Australasian Transport Research Forum 2012 Proceedings
26 - 28 September 2012, Perth, Western Australia
Publication website: http://www.patrec.org/atrf.aspx

Public transport use in Australia's capital cities: Modelling and forecasting

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Abstract

Australia is one of the most urbanised countries in the world. Urban public transport is critical to Australia's transport system and essential to the economic and social quality of life of metropolitan citizens.

Public passenger transport in Australia's capital cities has been undergoing resurgence for at least the last decade, as a result of population growth and lower urban public transport (UPT) real fares. However, the recent sharp increases in public transport patronage, well in excess of population growth, have been driven by pressures on household budgets.

Modelling the share of UPT by capital cities requires two main variables, namely real fares and the 'discretionary income constraint' variable or DIC. The DIC variable is a derivative of several household costs, such as mortgage, rent, food, petrol and household savings.

Accurate forecasts of future public transport patronage are critical in forward planning, particularly because investments in rolling stock and infrastructure can be of considerable cost and can have long lead times in project delivery. To this end, the paper presents modelling and long–term forecasts (base case) for urban public transport use in Australia's capital cities. Modelling was done using data from 1977 to 2010 and forecasts were derived for 2011 to 2030.

Due to uncertainty as to the future for petrol prices and urban public transport (UPT) fares, a sensitivity analysis was done to examine the possible effects of high and low petrol prices, high UPT fares and a persistent effect of the Global Financial Crisis (GFC) on the future UPT tasks in all capital cities.

1. Introduction

Australia's capital cities are the engine rooms for economic growth and innovation. Over half (53 per cent) of Australia's economic activity occurs in Sydney, Melbourne and Brisbane, and a further 15 per cent in Perth and Adelaide (Commonwealth of Australia 2010). Between 2001 and 2006, the capital cities were associated with three-quarters of the growth in the national economy (Raskall 2010).

Over the past century, Australia has seen a marked change in the nature of urban public transport. BTRE (2008) reported that total motorised passenger travel in the urban areas has grown remarkably— almost ten-fold over the 65 years since the end of the Second World War. But private road vehicles currently represent about 90 per cent of city motorised passenger transport and urban public transport about 10 per cent. Recently, Cosgrove (2011) discussed a variety of urban public transport issues in Australian cities, including past effects of transport reforms on passenger modal choice; the influence of fuel price or UPT fare variations; the results of changes to infrastructure provision; congestion impacts on travel behaviour; economic effects on travel patterns; and the possible extent of future patronage growth for public transport in Australian cities.

However, the public transport system is unquestionably an important part of the transport task and effective public transport systems offer compelling benefits for the Australian community and environment. But Australian capital cities rely heavily on private motor vehicle transport, especially cars, for routine journeys, such as travel to place of work or study.

Although people's choice of different modes of transport depend on individual preferences (Victorian Department of Transport 2010), effective public transport systems offer compelling benefits for the Australian economy, community and environment (ARA 2007, Commonwealth of Australia 2009). Despite this, Australian capital cities are suffering an economic and social burden from increased road congestion. Public transport can play a key role in easing traffic congestion, thereby improving city liveability and reducing the required expenditure on roads (ARA 2006).

Understanding the determinants of the past urban public transport task is important for determining the likely future needs for infrastructure development and investment as well as for congestion amelioration and road safely. Allsop (2008) stated that the modelling of transport systems and their use has two main purposes, as follows:

1. to estimate features of an existing transport system and its use that are difficult to observe, and
2. to estimate features of a transport system and its use in circumstances that do not yet exist.

The main objectives of this study are:

- to model capital city public transport tasks in Australia between 1976–77 (hereafter termed as 1977) and 2009–10 (hereafter termed as 2010), and
- to produce long–term forecasts from 2010–11 (hereafter termed as 2011) to 2029–30 (hereafter termed as 2030).

The models explain the UPT share of the total passenger task (UPT plus private) as a function of DIC and real UPT fares. The discretionary income constraint variable is a derivative of several costs, such as mortgage, rent, food, petrol and household saving.

In addition, a sensitivity analysis is carried out to assess the possible effect of high and low petrol prices, high UPT fares and a persistent GFC effect on the future UPT tasks in all capital cities.

This paper is based on a forthcoming BITRE Report with the same title (BITRE 2012a).

2. Data sources

Data for UPT and total passenger task in eight capital cities are sourced from BITRE Report 129 (BITRE 2012a).

The parameters used in modelling the UPT shares include the household discretionary income constraint and UPT fares. The discretionary income constraint variable is a derivative of several costs, such as mortgage, rent, food, petrol, and household savings. A number of data sources were used to obtain these factors, including

- Nominal fare index– Consumer Price Index (CPI) sourced from the ABS ‘Consumer Price Index, Australia’ publication (ABS Cat. No. 6401.0, various issues).
- CPI was sourced from the ABS ‘Consumer Price Index, Australia’ publication (ABS Cat. No. 6401.0, various issues).
- Rents and house prices were sourced from ‘Real estate market facts: a quarterly review of major residential property markets in Australia’ publication (several issues) (Real Estate Institute of Australia).
- Savings rates were sourced from the ABS ‘Australian National Accounts: National Income, Expenditure and Product’ (ABS Cat. No. 5206.0, various issues).

3. Methodologies of the study

3.1 Variables used for modelling

Modelling the share of UPT in the total passenger task by capital city required two main variables, namely real UPT fares and discretionary income constraint. Details of the calculation of these two variables are given below.

3.1.1 Calculation of real fare

The real UPT fare index for each capital city was calculated as:

Real fare index = Nominal fare index / Consumer Price Index (CPI) *100

In this exercise, nominal fares and CPI were indexed (1989–90 = 100).

3.1.2 Calculation of discretionary income constraint (DIC)

Calculation of discretionary income constraint (or real weekly budget cost) is a complex procedure. It requires a number of different datasets, such as costs of petrol, food, rent/mortgage, savings rate and CPI index.

Discretionary income constraint in terms of real $/week/household for each of the eight capital cities was calculated in three steps, as follows:

Step 1: Nominal weekly cost (nominal $/week/household)
= PC+FC+((RC+MC)/2)

Step 2: Real weekly cost (real $/week/household)
= (Nominal weekly cost ($/week/household) / (CPI*100)

Step 3: Weekly discretionary income constraint (real $/week/household)
= (Real weekly cost ($/week/household)) * (1+SR/100)

where
DIC = Discretionary income constraint (real $/week/household)
PC = Petrol cost ($/week/household)
FC = Food cost ($/week/household)
RC = Rent cost ($/week/household)
MC = Mortgage cost ($/week/household)
CPI = (GST/Medicare adjusted CPI)
SR = Savings rate (per cent).

3.2 Modelling methodology

Due to the nature of the data, the UPT shares (UPTS – the dependent variable) for each capital city between 1977 and 2010, real fares and discretionary income constraint (RF and DIC - the two main independent variables) were all transformed into logarithmic values for the regression analyses. Also, different dummies were used, depending on the capital city (i.e. capital city–specific dummies). For example, an Olympic dummy was used for Sydney (2000–01), a Melbourne dummy (from 1988-89 to 1990-91), a Bicentennial celebration dummy (Expo88) for Brisbane (1987-88 and 1988-89), a rail dummy for Perth (from 1994 to 2010). Due to the lag in supply expansion (i.e. effect of discretionary income constraint), a specific dummy (SupplyLag) was used for Melbourne (2005-07) and Perth (2006-08). Different time trends were also used for Brisbane, Adelaide, Hobart and Darwin. Again, depending on the nature of data, specific ‘year’ dummies were used for each capital city.

