



Public transport pricing

Research paper

The Productivity Commission acknowledges the Traditional Owners of Country throughout Australia and their continuing connection to land, waters and community. We pay our respects to their Cultures, Country and Elders past and present.

The Productivity Commission

The Productivity Commission is the Australian Government's independent research and advisory body on a range of economic, social and environmental issues affecting the welfare of Australians. Its role, expressed most simply, is to help governments make better policies, in the long term interest of the Australian community.

The Commission's independence is underpinned by an Act of Parliament. Its processes and outputs are open to public scrutiny and are driven by concern for the wellbeing of the community as a whole.

Further information on the Productivity Commission can be obtained from the Commission's website (www.pc.gov.au).

© Commonwealth of Australia 2021



With the exception of the Commonwealth Coat of Arms and content supplied by third parties, this copyright work is licensed under a Creative Commons Attribution 4.0 International licence. In essence, you are free to copy, communicate and adapt the work, as long as you attribute the work to the Productivity Commission (but not in any way that suggests the Commission endorses you or your use) and abide by the other licence terms. The licence can be viewed at: <https://creativecommons.org/licenses/by/4.0>.

The terms under which the Coat of Arms can be used are detailed at: www.pmc.gov.au/government/commonwealth-coat-arms.

Wherever a third party holds copyright in this material the copyright remains with that party. Their permission may be required to use the material, please contact them directly.

ISBN 978-1-74037-741-6 (online)

ISBN 978-1-74037-740-9 (print)

An appropriate reference for this publication is:

Productivity Commission 2021, *Public transport pricing*, Research paper, Canberra

Publication enquiries:

Media, Publications and Web | phone 03 9653 2244 | email publications@pc.gov.au

Foreword

COVID-19 has decimated public transport patronage and revenue in all Australian cities. Patronage will likely return to normal in a few years, not least because of population growth, but the great disruption prompted by COVID-19 provides an opportunity to re-think public transport.

One aspect of this is pricing, which, in contrast to transport planning is crude and often locks in pricing structures and levels that are no longer relevant. That, and the generally steady decline in fare recovery will have budgetary impacts that risk under-funding of this crucial service. Service quality is the most important driver of patronage.

We do not start with the position that subsidies are bad in public transport. They are needed on both efficiency and equity grounds — for instance to manage road congestion and to promote social inclusion. In this report we have tried to develop practical ways to make fares and subsidies more aligned with governments' objectives for public transport and suggest institutional arrangements that could support this.

In the febrile climate of the COVID-19 crisis, some have been tempted by the seductive idea that zero fares would be a good way of reviving public transport. One insight from our work is that this would not be effective in achieving that goal. Instead, it would divert funds better spent on service quality, often to people with higher-incomes who do not need the subsidy.

We would like to thank all State and Territory Governments for their advice and information in preparing this report, as well as a range of experts, who have enriched our understanding.

We also wish to thank the staff team, headed up by Ralph Lattimore and Angela Woo, consisting of Roland Allen, Natalie Baker, Pragya Giri, Matthew Maltman, Hudan Nuch, Jasna Rogic, Shelby So and George Steel.

Michael Brennan
Chair

Paul Lindwall
Commissioner

Contents

Foreword	iii
Contents	v
Overview	1
Key points	2
1. Pricing for the public good — a different approach to achieving efficient prices	3
2. Equity goals are central to public transport pricing	12
3. Technology and pricing	15
4. Institutional arrangements to progress reform	17
Findings	19
1. Pressure points on public transport pricing	25
1.1 Context	26
1.2 With sufficient subsidies, public transport still plays a major role	30
1.3 Understanding the public transport system	32
1.4 Is COVID-19 a game changer that affects the desirable framing of transport fares?	40
1.5 Balancing goals	47
2. An economic lens on pricing	49
2.1 What is social marginal cost pricing and what does it mean for efficient fares?	50
2.2 Other factors important for fare setting	55
3. Peak pricing and demand management	59
3.1 The benefits of peak pricing	59
3.2 Features of effective peak pricing design	67
3.3 Complementing peak pricing through other measures	74
4. Modal and distance-based pricing	77
4.1 Modal pricing	77
4.2 Distance-based pricing	88
4.3 Combining peak, modal and distance-based pricing	91

5. Road congestion	93
5.1 The extent of road congestion and its costs	94
5.2 What role could public transport fares play?	98
5.3 Policy options	108
6. Better supporting social policy goals through pricing	115
6.1 Public transport equity in Australia	116
6.2 Public transport affordability	132
6.3 Addressing equity and affordability through fares	141
7. Technological progress and fares	149
7.1 Advanced ticketing and fare structures	150
7.2 Improving informed consumer choice	155
7.3 Changing the distribution model	159
7.4 Leveraging novel modes	168
8. Institutional arrangements for fare setting	175
8.1 Challenges in fare setting practices	176
8.2 Improving institutional arrangements	184
A. Consultation	197
Abbreviations and explanations	199
References	201

Overview

Key points

- * Subsidising public transport is necessary because of its role as a human service that aims to provide affordable transport to most people. Subsidies can also be justified on efficiency grounds, not least because of their role in partially addressing road congestion and in meeting the large fixed costs of transport networks.
- * However, most jurisdictions use relatively simple and ad hoc approaches to setting fares and subsidies, which do not systematically address either equity or efficiency goals. Fares often do not change from year to year or only increase with inflation.
- * Consequently, public transport fares have become decoupled from costs, with the risk that governments' budgetary comfort zones will be breached, jeopardising future service quality, which is the most important driver of patronage.
- * Better pricing would recognise that peak charges should be higher and timed to make improved use of transport assets, prices should better reflect that buses are less costly than trains, and longer distances travelled should come with higher prices.
- * Avoidable road congestion in Australia's cities cost an estimated \$24 billion in 2018-19 and, unless countered, will grow by an estimated 45 per cent by 2029-30. Lower public transport pricing partly assuages congestion, but road user charges are a much better solution for road congestion and would make peak pricing on public transport more effective for demand management. Judiciously applied parking levies would also help and can be introduced now.
- * At current subsidised levels, most people can afford public transport. However, concessions are inadequately targeted. Some people experiencing disadvantage cannot access concessional fares, while some high-income customers are eligible for generous discounts.
- * The disruption to public transport arising from COVID-19 provides a few years of breathing space for jurisdictions to re appraise pricing structures and levels, and to transition to new models. The NSW Independent Pricing and Regulatory Tribunal (IPART) and Infrastructure Victoria have already developed pricing approaches that could usefully be replicated — to varying degrees — in all jurisdictions.
- * IPART, in particular, has a unique role in providing transparent rigorously-based pricing advice to the NSW Government. Other jurisdictions, particularly larger ones, could benefit from a similar arrangement.
- * The temptation to lower prices in the period before a resumption of normality in public transport use would merely savage revenue by more and would be an ineffectual way of increasing patronage. Fear trumps a few dollars of ticket discounts.

The efficient movement of people around Australian cities entails large publicly-funded investments, and a wide array of regulations, subsidies, and government-determined prices. These aspects all have consequences for the average citizen — crowding and congestion, accessibility to places of work, convenience and cost. Accordingly, government decisions about any aspects of transport (public or not) are often controversial, no more so than when they involve pricing, and associated service quality.

Arguably, most governments are sophisticated public transport planners, but crude price setters. The subsidy and pricing arrangements used by most state and territory governments are driven less by a coherent policy, and more by inertia, political imperatives and non-targeted approaches to meeting affordability goals. In the last decade, if they increased at all, fares often rose only with inflation even if there were larger cost pressures. Fare structures tend to be too simplistic, foregoing some of the advantages of differentiating fares by the type of public transport, and the time and distance of travel.

COVID-19 has sharpened public focus on public transport. By closing workplaces, lockdowns have contributed to reduced patronage, as have social distancing requirements and people's safety fears (which is why patronage has fallen markedly even in jurisdictions without lockdowns). Patronage levels in the most affected jurisdictions have been as low as 11 per cent of their pre-pandemic levels but have still fallen to 80 per cent or less in states without significant community transmission. This has led to major financial stresses for this essential public service. For instance, revenue from metropolitan fares in Victoria in 2020-21 were 70 per cent lower than their level in 2018-19. Even when the fear abates, the shift to greater working from home will place enduring pressures on patronage rates.

