (1.11)	
Hobart	-0.025 (0.29)		-0.041 (0.61)	
Boston	-0.196 (5.22)		-0.202 (5.11)	
Los Angeles-Long Beach	-0.180 (5.43)		-0.173 (4.83)	
Seattle-Bellevue-Everett	-0.144 (3.36)		-0.178 (3.66)	
Minneapolis – St Paul	-0.134 (3.00)		-0.174 (3.65)	
Dallas – Fort Worth	-0.178 (4.59)		-0.183 (4.20)	
Philadelphia	-0.152 (4.03)		-0.193 (4.62)	
Lisbon	-0.335 (10.22)		-0.106 (3.07)	
Lyon	-0.167 (3.67)		-0.323 (6.57)	
Toulouse	-0.040 (0.85)		-0.232 (4.66)	
Birmingham	0.036 (1.14)		0.025 (0.74)	
Countries				
Australia		-0.091 (4.48)		-0.061 (3.16)
U.S.		-0.194 (10.34)		-0.201 (9.89)
France		-0.135 (4.35)		-0.299 (9.05)
Portugal		-0.360 (14.53)		-0.123 (4.82)
Socioeconomic characteristics				
Gender female	0.085 (5.89)	0.087 (5.99)	0.115 (7.98)	0.117 (8.08)
Adjusted R-squared	**0.0319**	**0.0325**	**0.0319**	**0.0314**

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