Separate models were estimated for each capital city due to fundamental differences between capital cities in the nature of their UPT travel demands. The eight models used were of the following forms:

For Sydney,
$LnUPTS = i+a1*LnRF+a2*LnDIC+a3*OLYMDUM+a4*DUM_{(77\text{-}83)}+a5*DUM_{(04\text{-}10)}$

For Melbourne,
LnUPTS = i+a1*LnRF+a2*LnDIC+a3*DUM$_{(77-81)}$+a4*DUM(SupplyLag)+a5*Mel-DUM$_{(89-91)}$

For Brisbane,
LnUPTS = i+a1*LnRF+a2*LnDIC+a3*BICENTDUM+a4*TIME

For Adelaide,
LnUPTS = i+a1*LnRF+a2*LnDIC+a3*TIME+a4*DUM$_{(81-85)}$

For Perth,
LnUPTS = i+a1*LnRF+a2*LnDIC+a3*RAILDUM+a4*DUM(SupplyLag) +a5*DUM$_{(89-91,97)}$

For Hobart,
LnUPTS = i+a1*LnRF+a2*LnDIC+a3*TIME+a4*DUM$_{(77-81)}$

For Darwin,
LnUPTS = i+a1*LnRF+a2*LnDIC+a3*TIME

For Canberra,
LnUPTS = i+a1*LnRF+a2*LnDIC+a3*DUM$_{(77-82)}$+a4*DUM$_{(96-10)}$+a5*DUM$_{(97-98)}$

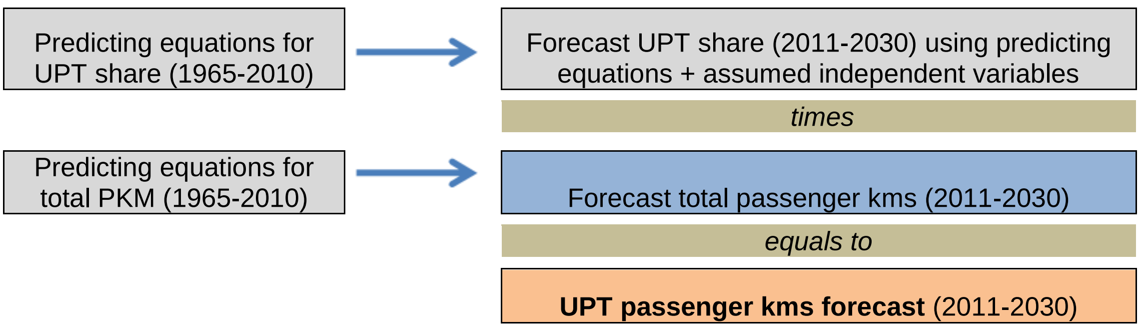
where

LnUPTs	= Log of UPT share in the capital city
i	= Intercept
a1 ... a5	= Estimated coefficients
LRF	= Log of the real urban transport fare
LnDIC	= Log of discretionary income constraint
OLYMDUM	= Olympic dummy (for Sydney)
Mel-DUM	= Melbourne dummy
BICENTDUM	= Bicentennial celebration dummy (for Brisbane)
RAILDUM	= Rail dummy (for Perth)
TIME	= A time trend for Brisbane (77-78), Adelaide (77-10), Hobart (77-10) and Darwin (77-91, then kept same)
DUM(SupplyLag)	= SupplyLag dummy (due to lag in supply expansion for Melbourne and Perth)
DUM	= Year specific dummy, as mentioned in the above equations.

3.3 Forecasting methodology

Forecast UPT shares between 2011 and 2030 were obtained from the predicted equations for UPT share (1977–2010) and assumed values of independent variables (i.e. constant real fares and DIC). Forecasts of total passenger kilometres were derived from city models outlined in BITRE (2012c), where real petrol prices and unemployment were kept constant and the GFC effect wore off by 2020. The forecast UPT shares were then multiplied by forecast total passenger kilometres which gave the UPT task forecasts in terms of passenger kilometres. The schematic diagram for forecasting UPT passenger task between 2011 and 2030 is shown in Figure1.

Figure 1 Schematic diagram showing steps for forecasting UPT task in capital cities.



In other words, forecast of UPT task can be calculated from the following simple equation:

$UPT_{Forecast} = Total_{Forecast} * UPT_{Share}/100$

where

$UPT_{Forecast}$ = UPT passenger task (billion PKM)
$Total_{Forecast}$ = Total passenger task (billion PKM)
UPT_{Share} = UPT share (per cent).

4. Results and forecasts

4.1 Modelling results

Equations for determining the (log of) UPT share were estimated for all capital cities. Results for Melbourne are presented in Table 1. Regression coefficients for real fares and discretionary income constraint for all capital cities are provided in Table 2.

Figure 2 shows Melbourne's UPT share, real fares and DIC variables.

As can be seen from Table 1 for Melbourne, the results of the model show highly significant effects (p = <0.001) for all independent variables. The discretionary income constraint coefficient is estimated to be around 0.959 (p = <0.001).

The regression equations are of a double log form (see Table 1), and thus the coefficients represent elasticities. The elasticities of the real UPT fares varied from -0.0762 (for Sydney) to -0.6484 (for Perth) (Table 2). The elasticities of the real UPT fares are highly significant (p<0.001) for Melbourne, Brisbane, Adelaide, Perth and Canberra, while the elasticities for Sydney, Hobart and Darwin came out as insignificant (p>0.05).

Similarly, the elasticities of the discretionary income constraint varied from 0.0599 (Darwin) to 0.9587 (Melbourne) (Table 2). The elasticities of discretionary income constraint were highly significant for all capital cities (p<0.001), except for Darwin and Canberra (p>0.05).

The fit for the models of actual UPT shares for all eight capital cities are shown in Figure 3.