Patronage levels will finally recover with long-term population growth, so now is the time to plan for pricing levels and structures using proven frameworks and institutional arrangements that maximise public benefits, while averting the long-run tendency for cost recovery rates to fall. The goal is not to recover all of the costs of public transport. That would be a folly in cities dominated by cars (box 1), and in any case, subsidies are justified on both equity and efficiency grounds.

1. Pricing for the public good — a different approach to achieving efficient prices

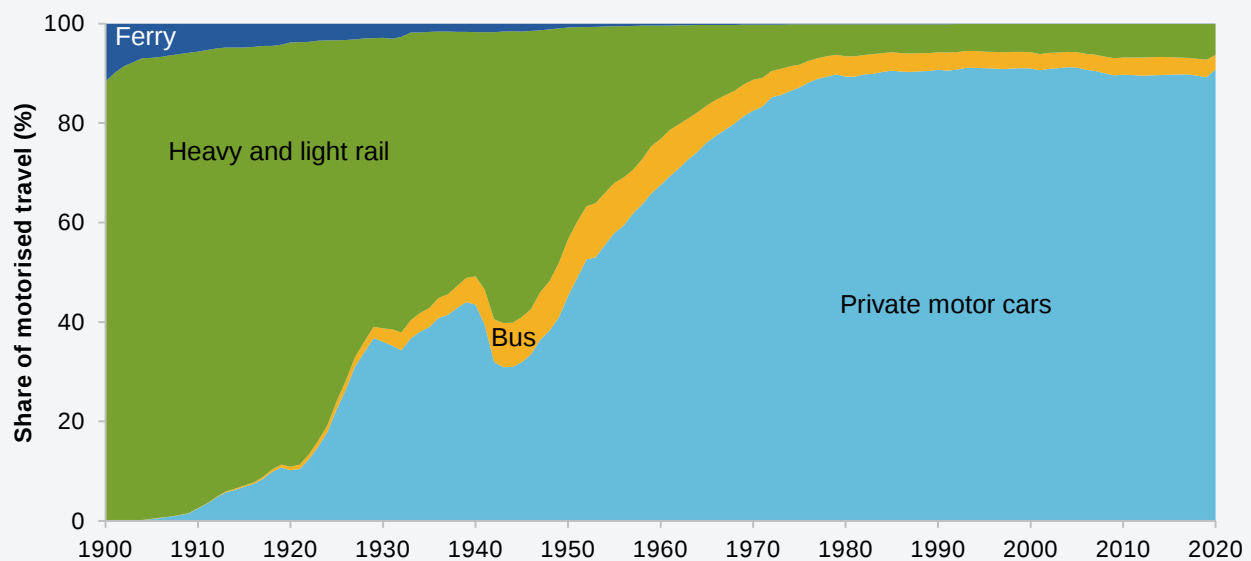
Taxpayer subsidies are generally the most efficient way of recovering the large fixed costs of public transport networks — the vehicles, tracks, bus and rail stations, and land corridors. This is unlike most other large networks, like electricity and water, which by virtue of their monopoly status, can price discriminate to a greater degree, including through lump sum charges.

A combination of fares and additional subsidies are needed to meet the remaining costs. The best practical approach is to equate prices with their *net* incremental social and economic costs ('social marginal costs'), as used for pricing advice by IPART in New South Wales (figure 1). Under this approach, prices are set to:

- **the operating costs of running a service** (for example, the fuel and driver costs of a bus for a given trip or kilometre of travel)
- **less the incremental benefits of reducing road congestion** (recognising that an increase in fares can make some people drive, which at the margin, decreases traffic flows and increases trip duration for all motorists)
- **less the gains from more frequent services** (recognising that cheaper fares encourage more patronage, which allows more buses or trains on a route, which increases service frequency to the benefit of all customers)
- **plus the costs of overcrowding on public transport** (recognising that people do not like standing or being jostled on public transport so that prices should be higher at times where this occurs, typically peak travel. Crowding will re-appear as the pandemic recedes)
- **plus the efficiency losses from the taxes used to fund the subsidies to public transport** (recognising that taxes distort consumption, investment and labour supply and demand).

Box 1 – The car made full cost recovery untenable

Until the mid-20th century, fares largely met the costs of public transport, a reflection of its dominance as the preferred mode for moving around most Australian cities. That dominance ended with the rising affordability and convenience of cars, and the associated increase in the demand for mobility. (Kilometres travelled per person in Australia's capital cities grew by 400 per cent between 1901 and 2020, mostly through use of the private car.) The share of public transport in total motorised transport services (measured as passenger kilometres) fell from 90 per cent in 1921 before stabilising at about 10 per cent from the late 1970s.



In the face of the flagging demand, the capacity for public transport operators to set prices that meet costs became untenable. Public transport pricing policy has pivoted away from a commercial model, which was expedient when there were few private alternatives, to a framework that recognises that subsidies are needed for viability, equity and efficiency.

Depending on the jurisdiction, just before the pandemic, fares recovered between about one tenth and one third of operating costs (before further deteriorating as patronage plunged with the onset of the COVID-19 pandemic). Recovery rates are lower if the large capital costs of public transport — especially rail — are included. The gap between real costs and fares is invisible to transport users, who are generally unaware that their trip can sometimes cost ten or more times the fare they pay.

Low fare recovery translates into billions of dollars of annual public transport subsidies, such that they comprise a major spending item in state and territory budgets. Just as an illustration, public transport subsidies in Canberra, Perth and Melbourne were between about \$700 and \$1200 per household prior to the pandemic.

Given the magnitude of these household contributions, it is important they 'buy' the best outcomes for the community as a whole, especially as there are many other competing uses for funds.

Figure 1 – Social marginal cost is one key determinant of efficient fares

Fare based on:	Costs and benefits captured under social marginal cost (SMC)	Other factors not captured under SMC pricing
Efficient cost of supply	- Financial cost of service delivery	Long-run costs of infrastructure investment
	- Social cost of public funds (deadweight loss of tax)	Technological feasibility (e.g. ticketing system constraints)
Efficient use of public transport networks	- Social cost of crowding	Equity and accessibility
	+ Social benefits of reduced road congestion, accident and environmental costs	Behavioural pre-conditions for fare responsiveness
	+ Social benefits of frequent services ('Mohring' effect)	Service quality and frequency

A critical element of this pricing approach is that it does not seek to recover average costs, which include the costs of an already built network. *Fully* cost-reflective prices for an underutilised train service in the off-peak period could be astronomical, even though the cost of an additional trip that used that capacity would be low.

While social marginal cost pricing generally leads to large subsidies, it does not explicitly address affordability. Nevertheless, marginal cost pricing would usually result in higher peak to off-peak fare ratios, lower relative bus to train fares, and higher charges for longer distances, all of which tend to affect higher-income earners more (as discussed later). At the pragmatic level, 'optimal' prices are only approximate given the variation in cost of delivery across the network, as well as the highly variable social costs like crowding and congestion. As ticketing systems develop, there might be scope for more complex prices, but pricing will only ever approximate incremental costs.

Social marginal cost pricing is a practical and conceptually sound approach for governments to make informed pricing decisions when coupled with recognition of equity, simplicity and other pricing considerations.

Peak pricing

The peaks in hourly demand for public transport coincide with private road transport and reflects the typical starting and finishing times for work and school. Trains and buses are little used between 10 am to 3 pm on weekdays in all Australian cities (figure 2 shows one example). Peak demand has several implications for pricing of transport networks.

First, there are higher incremental costs to the network of adding capacity at peaks, which higher pricing could partly reduce. These costs are particularly high for rail. For instance, the capacity cost of an incremental expansion of rail in Melbourne is more than \$12 per trip compared with buses, where it is below \$2. This is one reason why the well-known economist, Edward Glaeser coined the phrase 'bus good, train bad' and referred to buses as the 'forgotten children' of transportation.

Second, while service frequency and capacity rise during peaks, public transport is still often crowded. While some crowding is optimal given the high costs of adding to capacity, the degree and duration of crowding on public transport is costly for consumers. The monetary equivalent to the non-financial costs of 20 minutes of

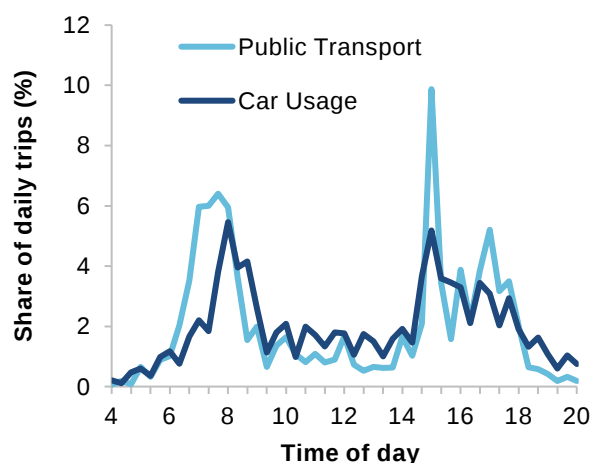
standing versus sitting for a Sydney rail trip amounts to 85 per cent of the zone 2 dollar fare, so nearly doubling the overall effective cost of fare at current usual levels.

Third, alternatives to public transport — primarily private vehicles on roads — are often highly congested, so getting even a few cars off the road can make traffic flow more freely. In saying this, the goal of pricing should not be to maximise use of public transport. It cannot reproduce the convenience and flexibility of motor vehicles (and over shorter distances, walking and cycling). Indeed, one of the benefits of public transport is that lowering road congestion improves the useability of roads, to the benefits of car users.

Figure 2 – Twin peak dilemmas — road congestion and public transport crowding

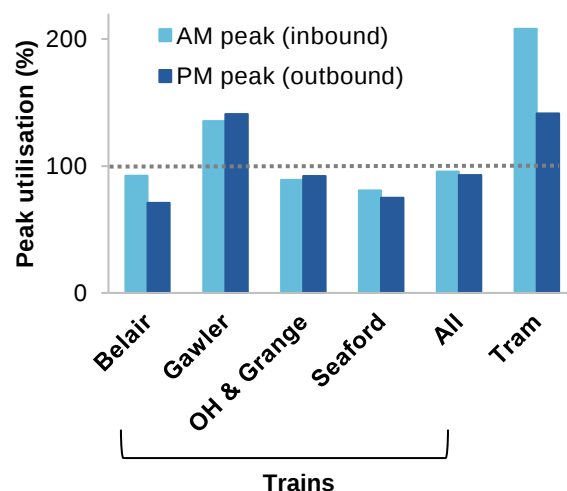
Peak travel patterns align private and public transport

Southeast Queensland, 2017-18



There aren't seats for everyone during peak

Adelaide train and tram peak utilisation, August 2019



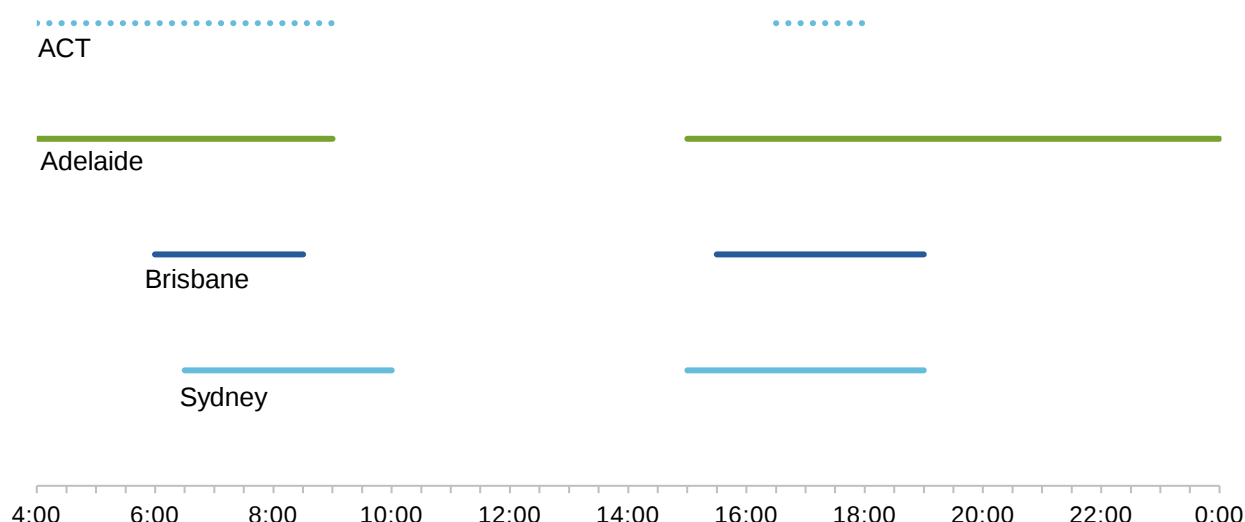
Setting peak prices invites two questions: what is the right price and when do we charge it? The answers depend on the degree of peakiness, its duration, the capacity of existing public transport services at peak times, the level of congestion in cities and the responsiveness of public transport users to the differential between peak and off-peak prices. As Australia's cities vary across most of these dimensions, no single price or time is right, which is why peak pricing requires a jurisdiction-by-jurisdiction assessment. As a reflection of this, many jurisdictions use peak pricing, though the degree to which they do so, and their timing, varies (figure 3).

While still retaining free early-bird train travel, the Victorian Government ceased offering discounts for travel at off-peak times during the day and evening, notwithstanding capacity constraints on its networks at peak times. The other jurisdictions that do not have peak pricing (Western Australia, Tasmania and the Northern Territory) are not currently facing capacity or crowding issues on their transport networks. That does not rule out the case for some price difference between peak and off-peak periods for them. A potential advantage of higher relative peak fares is the scope for more cost recovery during this period. Furthermore, demand is more sensitive during the off-peak period so that the revenue effects of lower prices during this period are partly offset by increasing demand, while also providing (blunt) assistance to off-peak travellers, who tend to have lower income.

Creating differentials between peak and off-peak fares can shift demand. For instance, the Commission estimates that for Sydney's public transport services, a 10 per cent increase in peak fares from current levels on all modes would increase non-peak journeys by about 3 per cent and reduce peak ones by about 2 per cent (while also raising revenue). While these effects are modest, they may still reduce crowding and defer costly lumpy

investments in capacity for crowded services. More flexible hours of work are likely to endure after the COVID-19 pandemic, which may also increase people's responsiveness to peak prices. A person could, for example, work from home from 8 am to 10 am and then commute at a time when public transport prices and crowding are lower (or switch to an earlier morning commute and an earlier time to leave work).

Figure 3 – Peak period lengths vary by jurisdiction



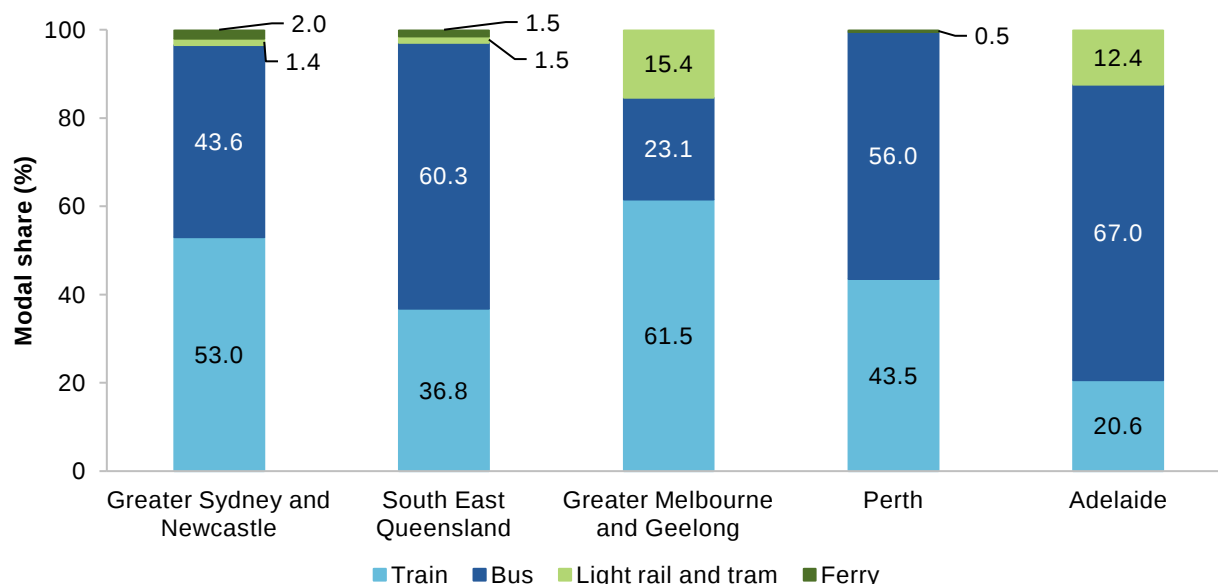
Some reforms to peak pricing are justified:

- Current peak/off-peak differentials are commonly only between 20 to 30 per cent, which limits the degree to which people will move the time of their travel. A higher peak surcharge will raise more revenue and better smooth demand. Every dollar of avoided subsidy reduces the economic inefficiencies of tax or allows governments to spend on higher priority areas.
- There are grounds for morning peak periods to start later and end sooner to better match peak demand. For instance, in Sydney, a person commencing their journey just before 10 am still pays the peak fare.
- Introducing a shoulder price would reduce crowding and the need for excess capacity, though a trial might precede wholesale implementation to provide evidence on the demand effects of this approach.
- Different modes of public transport can have different peak periods, which may justify different peak pricing times.