Table 1 Regression results for modelling UPT share (per cent), Melbourne, 1977–2010

Dependent variable: LnUPTS Melbourne

Regression Statistics	
Multiple R	0.984187
R Square	0.968624
Adjusted R Square	0.963021
Standard Error	0.022972
Observations	34

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	0.45617	0.09123	172.87926	3.84E-20
Residual	28	0.01478	0.00053		
Total	33	0.47094			

	Coefficients	*Std. Error*	*t-Statistics*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-2.37802	0.24159	-9.84320	1.36E-10	-2.87289	-1.88314
Ln(Real fares)	-0.25686	0.04025	-6.38114	6.60E-07	-0.33931	-0.17440
Ln(DIC)	0.95869	0.04372	21.93056	3.57E-19	0.86914	1.04824
Dummy (77-81)	0.07061	0.00417	16.93382	3.03E-16	0.06207	0.07915
Dummy (SupplyLag)	-0.03800	0.01539	-2.46920	0.01991	-0.06953	-0.00648
Melbourne Dummy	-0.21002	0.02367	-8.87380	1.26E-09	-0.25849	-0.16154

Table 2 Regression coefficients for real fares and discretionary income constraint and coefficients of determination (R^2), all capital cities

Capital city	Real fares			Discretionary income constraint (DIC)			R^2
	Coefficient	t-statistics	p-value	Coefficient	t-statistics	p-value	
Sydney	-0.07624	-2.01869	0.05319	0.24280	4.51046	0.00011	0.7776
Melbourne	-0.25686	-6.38114	0.00000	0.95869	21.93056	0.00000	0.9686
Brisbane	-0.10463	-3.49143	0.00156	0.60995	11.28789	0.00000	0.8660
Adelaide	-0.48667	-6.35409	0.00000	0.31560	4.07376	0.00033	0.8732
Perth	-0.64837	-11.22689	0.00000	0.50293	8.61738	0.00000	0.9256
Hobart	-0.38886	-1.78982	0.08393	0.30529	3.03695	0.00501	0.9798
Darwin	-0.11979	-1.51545	0.14013	0.05994	0.61825	0.54108	0.9582
Canberra	-0.42852	-9.62645	0.00000	0.08853	1.66378	0.10731	0.9055

Figure 2 Actual UPT share (per cent), real fares (cents) and discretionary income constraint (DIC) (real $/week/household), Melbourne, 1977–2010

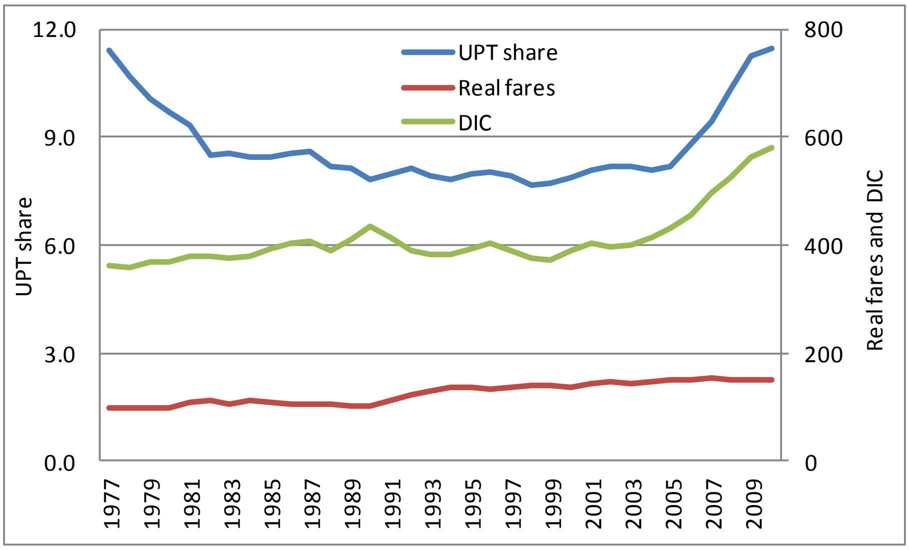
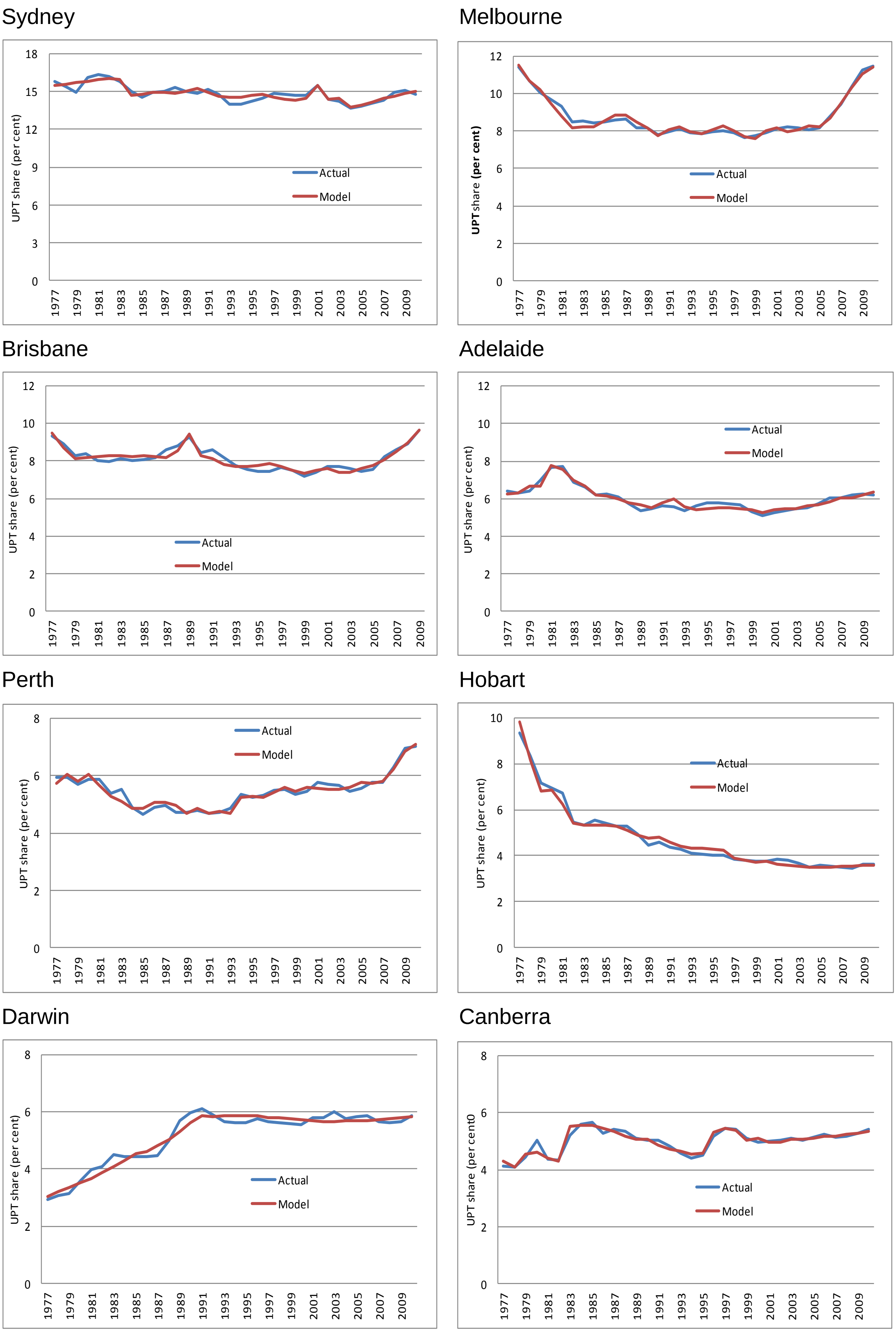