Modal pricing – ‘to do or not to do, that is the question’

While a few Australian jurisdictions have only one mode of public transport, Australia's biggest cities all carry large numbers of passengers on multiple modes — mainly rail, tram and bus (figure 4). In most Australian cities, there are no variations in fares between travel by different modes of public transport (modal pricing), though such pricing variations are common overseas.

Figure 4 – Public transport modal shares vary by jurisdiction
Share of total public transport trips, 2018-19



There are persuasive arguments for some form of modal pricing, though the ultimate margins between modes depend on contrary forces. Buses, for example, contribute to road congestion (though to a much lesser extent than cars). Trains do not necessarily do so, though the large number of level crossings in Melbourne have major effects on congestion, which is motivating their removal in that city.

Trains also travel longer distances than buses so the average total cost per kilometre of *existing* train lines are lower. But the story changes for incremental expansions of the transport network because bus expansion costs a fraction of rail. Furthermore, as bus services can be expanded at relatively low cost, they provide more flexibility in meeting the changing needs of a city (such as through new routes or on-demand services) and can more readily take advantage of new technologies (say autonomous buses). It is easy to increase the frequency of bus services (if justified by more demand). Existing rail networks in most Australian cities are too congested to do that. Train routes and technologies are like long-term contracts without exit clauses.

Modal pricing might also help to manage crowding on public transport. In theory, the first best option to address differences in crowding would be mode-neutral — if the train was less crowded than the bus at peak, prices for that train service would be lower, and vice versa. However, complexity confounds consumers. As buses generally tend to be less crowded than trains at peak times, a reasonable rule of thumb is to set lower fares for buses. (Notably, 70 per cent of bus routes operate in Melbourne at less than one third of their capacity at the morning peak.)

The gains from modal pricing depends on several factors. As in peak pricing, higher prices for train services than buses will tend to raise more revenue, which reduces the efficiency cost of taxes needed to fund subsidies. As differences in modal prices prompt only modest shifts by customers from rail to bus, the other efficiency benefits are modest. Nevertheless, modal pricing could still help reduce crowding on trains or the need to expand rail capacity (which being lumpy, entails large costs). Moreover, an equity benefit of lower-cost bus services is that they tend to cater to lower-income people.

The main drawback of modal fares is that they make it harder for governments to implement integrated fares — fares set for journeys with multiple legs on different modes. However, if the concern is to avoid different

fares for each leg, then discounts for additional trips or a charge only for the most expensive mode for a multimode trip would better target these users. In any case, most journeys only use one mode.

Overall, modal pricing is an appealing option. It would be most attractive where train or tram services are unable to cost effectively be expanded to meet growing demand.

Distance-based pricing

Distance-based fares are more cost-reflective than flat fares in capturing both capacity- and distance-related costs. Melbourne, Brisbane, Perth and Hobart have fares based on travel distance zones of varying granularity (for example 8 zones in Brisbane and 3 in Melbourne), while Sydney has general price bands that depend on kilometres travelled. Adelaide, Canberra and Darwin do not have distance-based fares.

There are several complexities that sometimes work against the desirability of pure distance pricing. Bottlenecks — for example, a particular segment of a train line that limits overall capacity — may be more likely to determine costs than the distance travelled. And longer-distance public transport trips produce larger incremental reductions in road congestion costs.

Overall, however, distance pricing is generally more efficient than flat fares, and particularly so for cities that rely primarily on buses because the operating costs of buses comprise a greater share of total costs compared with trains.

Combining peak, modal and distance-based pricing

Though each of the above pricing options can individually improve fares, combining them would go even further in aligning fares to the variation in social marginal cost by time of day, mode and distance. New South Wales is the only jurisdiction with peak, modal and distance-based pricing, and other jurisdictions experiencing congestion and crowding problems would also likely benefit from a similar approach, depending on how social marginal costs vary across each specific network. While fare combinations could increase the complexity of fare structures for both users and ticketing systems, this could be reduced through technological advances in ticketing and more informative smartphone applications.

Second best remedies for Australia's \$24 billion road congestion problem

Road congestion is a major issue in many Australian cities, though it is more pronounced in larger ones. The Commission estimates that the avoidable social costs of congestion in Australia were about \$24 billion in 2018-19 before the pandemic and just above \$21 billion in 2019-20 after lockdowns affected urban travel (all in 2018-19 prices). These costs mainly reflect the value of time lost on congested roads. In 2019-20, road congestion costs were about \$1500 per head in highly congested cities like Sydney but still about \$600 per capita in Canberra. While the pandemic reduced congestion pressures, private transport rebounded as lockdown were lifted. Urban road congestion costs are expected to rise in real terms by about 45 per cent from 2018-19 to 2030-31.

While motorists are subject to an array of user charges — insurance, registration, fuel excise, road tolls and, in some cities, parking levies — none are well targeted at relieving congestion. The effective road user charge in Sydney during peak weekday times — what the average user pays in fuel excise, tolls and parking levies — is dwarfed by average external congestion costs during peak weekday times.

Absent congestion charging for road use, pricing of public transport prices can only provide a second-best and partial solution to clogged roads.

In Sydney, Australia's most congested city, the benefits in 2019 of reduced congestion to other road users of avoiding a car trip during peak hours was \$2.22 per passenger journey plus 40 cents per kilometre per passenger. All other things being equal, this justifies lower public transport prices. IPART, for instance, constrains its recommended increases in transport prices because it recognises that higher public transport prices will divert some people to cars, and that even small marginal traffic increases can add considerably to travel times. To give an illustration, a 20 per cent increase in public transport fares has small overall impacts on car journeys across Sydney but would be expected to increase travel times on the already busy Parramatta Road from Haberfield to Central Sydney by 5 minutes (a 15 per cent increase in travel time during peak use of this road). This may seem small, but it affects thousands of car users daily and adds up when repeated across other congested routes.

The impact of higher public transport prices on congestion will vary in other Australian cities but is roughly correlated with average congestion levels. The 'right' marginal cost of congestion depends on the actual traffic flows and city design, though most jurisdictions have elaborate traffic flow models that would let them compute marginal congestion costs.

But these models may better be applied to other congestion policies, as there is limited capacity for public transport pricing to further reduce road congestion.

- The responsiveness of car use in peak hours to public transport pricing is low. This reflects two factors. First, public transport demand is relatively unresponsive to peak hour fares. Second, any given percentage increase in public transport represents a much smaller percentage reduction in car use because the number of car users are many times larger than public transport users.
- Fare increases tend to have larger effects on congestion costs than fare decreases.
- Public transport pricing is blunt. There may be large parts of a city where pricing has little effect on congestion.

This does not mean that public transport plays a small role in addressing congestion. Were public transport not to exist at all, congestion in Australia's cities would rise significantly. Globally, a revealing natural experiment occurred in Los Angeles where, following a 35-day public transport strike, highway delays increased by about 50 per cent. But that effect is about service provision, not pricing.

So what can be done about road pricing?

While an oft-repeated (and largely ignored) policy recommendation, well-designed road user pricing could better target congestion and act as a funding source. Road congestion charging is in its infancy in Australia and globally, though heavy vehicle charges, the recent shift to road pricing of electric vehicles in some jurisdictions, and a trial of road pricing in Melbourne point to realistic scope for reform, especially given the available technologies for its easy adoption.