Figure 3 Actual and modelled UPT share (per cent), all capital cities, 1977–2010



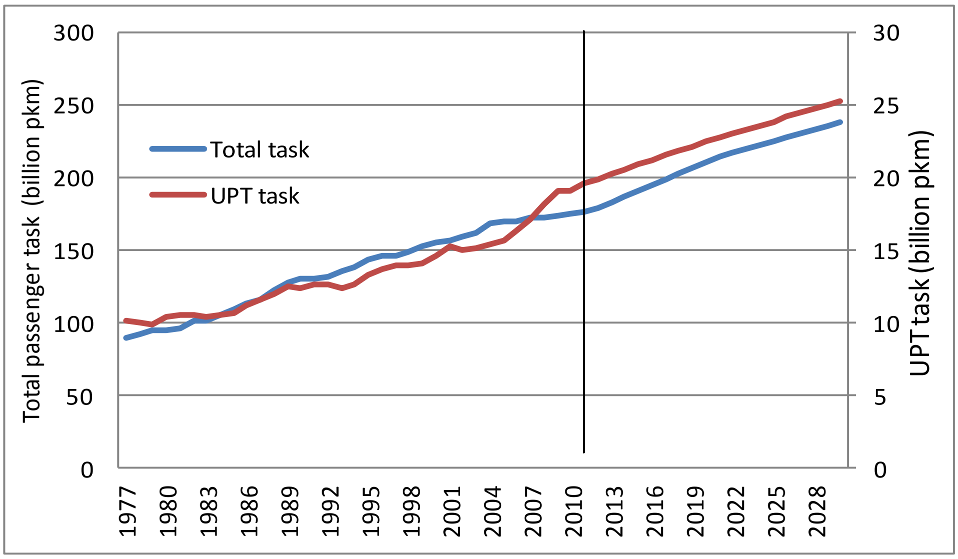
4.2 Total passenger (private plus UPT) and UPT tasks: estimates (1977–2010) and forecasts (2011–2030)

4.2.1 Total (sum of all) capital cities

Between 1977 and 2010, total passenger task (both public and private) nearly doubled, from 89.1 billion PKM to 174.9 billion PKM (Figure 4), an average annual growth rate of 2.07 per cent. This growth has been driven by increases in population, vehicle ownership, increasing incomes and urban decentralisation. However, during the last decade (2001–2010), the growth slowed down to an average annual growth rate of 1.27 per cent. This slower growth is mainly due to petrol price rises plus the effects of the global financial crisis.

The total passenger task is forecast to increase by more than 35 per cent over the next two decades, from 176.2 billion PKM in 2011 to 238.8 billion PKM in 2030 (Figure 4). The average annual growth rate is forecast at 1.61 per cent. Catering for this forecast increase in the total passenger transport task will present a significant challenge within urban areas.

Figure 4 Total passenger and UPT task (billion PKM), all capital cities, 1977–2030



Note: Data from 1977 to 2010 are estimates, while from 2011 to 2030 are forecasts.

Although there were several plateaus between 1977 and 2010 (due mainly to economic slowdowns), total (sum of all capital cities) UPT task increased from 10.1 billion PKM in 1977 to 19.1 billion PKM in 2010 (Figure 4), an average annual growth rate of 1.96 per cent.

Between 2011 and 2030, the total UPT task is forecast to grow from 19.59 billion PKM to 25.28 billion PKM (Figure 5). This equates to an average annual growth rate of 1.35 per cent per annum, which is slower than the historical growth rate of 1.96 per cent per annum. This forecast increase of UPT task is due mainly to the projected population growth in capital cities. The UPT task as a share of the total passenger task is forecast to decline slightly; from 11.1 per cent in 2011 to 10.6 per cent in 2030 (see Table 5, last column).

It is interesting to note that, during the last decade (2001–2010), total UPT task increased sharply, on average by 2.57 per cent per annum, which is well above population growth (1.58 per cent) during the same period. The UPT mode share increased from 9.8 per cent to 10.9 per cent. The key determinants of this growth were falling real UPT fares and increasing discretionary income constraints (including the effects of the global financial crisis on the savings rate).

4.2.2 Individual capital cities

Table 3 provides estimates and forecasts of the total urban (UPT plus private) passenger task and the UPT task for each of the eight capital cities.

Between 1977 and 2010, among the five large capital cities (i.e. Sydney, Melbourne, Brisbane, Adelaide and Perth), the total urban passenger transport tasks were much higher in two largest capital cities (i.e. Sydney and Melbourne), while total urban passenger transport tasks were much lower in three minor capital cities (i.e. Hobart, Darwin and Canberra). During this period, the average annual growth rates among five large capital cities show that Brisbane had the highest growth rate (3.02 per cent), followed by Perth (2.56 per cent), while Adelaide had the lowest growth rate (1.23 per cent). Similarly, the average annual growth rate of total passenger task in three small capital cities was highest in Darwin (3.07 per cent), followed by Canberra (2.42 per cent) and lowest in Hobart (1.51 per cent).

During the late 1970s and early 1980s, the level of the UPT task decreased in Melbourne and then increased gradually until 2005, followed by a sharp increase until 2010. In contrast, the UPT task in Sydney increased gradually during this period, although there were a few decreases. However, between 1977 and 2010, the average annual growth rates of UPT task among five large capital cities show that Perth had the highest growth rate (3.09 per cent), closely followed by Brisbane (3.02 per cent) and lowest in Adelaide (1.14 per cent). UPT tasks were much lower in three minor capital cities (i.e. Hobart, Darwin and Canberra), with only bus systems for urban public transport in these three cities. The average annual growth rate of the UPT passenger task in the three small capital cities was highest in Darwin (5.28 per cent), followed by Canberra (3.27 per cent), while the UPT passenger task showed negative growth in Hobart (-1.34 per cent).

Between 2011 and 2030, among the five large capital cities, the total (private plus UPT) passenger task is forecast to grow from 56.37 billion PKM to 71.47 billion PKM in Sydney, from 50.04 billion PKM to 68.48 billion PKM in Melbourne, from 25.44 billion PKM to 39.99 billion PKM in Brisbane, from 13.88 billion PKM to 16.19 billion PKM in Adelaide and from 22.04 billion PKM to 31.69 billion PKM in Perth. Similarly, among three small capital cities, total passenger task is forecast to grow from 2.42 billion PKM to 2.91 billion PKM in Hobart, from 1.17 billion PKM to 1.75 billion PKM in Darwin and from 4.88 billion PKM to 6.29 billion PKM in Canberra during the same period. The average annual growth rates, among the five large capital cities, are expected to be highest in Brisbane (3.02 per cent) followed by Perth (2.56 per cent) and lowest in Adelaide (1.23 per cent), while Sydney and Melbourne will have average annual growth rates of 1.85 per cent and 1.96 per cent, respectively. Similarly, among three small capital cities, the average annual growth rate of total passenger task is expected to be higher in Canberra (3.27 per cent), followed by Darwin (3.07 per cent) and lowest in Hobart (1.51 per cent).