For road user charges to alleviate congestion, they should be targeted at areas and routes most prone to congestion. This could be achieved by implementing, for example:

- CBD 'cordon' charges — in which drivers are charged for entering a city's CBD at hours when roads are congested
- corridor charges, where drivers are charged based on how far they travel along congested arterial roads and freeways in the peak direction.

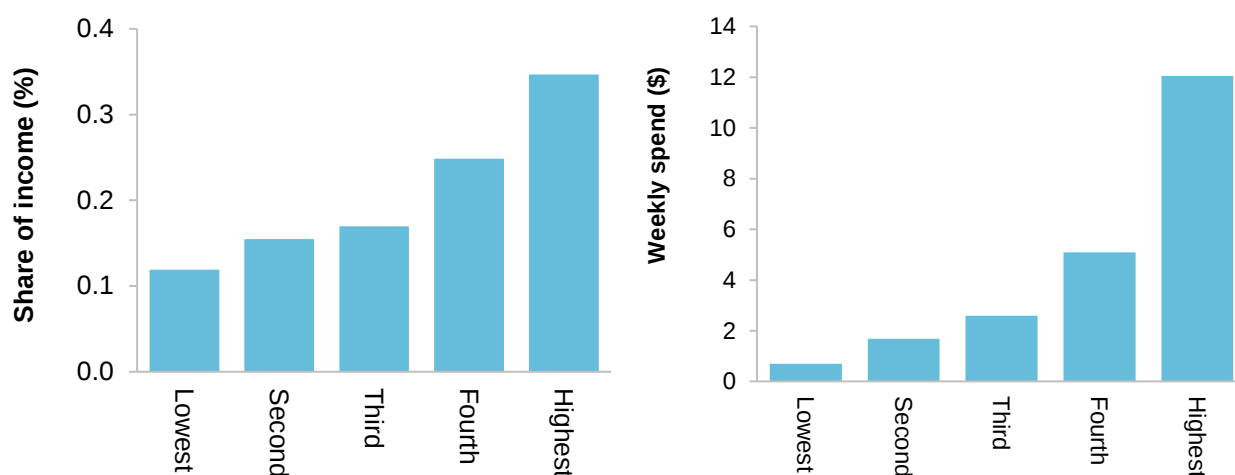
With the expected growth of electric vehicles over coming years — especially with the Australian Government's recently announced Future Fuels and Vehicles Strategy — it is critically important to have in place a sensible road pricing system.

Well-designed parking levies can also play a role in reducing congestion, particularly until road user charges are fully implemented. Implementation involves little new technology, does not raise privacy concerns, can be rolled out incrementally or contained to 'hot zones', and is likely to be publicly acceptable if not too highly priced. Area-wide parking charges have been in place in several major Australian cities since the 1990s. Overall, a 10 per cent increase in parking charges reduces car use by between about 2 and 13 times more than the reduction achieved by a 10 per cent decrease in public transport prices. By reducing demand for parking, higher fees can also reduce 'cruising' to find spare spots, which can also be a major source of road congestion.

Parking levies are also progressive when compared with public transport subsidies (figure 5). Commuters who park in the CBD typically also have higher ability to pay and higher likelihood of alternative travel options. Lower-income people often use cars, but do not often park them in costly and busy CBD locations. Parking levies will also not affect road users that use loading zones for courier and delivery services, and indeed, by reducing congestion, will generally improve the efficiency of such services.

Existing parking levies have some deficiencies. For example, they typically do not differentiate between peak and off-peak road use, with operators often setting higher prices for short-stay parking when the biggest effects on congestion relate to long-stay parking. Employers sometimes meet the costs of parking for their employees, which removes any incentive to avoid parking and the associated congestion. And parking levies do not address the road congestion from traffic that moves through a CBD but does not stop there.

Figure 5 – Car parking costs fall mainly on higher-income users



In light of these, the initial direction of policy could be the introduction of levies that are lower for off-peak arrival and departure times, targeting levies at zones that are most likely to reduce congestion, and implementing measures that increase the pass-through of parking costs to motorists (such as encouraging cashing out of free parking offered by employers and removing some of the fringe benefit tax exemptions that apply to parking).

Once governments introduce road user charging (and/or effectively targeted parking levies), the road congestion justification for public transport fare reductions will become much weaker.

Free public transport is unwise

The fare reforms above involve changing the structure and level of fares, but still aim to achieve an efficient and sustainable level of cost recovery. Some advocate free public transport to ensure affordability for all, to maximise the use of existing capacity, to counter road congestion and pollution, and to make cities more liveable.

As suggested by global experiences, these benefits are largely illusory. Where free fares were introduced, patronage increased, but usually made little difference to road congestion and sometimes had the perverse impacts of shifting people from walking and cycling to public transport.

IPART modelled free public transport in Sydney, finding that demand would increase by about 40 per cent. But the reduction in car use was far less — between two and five per cent. This is because car use is far greater than public transport, so even sizeable percentage increases in public transport will not have similar percentage impacts on car use. Moreover, the proportionate effect on congestion is not equivalent to the effect on car use because some roads are not congested in the first place, the substituted travel is not all at peak, and the number of car trips and their length are different. Overall, the evidence suggests that at the low prices that already exist for public transport, free transit would usually not make additional inroads to congestion.

An incidental concern about very low or free fares is that, unless accompanied by improvements in (costly) service capacity, they induce greater crowding on public transport, which represents a hidden price increase for users, and undermines the impact of low monetary prices. (This is more of an issue once patronage returns to pre-pandemic levels.)

Similarly, free fares are a poor measure to achieve social inclusion and affordability because there are other more important barriers to access and as most users of public transport have few financial barriers to using it at current highly subsidised fare levels (as discussed further below).

Melbourne's Free Tram Zone (FTZ) provides a useful case study that illustrates some of the practical pitfalls of free fares. As the use of Melbourne's FTZ is limited to those travelling only within the free fare zone, the beneficiaries are those living and working within the CBD — a group of relatively high-income users, on average. Free trams did not reduce traffic congestion in the CBD, and instead increased crowding on trams. Overcrowding also meant that the time gains from removing payment were offset by longer embarkment and disembarkation times. As a result, tram movements remain largely unchanged within the FTZ. There was little evidence that free trams cost-effectively stimulated tourism.

Moreover, 'free' is an artful word that hides the necessity that the costs of running public transport must still be met. Unlike the Australian Government, State and Territory Governments currently have narrower and less efficient tax bases. So any additional subsidies to public transport must require cuts to other crucial spending areas or rising inefficiencies associated with greater taxes. Free public transport would lead to a growing gap between fare revenue and costs with the need for ever rising subsidies and the risk of underfunding of services, which is unlikely to be a tenable policy strategy.

Whether any given free service is justified depends on the city and traffic context, user types, and revenue sources, but the Melbourne free tram case study suggests that the circumstances in which free fares are justified will be special. One circumstance when it is not is as a response to the massive reduction in public transport patronage associated with COVID-19. Free fares would merely savage revenue by more and, given the low responsiveness of patronage to fares, would be an ineffectual way of increasing demand.

2. Equity goals are central to public transport pricing

Public transport promotes the economic participation and social inclusion of those for whom the use of alternative ways of travelling are unaffordable, impractical, or not possible, some of whom are the most vulnerable and isolated in the community. In 2018, about 15 per cent of the total population aged over 16 years did not hold a car driver's license, with this particularly affecting lower-income, young and retired people, and more generally females. The costs of owning cars are also beyond many households. The average weekly costs of car ownership — including purchase, insurance, fuel and maintenance — was

about \$190 a week in 2015-16, which is not a readily affordable option for some of the lowest income households. Rising fuel prices and other running costs over the past five years will have worsened this.

All governments have largely achieved their primary goal of affordable public transport. Given large fare subsidies, public transport prices are not a significant source of financial distress for most low-income Australians. Few people say that fares are a barrier to travel. Annual spending on public transport accounts for just over 4 per cent of disposable income for the poorest households who spend anything on it at all, and it is a much smaller source of budgetary pressure than private motor vehicle transport and essential services for such households (figures 6 and 7).

For example, total motor vehicle expenditures (purchase, fuel, maintenance, parking) are more than 30 times greater than public transport spending for the lowest-income households. The consequence is that even small changes in the costs of motoring have far bigger effects on budgets for lower-income households than similar proportional changes in public transport fares.

Figure 6 – Spending patterns by income group

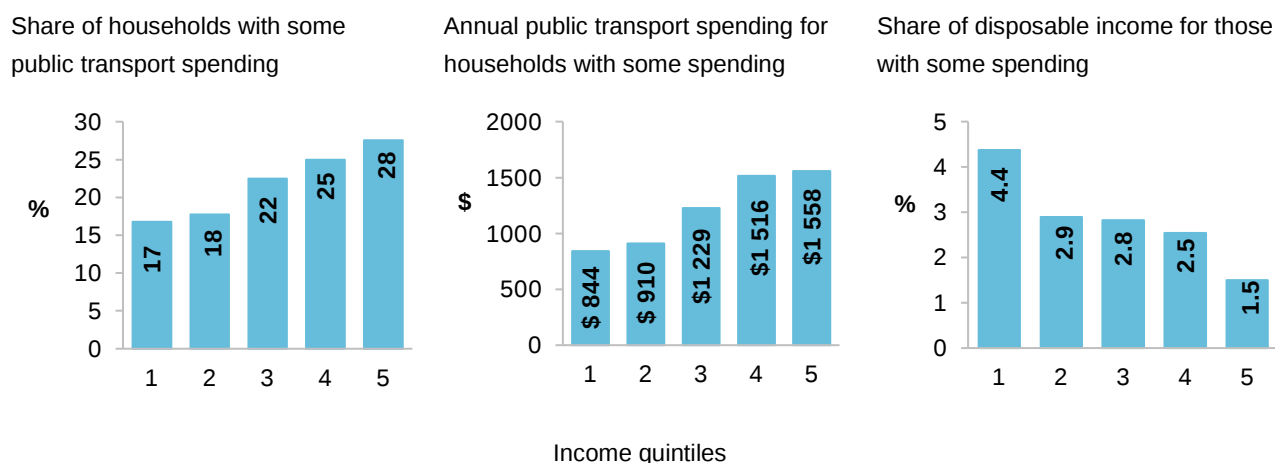
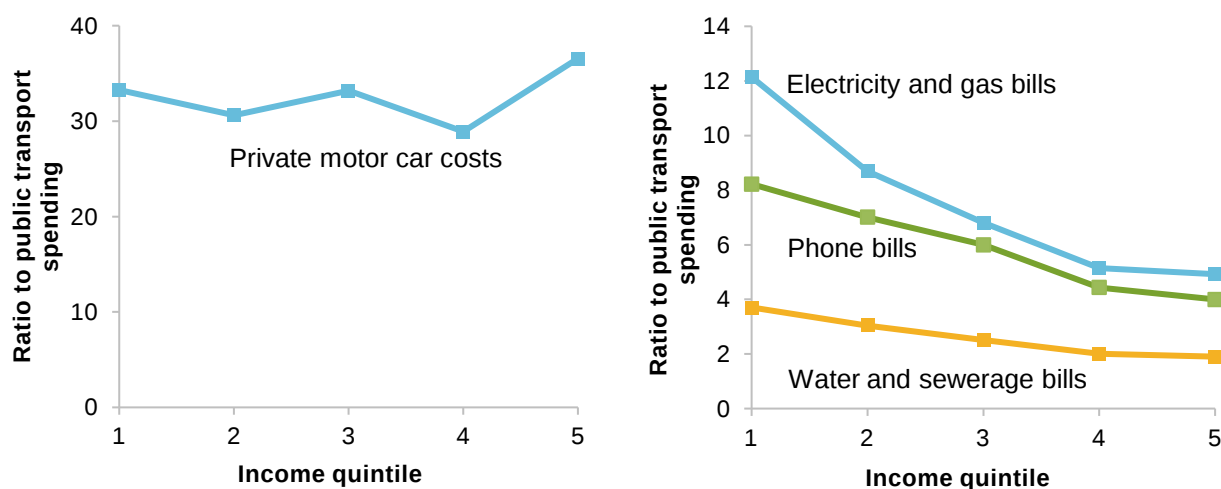


Figure 7 – Other essential expenditures are multiples of public transport spending, particularly for low-income households



In considering affordability of public transport for employed people, standard fares for regular 5 day a week commuting from the outer suburbs to CBDs are between 2.6 per cent (Darwin) and 7.3 per cent (Brisbane) of

minimum adult wages and between 1.2 and 3.4 per cent of average full-time weekly earnings. For many, the wage shares will be smaller than this because most travel is not to CBDs. Therefore, it is unlikely that, at these levels, public transport fares affect labour participation.

The relationship between income and public transport use partly reflects its primary role as a way of getting to work. Households with employed family members tend to have higher incomes than others; about 16 per cent of people with a job use public transport on all or most days compared with about half this for people without a job. A further contributor to the relationship between income and public transport is the design of Australian cities, and in particular, the role that rail plays in moving people to the CBD where wages tend to be high. Accordingly:

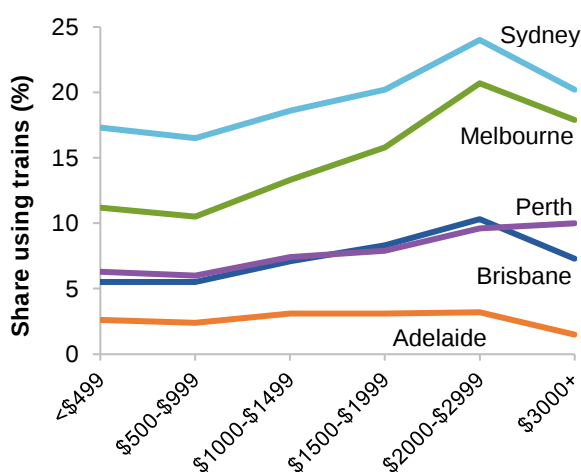
- The wages of people commuting to work by train is between about 10 and 20 per cent higher than car users in Brisbane, Sydney, Melbourne and Brisbane, with only Adelaide being an exception (where wages levels are slightly lower for train users). In the car-oriented cities of Canberra and Hobart, buses are the main public transport mode and are used by people whose incomes are between 11 and 17 per cent lower than car users. While the likelihood of train use for commuting tends to rise with income, the likelihood of using buses is greatest for the lowest-income households, with the exception of Sydney (figure 8).
- On the whole, higher-income people tend to take longer public transport commutes (by train or bus) than lower-income people. However, regardless of income, most public transport trips are less than 20 kilometres.

For all types of trips, the relationship between income and distance varies by mode of travel and city. For example, in Melbourne, the median distance travelled by people in the lowest income quintile was about 30 per cent longer than those in the highest quintile if they travelled by train, but about 40 per cent shorter if they travelled by bus.

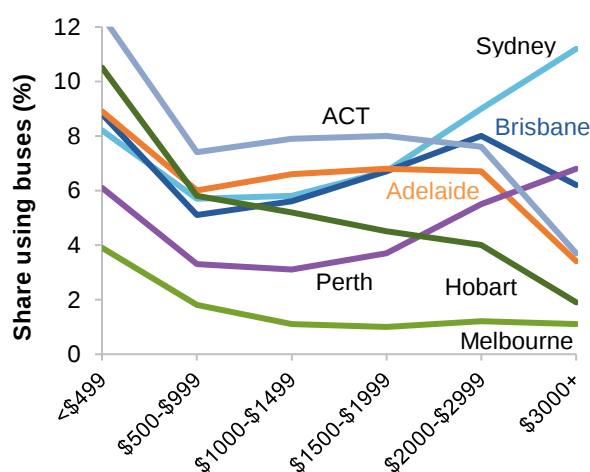
These patterns suggest that higher prices for trains than buses would be consistent with both equity and efficiency goals, and that the distributional consequences of distance-based charging (discussed above) depend on mode, trip purpose and public transport mode.