Between 2011 and 2030, among the five large capital cities, the UPT task (in passenger kilometres or PKM) is forecast to grow from 8.49 billion PKM to 10.55 billion PKM in Sydney, from 5.83 billion PKM to 7.35 billion PKM in Melbourne, from 2.48 billion PKM to 3.71 billion PKM in Brisbane, from 0.89 billion PKM to 0.99 billion PKM in Adelaide and from 1.50 billion PKM to 2.14 billion PKM in Perth. Similarly, among three small capital cities, UPT passenger task is forecast to grow from 0.08 billion PKM to 0.10 billion PKM in Hobart, from 0.07 billion PKM to 0.10 billion PKM in Darwin and from 0.26 billion PKM to 0.33 billion PKM in Canberra. During this forecast period, among the five large capital cities, the average annual growth rates of the UPT task are expected to be highest in Brisbane (2.14 per cent) followed by Perth (1.90 per cent) and lowest in Adelaide (0.55 per cent), while Sydney and Melbourne will have average annual growth rates of 1.15 per cent and 1.23 per cent, respectively. Similarly, among three small capital cities, the average annual growth rate of the UPT task is expected to be higher in Darwin (2.20 per cent) followed by Canberra (1.34 per cent) and lowest in Hobart (0.97 per cent).

Between 1977 and 2010, the UPT shares of the total passenger task decreased in Sydney, Adelaide and Hobart, but increase in other capital cities, except Brisbane, which was stable (Table 4). The UPT shares are expected to decline slightly during the next 20 years, from 2011 to 2030.

Table 3 Total and UPT tasks (billion PKM), all capital cities, 1977–2030

Year	Sydney		Melbourne		Brisbane		Adelaide		Perth	
	Total	UPT	Total	UPT	Total	UPT	Total	UPT	Total	UPT
1977	30.51	4.81	26.28	3.00	9.41	0.88	9.31	0.60	9.46	0.56
1978	31.21	4.80	27.22	2.90	9.84	0.87	9.56	0.60	9.92	0.59
1979	32.03	4.80	27.89	2.81	10.25	0.85	9.61	0.62	10.18	0.58
1980	32.71	5.28	27.94	2.70	10.47	0.88	9.44	0.66	10.23	0.60
1981	33.29	5.45	28.39	2.65	10.86	0.87	9.38	0.72	10.33	0.61
1982	34.51	5.58	29.79	2.53	11.65	0.93	9.72	0.75	10.81	0.58
1983	34.11	5.40	30.01	2.56	11.88	0.96	9.69	0.67	10.89	0.60
1984	35.52	5.34	31.15	2.62	12.42	0.99	10.13	0.67	11.50	0.56
1985	36.92	5.36	32.21	2.72	12.84	1.04	10.50	0.65	11.88	0.55
1986	38.06	5.68	33.49	2.87	13.50	1.11	10.81	0.67	12.29	0.60
1987	38.86	5.84	34.48	2.97	13.89	1.19	10.97	0.67	12.58	0.62
1988	40.61	6.22	36.08	2.95	14.73	1.29	11.34	0.65	13.17	0.62
1989	41.97	6.31	37.83	3.09	15.79	1.47	11.72	0.63	13.83	0.65
1990	42.84	6.38	38.55	3.01	16.15	1.36	11.91	0.65	14.23	0.68
1991	42.84	6.50	38.33	3.06	16.42	1.41	11.81	0.66	14.10	0.66
1992	43.32	6.41	38.88	3.16	16.98	1.39	11.89	0.66	14.30	0.68
1993	44.17	6.19	39.55	3.13	17.73	1.38	12.07	0.65	14.82	0.72
1994	45.18	6.31	40.29	3.16	18.30	1.38	12.12	0.68	15.73	0.84
1995	46.69	6.66	41.53	3.31	19.08	1.42	12.26	0.71	16.72	0.88
1996	47.12	6.82	42.26	3.39	19.57	1.46	12.22	0.71	17.10	0.91
1997	47.27	7.03	42.57	3.37	19.78	1.51	12.26	0.70	17.29	0.95
1998	47.91	7.09	43.25	3.31	20.16	1.52	12.42	0.70	17.52	0.97
1999	49.01	7.20	44.42	3.43	20.49	1.47	12.78	0.68	17.93	0.96
2000	50.25	7.39	45.50	3.59	21.12	1.56	13.16	0.67	18.20	0.99
2001	50.42	7.79	45.67	3.70	21.25	1.64	13.14	0.69	18.05	1.04
2002	50.83	7.32	46.59	3.82	21.94	1.69	13.34	0.72	18.43	1.05
2003	51.54	7.32	47.44	3.88	22.57	1.72	13.78	0.75	18.91	1.07
2004	53.73	7.36	48.97	3.96	24.04	1.79	13.94	0.77	19.82	1.08
2005	54.06	7.46	49.25	4.02	24.26	1.84	13.69	0.78	20.13	1.12
2006	53.97	7.59	49.27	4.34	24.47	2.01	13.59	0.82	19.95	1.15
2007	54.62	7.80	49.92	4.71	25.03	2.15	13.71	0.83	20.36	1.18
2008	54.75	8.16	50.34	5.21	25.33	2.26	13.63	0.84	20.73	1.30
2009	55.11	8.32	49.76	5.60	25.03	2.42	13.71	0.86	21.44	1.49
2010	55.81	8.24	49.87	5.71	25.08	2.35	13.93	0.87	21.80	1.53
2011	56.37	8.49	50.04	5.83	25.44	2.48	13.88	0.89	22.04	1.50
2012	57.21	8.60	51.16	5.92	26.10	2.54	13.97	0.89	22.48	1.53
2013	58.16	8.73	52.38	6.01	26.96	2.61	14.16	0.90	23.09	1.57
2014	59.08	8.85	53.58	6.11	27.81	2.68	14.34	0.91	23.69	1.61
2015	59.97	8.97	54.77	6.19	28.62	2.74	14.51	0.91	24.29	1.65
2016	60.87	9.08	55.98	6.28	29.44	2.81	14.68	0.92	24.89	1.69
2017	61.75	9.20	57.17	6.37	30.25	2.87	14.83	0.92	25.49	1.73
2018	62.60	9.31	58.35	6.45	31.07	2.93	14.99	0.92	26.07	1.77
2019	63.46	9.42	59.55	6.53	31.91	3.00	15.14	0.93	26.65	1.81
2020	64.32	9.52	60.76	6.61	32.76	3.06	15.29	0.94	27.23	1.85
2021	65.19	9.63	61.98	6.69	33.63	3.13	15.45	0.94	27.82	1.89
2022	65.88	9.74	62.70	6.77	34.31	3.19	15.53	0.95	28.26	1.92
2023	66.57	9.84	63.42	6.84	34.99	3.25	15.62	0.95	28.70	1.95
2024	67.27	9.94	64.14	6.91	35.68	3.32	15.71	0.96	29.13	1.98
2025	67.96	10.04	64.86	6.99	36.38	3.38	15.79	0.96	29.56	2.00
2026	68.66	10.14	65.59	7.06	37.09	3.44	15.88	0.97	29.98	2.03
2027	69.36	10.24	66.31	7.13	37.80	3.51	15.96	0.97	30.40	2.06
2028	70.06	10.34	67.03	7.21	38.53	3.57	16.04	0.98	30.81	2.09
2029	70.77	10.45	67.76	7.28	39.26	3.64	16.12	0.98	31.21	2.11
2030	71.47	10.55	68.49	7.35	39.99	3.71	16.19	0.99	31.69	2.14
Average annual growth rate (per cent)										
1977-2010	1.85	1.65	1.96	1.97	3.02	3.02	1.23	1.14	2.56	3.09
2011-2030	1.26	1.15	1.67	1.23	2.41	2.14	0.82	0.55	1.93	1.90

(continued)

Table 3 Total and UPT tasks (billion PKM), all capital cities, 1977–2030 (continued)

Year	Hobart		Darwin		Canberra		All capitals	
	Total	UPT	Total	UPT	Total	UPT	Total	UPT
1977	1.48	0.14	0.41	0.01	2.21	0.09	89.07	10.09
1978	1.54	0.13	0.43	0.01	2.31	0.09	92.03	10.00
1979	1.58	0.11	0.46	0.01	2.40	0.11	94.41	9.89
1980	1.60	0.11	0.48	0.02	2.44	0.12	95.29	10.37
1981	1.63	0.11	0.51	0.02	2.46	0.11	96.84	10.53
1982	1.68	0.09	0.56	0.02	2.60	0.11	101.31	10.60
1983	1.67	0.09	0.57	0.03	2.66	0.14	101.48	10.45
1984	1.75	0.10	0.62	0.03	2.81	0.16	105.91	10.48
1985	1.83	0.10	0.67	0.03	2.96	0.17	109.79	10.62
1986	1.90	0.10	0.72	0.03	3.08	0.16	113.86	11.23
1987	1.91	0.10	0.75	0.03	3.16	0.17	116.60	11.61
1988	1.96	0.10	0.77	0.04	3.34	0.18	122.00	12.05
1989	2.03	0.09	0.79	0.04	3.52	0.18	127.49	12.46
1990	2.12	0.10	0.81	0.05	3.66	0.18	130.26	12.42
1991	2.13	0.09	0.81	0.05	3.70	0.19	130.13	12.62
1992	2.16	0.09	0.83	0.05	3.80	0.18	132.17	12.62
1993	2.24	0.09	0.85	0.05	3.95	0.18	135.37	12.38
1994	2.29	0.09	0.87	0.05	4.05	0.18	138.83	12.70
1995	2.33	0.09	0.93	0.05	4.17	0.19	143.69	13.31
1996	2.35	0.09	0.97	0.06	4.23	0.22	145.81	13.65
1997	2.34	0.09	0.99	0.06	4.24	0.23	146.74	13.93
1998	2.30	0.09	1.01	0.06	4.25	0.23	148.82	13.96
1999	2.29	0.09	1.02	0.06	4.34	0.22	152.28	14.10
2000	2.30	0.09	1.03	0.06	4.42	0.22	155.98	14.57
2001	2.24	0.09	1.00	0.06	4.35	0.22	156.11	15.22
2002	2.28	0.09	1.01	0.06	4.44	0.22	158.86	14.96
2003	2.36	0.09	1.02	0.06	4.58	0.23	162.20	15.12
2004	2.47	0.09	1.06	0.06	4.78	0.24	168.80	15.35
2005	2.43	0.09	1.04	0.06	4.78	0.25	169.64	15.61
2006	2.43	0.09	1.05	0.06	4.77	0.25	169.51	16.31
2007	2.46	0.09	1.08	0.06	4.80	0.25	172.00	17.06
2008	2.45	0.08	1.11	0.06	4.78	0.25	173.12	18.17
2009	2.41	0.09	1.13	0.06	4.83	0.25	173.43	19.09
2010	2.42	0.09	1.12	0.07	4.87	0.26	174.91	19.12
2011	2.42	0.08	1.17	0.07	4.88	0.26	176.24	19.59
2012	2.45	0.09	1.18	0.07	4.96	0.26	179.50	19.90
2013	2.48	0.09	1.22	0.07	5.06	0.27	183.51	20.25
2014	2.51	0.09	1.27	0.07	5.15	0.27	187.44	20.59
2015	2.55	0.09	1.31	0.08	5.25	0.28	191.27	20.91
2016	2.58	0.09	1.35	0.08	5.34	0.28	195.13	21.24
2017	2.61	0.09	1.39	0.08	5.43	0.29	198.92	21.55
2018	2.64	0.09	1.43	0.08	5.52	0.29	202.66	21.85
2019	2.67	0.09	1.47	0.09	5.60	0.30	206.44	22.16
2020	2.70	0.09	1.51	0.09	5.69	0.30	210.27	22.47
2021	2.73	0.10	1.55	0.09	5.78	0.31	214.13	22.78
2022	2.75	0.10	1.57	0.09	5.84	0.31	216.84	23.06
2023	2.77	0.10	1.60	0.09	5.89	0.31	219.57	23.33
2024	2.79	0.10	1.63	0.10	5.95	0.32	222.29	23.61
2025	2.81	0.10	1.65	0.10	6.00	0.32	225.02	23.89
2026	2.83	0.10	1.67	0.10	6.06	0.32	227.76	24.16
2027	2.85	0.10	1.69	0.10	6.12	0.33	230.49	24.44
2028	2.87	0.10	1.71	0.10	6.18	0.33	233.23	24.72
2029	2.89	0.10	1.73	0.10	6.23	0.33	235.97	25.00
2030	2.91	0.10	1.75	0.10	6.29	0.33	238.79	25.28
Average annual growth rate (per cent)								
1977-2010	1.51	-1.34	3.07	5.28	2.42	3.27	2.07	1.96
2011-2030	0.97	0.97	2.12	2.20	1.35	1.34	1.61	1.35

Note: Data from 1977 to 2010 are forecasts, while from 2011 to 2030 are forecasts.

Table 4 UPT share (per cent), as total passenger task, all capital cities, 1977–2030

Year	UPT share (per cent), as total passenger task								
	Sydney	Melbourne	Brisbane	Adelaide	Perth	Hobart	Darwin	Canberra	All capitals
1977	15.8	11.4	9.4	6.4	5.9	9.3	2.9	4.1	11.3
2010	14.8	11.5	9.4	6.2	7.0	3.6	5.9	5.4	10.9
2011	15.1	11.6	9.7	6.4	6.8	3.5	5.8	5.3	11.1
2030	14.8	10.7	9.3	6.1	6.8	3.5	5.9	5.3	10.6

Note: Data from 1977 to 2010 are estimates, while from 2011 to 2030 are forecasts.

4.3 Sensitivity analysis

Four scenarios (excluding the 'Base' scenario) have been identified to carry out the sensitivity analysis. These four scenarios are based on increases/decreases in petrol prices and real fares, as well as an assumed ongoing GFC effect (meaning the savings rate stays high). The assumptions considered under these scenarios (Scenarios 2 to 5) are as follows:

Scenario 1: 'Base case', as outlined in Section 3.3.

Scenario 2: 'High petrol price' (see below).

Scenario 3: 'Low petrol price' (see below).

Scenario 4: 'High UPT fares' - These were assumed to increase by 50 per cent by 2030, from 2010 base, making them much higher than in the base case.