Figure 8 – Trains and buses have different usage patterns

Trains for commuting



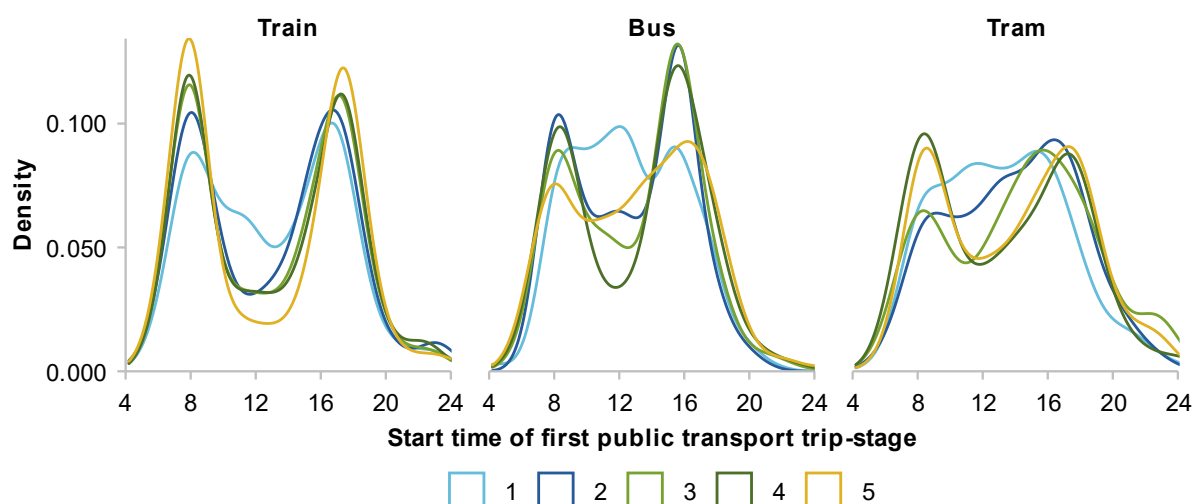
Buses for commuting



A similar story emerges for peak versus off-peak travel. Lower-income groups make relatively greater use of off-peak services for buses and trains (figure 9). This means that a greater margin between peak and off-peak travel would not only reduce crowding and the need for capacity expansion, but also support equity and affordability.

Figure 9 – People with lower incomes tend to travel during the off-peak

Frequency of starting time for public transport use in Greater Melbourne by main mode of travel



Average outcomes like these can fail to identify sub-groups for whom the prices of public transport may still act as a barrier to mobility. The rationale for transport concessions is to target these groups. Existing concessions (which vary considerably across jurisdictions) often do not target affordability well. Some people receive 50 per cent discounts because of their age alone, even if they have considerable means. (In theory, price discrimination by age can be justified if it raises revenue, but the evidence that concessions achieve this outcome in public transport is weak.) Meanwhile, some groups with very low incomes, such as those on JobSeeker payments, are not eligible for concessions in some jurisdictions, which is inconsistent with aspirations for affordable fares. Effective targeting could give governments greater scope to restructure fares without damaging re-distributional impacts.

3. Technology and pricing

Advanced and emerging technologies have the potential to improve the effectiveness of public transport fares, and to significantly change the role of pricing in urban transport.

In particular, moving to account-based ticketing (in which payment records and proof of entitlements are not kept on the card but stored on servers) could improve how passengers interact with fares and fare structures. For example, account-based ticketing enables the use of 'travel credits', which allows governments to provide various incentive structures for passengers (as trialled in New South Wales). It can also allow 'best fare mechanisms' that greatly simplify consumption decisions by navigating the fare structure on behalf of passengers. Reducing the costs of complexity would allow more granular fare structures (including pricing that differs by mode, distance, or time of day) and could improve the targeting of concessions. Overall, account-based ticketing would improve convenience and flexibility, may better allow integration through Mobility as a Service (MaaS), and increase patronage somewhat.

However, governments face a number of challenges in harnessing new technologies. Where adoption of a new technology is optional for users, it is more difficult for governments to justify large public investments (given the uncertainty around take-up rates) or to make fundamental changes to services (unless the needs of non-adopters are also catered for). Moreover, the benefits of new technology can be skewed to those most able to adopt them,

and risk excluding those facing financial and other barriers. For example, some jurisdictions with card-based ticketing continue to provide paper tickets as a residual option on social inclusion grounds.

At the same time, ticketing system upgrades have historically involved significant upfront costs. For example, the time taken to design and deliver the Victorian card-based ticketing system — myki — increased from two to nine years and cost an additional \$550 million — more than 50 per cent above the original budget. Many smaller jurisdictions would benefit from delaying such investments in favour of improving other areas of service quality.

Trip planning apps are already available in some form across all jurisdictions and help provide consumers with information about timetables and routes. Some jurisdictions have apps that provide real-time information about service arrivals/departures and levels of crowding, which allow users to better coordinate their travel (reducing effective waiting times) or self-select onto less crowded services (improving the effectiveness of peak pricing). Fares themselves could be made more salient to passengers via planning apps. There are good prospects that these functionalities could be diffused among all jurisdictions at trivial cost — either through open data (encouraging the development of apps by third party providers) or through public investments in app development.

Other technologies could significantly change the 'last mile' of travel — an ongoing obstacle to public transport use. The invisible 'price' posed by getting to and from public transport nodes can often be high relative to ticket prices. Park and ride facilities provide one solution, where feasible. Technological developments like shared bikes and scooters ('micro transit') offer another option, though the evidence suggests that these more often displace walking and cycling and indeed public transport itself, while increasing accidents, vandalism and dumping. They are likely to play a residual last mile role and only for some types of customers.

Car rideshare and demand-driven buses (where the bus comes to the customer) have more potential for meeting last mile needs, but are most suited if they are conceived as part of a new public transport paradigm — MaaS. Under MaaS, passengers can purchase transport services from a mix of public and private modes (such as micro transit and rideshare) using an integrated digital customer interface. In effect, MaaS is the culmination of developments in ticketing, apps to improve consumer information, and the leveraging of novel, technology-enabled modes of transport.

Trials of MaaS are ongoing internationally, including a trial in Sydney. The desirable pricing and design of MaaS remains contested, though one promising model is subscription in which people pay a fixed monthly fee for a given banquet of services, and with full or discounted payment for additional services once a limit is reached. However, subscription pricing generally does not provide incentives consistent with peak demand management and cost-based pricing. Achieving the full benefits of MaaS will require more sophisticated and informed price- and subsidy-setting.

There is a risk of technological exuberance with MaaS and some other prospective technologies that ignores uncertainty about their cost and practicality, consumer acceptance and the fact that a key role of public transport is as a human service that must affordably cater for the needs of people with low income. As one transport expert has put it: 'There is a lot of hype and rhetoric surrounding MaaS and little evidence on whether it will be a feasible, viable or desirable way to investigate and undertake future travel'.

Similarly, there are varied views about the feasibility and timing of adopting autonomous passenger vehicles at scale. Should this occur, it would significantly shift the urban transport landscape, allowing greater viability for last mile microtransit and potentially substituting for mass transit in some instances. However, to achieve the potential benefits of autonomous vehicles in reducing both transport and congestion costs, governments will still have a role in providing public mass transit. Indeed, there would be even greater need to coordinate fare-setting, road pricing, regulation, and service provision.

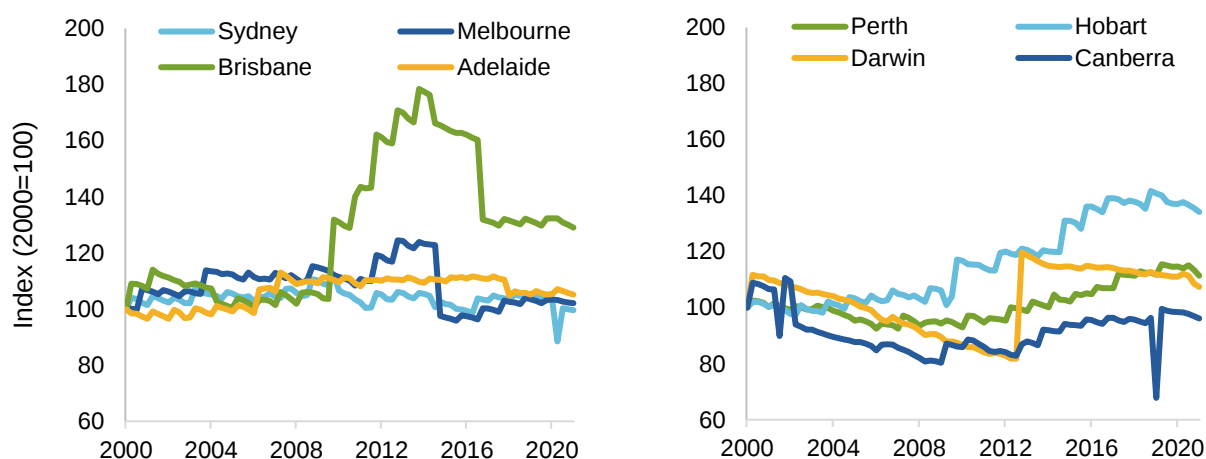
4. Institutional arrangements to progress reform

From a policy and regulatory perspective, public transport is the odd one out when compared with other essential services, notwithstanding broadly similar features. Similar to other network utilities like electricity, water and telecommunications, public transport requires large capital expenditure on long-lived assets, has scale and network economies, and faces peak capacity constraints. Its distinguishing features are that it has significant equity and social inclusion benefits that are not readily resolved through hardship and community service obligations, that it counters some of the adverse impacts of cars on cities, and that competition from private ‘wheels and legs’ prevent the exercise of market power. The latter feature means that the necessity for independent regulation of its prices and conduct is much diminished. Consequently, decision making is usually more akin to that used for other most government expenditures, such as for health and community care.