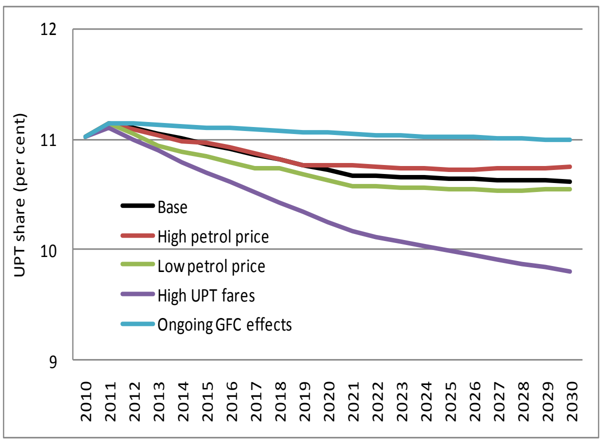
Scenario 5: 'Ongoing GFC effect' – Instead of wearing off by 2020, the 'GFC effect was assumed to persist for the whole forecast period, continuing its negative effect on the UPT task.

The 'High' and Low' petrol prices for each capital city were generated from the Australian 'real 2010 total petrol price', presented in BITRE Report (BITRE 2012b). 'Real 2010 total petrol price' for Australia was derived from the USDA forecasts of real exchange rates (USDA-ERA 2011). Excise was assumed to remain constant in nominal terms at the 2011 estimated amount. Sales tax rates were held constant at estimated 2011 values (for details, see BITRE 2012b).

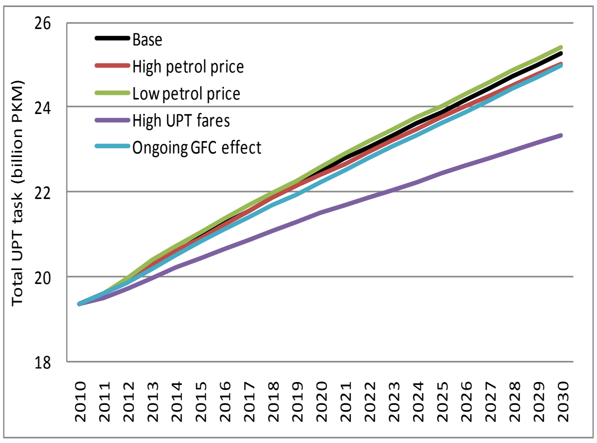
The results of a sensitivity analysis conducted using the models indicate that the total (sum of all capital cities) UPT task over the forecast period (2011–2030) would increase under a 'Low petrol price' scenario, decrease slightly under a 'High petrol price' scenario, and decrease significantly under 'High UPT fares' scenario compared with the 'Base' scenario, in terms of UPT share (Figure 5a) and UPT task (Figure 5b). (A 'low UPT fare' was not considered due to the already low cost recovery of UPT expenditures by governments).

Figure 5 Total UPT share (per cent) and task (billion PKM) by scenarios, total capital cities, 2010-2030

(a) UPT share



(b) UPT task



The size of the UPT task depends on two components. The first is the total passenger task in the city, and the second is UPT's share of this total task. Paradoxically, the decrease in total passenger task with a high petrol price outweighs the increase in UPT's share with a high petrol price. The result is a lower UPT task with high petrol price, and vice versa for a low petrol price. The effect of high petrol price on the size of the UPT task for total capital cities in 2030 is shown in Figure 6. Similar petrol price effects are also apparent in the high and low petrol price scenarios for all capital cities.

Figure 6 Effects of high petrol price on the size of the UPT task, total capital cities, 2030

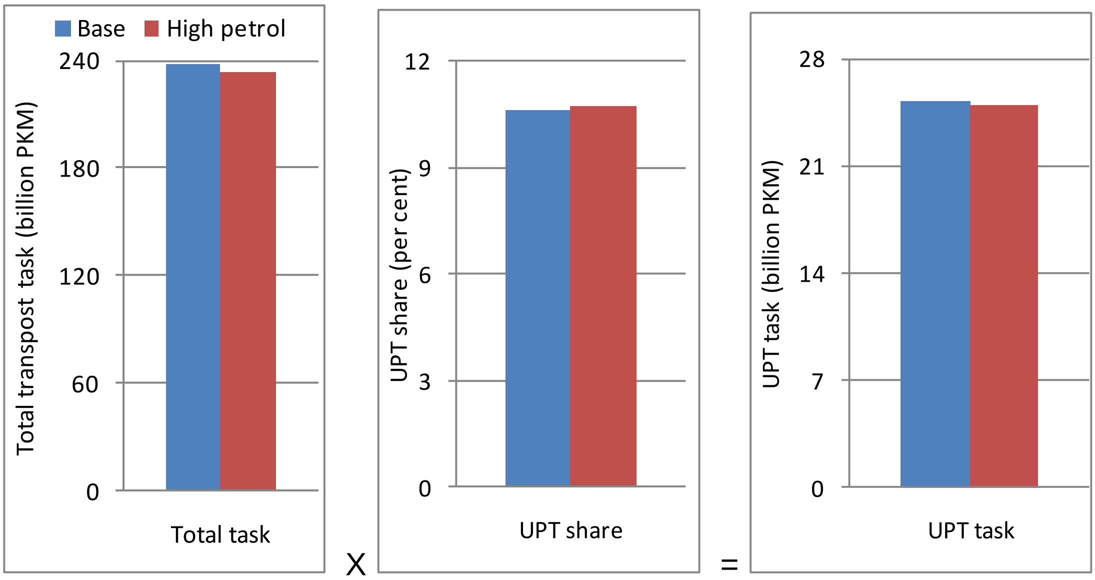


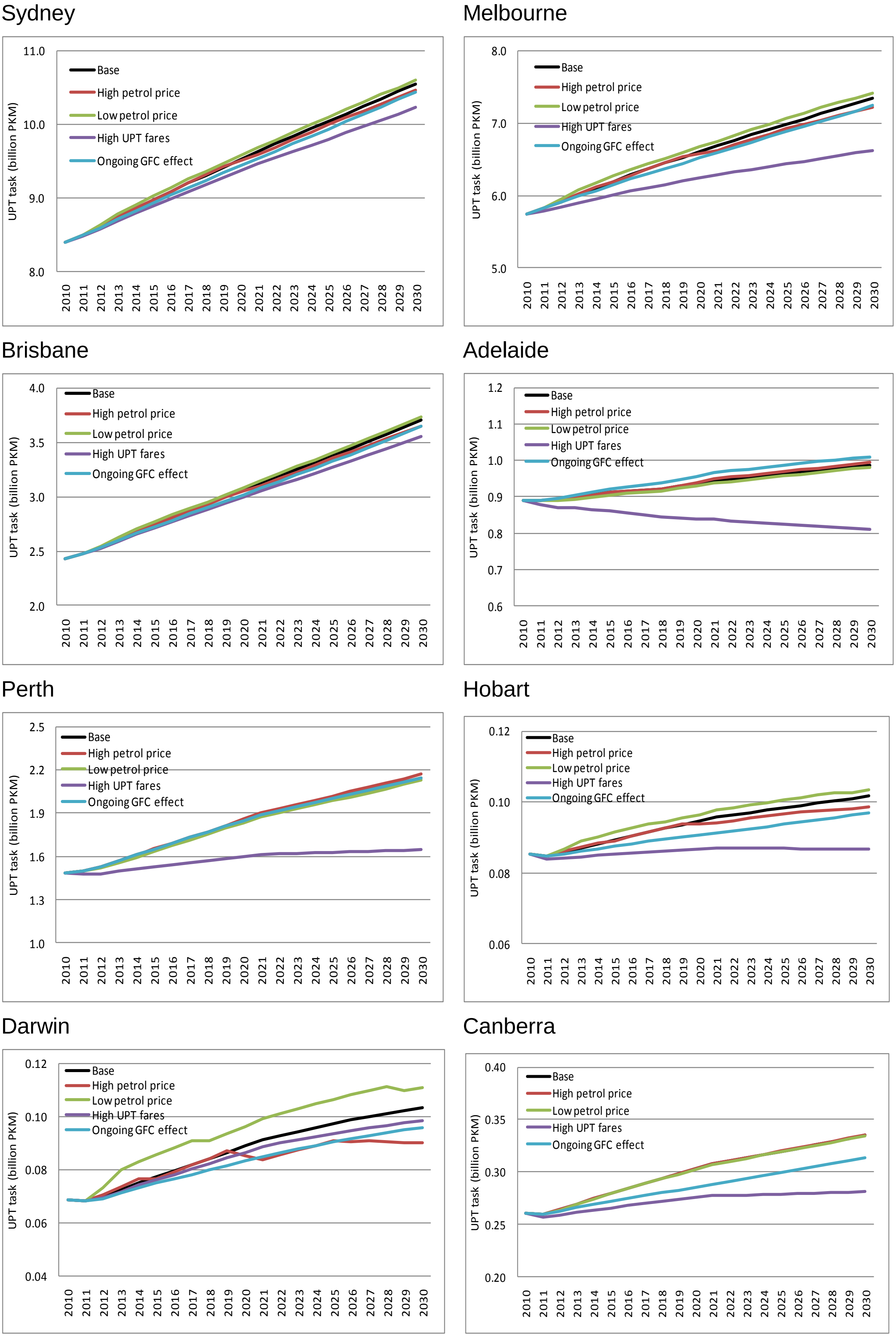
Table 5 presents changes in the UPT task (in percentage terms) under the various scenarios for each capital city as well as total (sum of all) capital cities from 'Base' in 2030. The total UPT task under the 'Base' scenario is forecast to increase to 25.28 billion PKM. When compared to the 'Base' scenario, the total UPT task would be 1.00 per cent lower at 24.99 billion PKM under a 'High petrol price' scenario, would be 0.54 per cent higher at 25.38 billion PKM under a 'Low petrol price' scenario, would be 7.60 per cent lower at 23.32 billion PKM under a 'High UPT fares' scenario and would be 1.13 per cent lower at 24.96 billion PKM under an 'Ongoing GFC effect' scenario. Generally, the change in the UPT task under the various scenarios would be greater in smaller capital cities.

Table 5 Change in UPT tasks (per cent) by scenarios from 'Base', 2030

Capital city	Scenarios			
	High petrol price	Low petrol price	High UPT fares	Ongoing GFC effect
Sydney	-0.82	0.47	-3.04	-1.04
Melbourne	-1.78	0.96	-9.89	-1.47
Brisbane	-1.48	0.66	-4.15	-1.60
Adelaide	0.85	-0.51	-17.91	2.39
Perth	1.19	-0.66	-22.28	0.00
Hobart	-2.79	1.71	-14.03	-4.72
Darwin	-11.65	7.29	-4.55	-7.07
Canberra	0.18	-0.12	-15.34	-6.38
All capitals	-1.00	0.54	-7.60	-1.13

The scenario forecasts of the UPT task for each capital city show very similar patterns, but with different magnitudes and trends (see Figure 7). In all capital cities, the UPT task under a 'Low petrol price' would increase, while under all other scenarios (i.e. 'High petrol price', 'High UPT fares' and 'Ongoing GFC effect') they would shrink. However, the total UPT tasks in Melbourne, Adelaide, Perth, Hobart and Canberra under a 'High UPT fares' scenario show the largest decreases compared to other scenarios.

Figure 7 UPT task (billion PKM) by scenarios, all capital cities, 2010–2030



5. Potential uses of the data, policy implications and conclusion

The forecasts suggest that demand for urban public transport in Australia should grow by about one-third over the 20 years from 2010 to 2030. Such an indication of the future growth of the UPT task in capital cities can be useful in a variety of contexts, such as infrastructure planning, urban transport reform and energy efficiency. It can also provide insight into new and emerging policy issues for local, state and federal government agencies, investors, transport regulators, public transport users and city planners, relating to development of urban infrastructure, congestion amelioration and road safety.

6. References

Allsop, R.E. (2008) Transport networks and their use: how real can modelling get? *Phil. Trans. R. Soc. A*., June 13, 2008, 366 (1872), pp. 1879-1892; doi:10.1098/rsta.2008.0013.

Australasian Railway Association (2006) *National passenger Transport Agenda*, ARA Inc., (www.ara.net.au/dbdoc).

Australasian Railway Association (2007) *ARA RAILmates - Public Transport Part-2*, Information Sheet.

Bureau of Infrastructure, Transport and Regional Economics (2012a) *Public transport use in Australia's capital cities: Modelling and forecasting*, Report 129, BITRE, Canberra, (forthcoming).

Bureau of Infrastructure, Transport and Regional Economics (2012b) *Traffic growth: Modelling a global phenomenon*, Report 128, BITRE, Canberra

http://www.bitre.gov.au/publications/2012/files/report_128.pdf

Bureau of Infrastructure, Transport and Regional Economics (2012c) *Traffic growth in Australia*, Report 127, BITRE, Canberra http://www.bitre.gov.au/publications/2012/files/report_127.pdf

Bureau of Transport and Regional Economics (2008) *Urban passenger transport: how people move about in Australian cities*, Information Sheet 31, BTRE, Canberra

http://www.bitre.gov.au/publications/2009/files/is_031.pdf

City of Melbourne (2009) *Transforming Australian cities for a more financially viable and sustainable future*, (updated March 2010), City of Melbourne Project Team, 40 pages.

Commonwealth of Australia (2009) *Investment of commonwealth and State funds in public passenger transport infrastructure and services*, Report prepared by the Senate Standing Committee on Rural and Regional Affairs and Transport, Parliament of Australia, Canberra.

Commonwealth of Australia (2010) State of Australian cities 2010, Major Cities Unit, Infrastructure Australia, Canberra.

Cosgrove, D.C. (2011) Long-term patterns of Australian public transport use, *Australasian Transport Research Forum 2011 Conference*, 28–30 September 2011, Adelaide, Australia

http://www.atrf11.unisa.edu.au/Assets/Papers/ATRF11_0030_final.pdf

Raskall, P. (2010) Estimates of economic output and growth in major cities of Australia, Unpublished working paper.

Victorian Department of Transport (2010) Attitudes to public transport: market segmentation in Melbourne, In: *Transport Research and Policy Analysis Bulletin*, Vol. 9, Melbourne.

USDA-ERA (2011) Real exchange rate projections, US Department of Agriculture, Economic Research Service, database available at http://www.ers.usda.gov/data/macroeconomics/