The unique characteristics of public transport — and especially its social functions — justify government as the pricing *decision maker*. However, that does not preclude *advice* from an independent institution that systematically collects community views and uses a coherent framework to consider pricing options from a social and economic perspective, with transparency in its evidence and recommendations, as for standard utility regulators. Arguably, the present arrangements (New South Wales excepted) have thrown the institutional baby out with the bathwater, and with it, the potential to provide guidance on prices that more coherently meet the overarching objectives of governments for equity and efficiency.

All jurisdictions have high levels of expertise in transport modelling and understanding of cost pressures. Many publish data on usage patterns (such peak and off-peak patronage). This expertise and its associated data guide investment and other operational decisions. However, when it comes to pricing, most jurisdictions rely on simplistic annual reviews that tend not to assess fundamental fare structures. Common practice involves equalising fare growth to changes in the Consumer Price Index, overlaid by ad hoc changes stemming from electoral and other political commitments. Consequently, fare levels have been stagnant in recent years — declining in real terms in some jurisdictions — and sometimes abruptly when there were public backlashes to sudden fare rises, as in Queensland (figure 10). Given that operating costs have increased by more than general inflation, fare recovery rates have fallen. For example, in New South Wales, total operating costs have risen by 7 per cent per annum from 2014 to 2019, while fares only rose by an average of 1.5 per cent per annum over the same period.

Figure 10 – In most cities, real fares are similar to 20 years ago
Public transport price indexes, 2000–2021



Furthermore, jurisdictional annual review processes generally do not examine holistically the interaction between:

- the base fare level — whether the current level of real fares is meeting a jurisdiction's needs, and reflects the social marginal cost of transport provision, including the interaction with road transport and congestion
- the fare structure of a jurisdiction — whether the current mix of, and differentials for, peak, modal, and distance-based pricing are optimised, given a jurisdiction's intent to recover operating costs, encourage behavioural change, and manage road congestion
- the concession policy of a jurisdiction — whether eligibility requirements or price differentials are effective and consistent with general equity objectives of the jurisdiction.

Apart from New South Wales, when jurisdictions do consider these factors, they usually do so sporadically and partially. For example, several jurisdictions have reviewed some of these factors over the past decade (such as Victoria and Western Australia), though these were one-off reviews often targeted to a specific policy challenge. As a result, fare settings are largely historical artifacts, and, in many cases, the underlying fare settings structures have not been examined in several years.

For the larger jurisdictions, an institutional model akin to that used in New South Wales has strong appeal. The NSW Government determines transport pricing policy, but an independent body — IPART — regulates prices, recommends improved fare structures, and publishes public information on fare decisions. This model reduces (though does not eliminate) short-run pressures on governments to avoid fare increases and improves transparency and accountability.

One peculiarity of the IPART approach is that it is required to set a *maximum* weighted average price, notwithstanding that the biggest risk for pricing is that governments set fares too low to stabilise the long-run decline in cost recovery rates. On this basis, there are grounds for regulating minimum fare increases, in addition to the existing regulation of maximum fare increases. To the extent that the latter is justified it is not about the risk of the misuse of market power, but rather to avoid circumstances where the justifiable subsidy to public transport operators was set too low.

The IPART approach could be improved by including regular empirical assessment of the impacts of fares on people experiencing disadvantage and social inclusion. Sometimes fare changes are both efficient and meet the needs of low-income users, but even where this is not the case, information on the distributional and social impacts of public transport pricing (and service provision) would help guide government decision making about the right balance.

Without an independent body, jurisdictions could still improve institutional arrangements by:

- publishing a long-term strategy for fare setting with explicit rationales for fare decisions
- retaining real fares by increasing fares annually by at least the Consumer Price Index (if not already customary) and, probably more desirably, growth in public transport costs
- publishing the expected impacts of fare reforms, including any distributional results
- holding open consultations with stakeholders
- periodically instituting holistic reviews. Infrastructure Victoria is an exemplar, having recently conducted a wide-ranging review of public transport fares that considered multiple and novel changes to fares.

For smaller jurisdictions, the above approach may be more cost-effective than wholesale institutional change.

Findings

Pricing for more efficient public transport



Finding 3.1

Peak periods could be more influential

Reducing the length of peak periods and increasing the fare differential using a peak surcharge would improve the effectiveness of peak pricing to shift users' travel times.

- There are grounds for morning peak periods that start later and end sooner to better match peak demand. The NSW peak period currently ends at 10 am, which is too late to encourage office workers to shift their travel times. In Victoria, off-peak discounts on all modes would encourage beneficial behavioural shifts and flatten peaks.
- Afternoon peaks may desirably start with school closure times to encourage non-students to shift their demand for bus services to less congested periods. Reflecting that demand peaks occur later for trains, so too might the commencement of peak pricing, suggesting that modal peak pricing may be justified in some jurisdictions.
- In the jurisdictions where crowding on public transport is limited, the timing and level of peak pricing should be more driven by cost recovery and affordability considerations until capacity constraints start to emerge.

Peak and shoulder pricing also appears to be an attractive approach for further flattening highly peaky demand in jurisdictions experiencing significant network crowding. However, several practical limitations suggest that changes to peak/off-peak pricing and duration should be undertaken first, and then trials of shoulder pricing considered.



Finding 4.1

Modal pricing is more cost-reflective than flat fares

Cities without modal pricing — Melbourne, Brisbane, Adelaide, Perth and Canberra — would benefit from its adoption, particularly where network capacity constraints emerge. This would better align fares with the social marginal cost of trips, improve cost recovery, and — depending on the extent of passenger responsiveness — make incremental improvements to managing network crowding.



Finding 4.2

There are benefits to combining peak, modal and distance-based pricing

Governments should consider using peak, modal and distance-based pricing in combination. Fare structures could account for distance travelled through the use of zones or by combining a network access fee and per kilometre charge.

The benefits of combining peak, modal and distance-based pricing will depend on how social marginal costs vary across the transport network. Particularly in jurisdictions with crowding or congestion problems, the benefits of more cost-reflective pricing are likely to outweigh any adverse effects of fare complexity, though the latter can be further alleviated through advanced ticketing and more informative smartphone applications.



Finding 5.1

Road congestion costs billions

Road congestion imposed an estimated avoidable cost on motorists, businesses and the environment of \$23.6 billion in 2018-19 and could credibly rise to about \$35 billion by 2029-30 in 2018-19 prices. Congestion costs are especially high in Australia's biggest cities — being as high as an estimated \$1500 per person in Sydney in 2019-20.

Existing charges on road users do not sufficiently internalise the external costs created by driving on congested roads.



Finding 5.2

Public transport pricing has limited effects on road congestion

The capacity for public transport pricing to make a large difference to road congestion is limited:

- The responsiveness of car use to public transport pricing is relatively low. A 20 per cent increase in public transport prices at peak increases car use by about 1 per cent.
- Fare increases tend to have larger effects on congestion costs than fare decreases. In the case of moves to free fares — the most extreme fare reduction available — there is strong evidence of increases in patronage, but not much evidence that it makes a substantive difference to road congestion.

Moving people from roads to public transport worsens crowding on public transport — the counterpart to road congestion — so that reductions in fares would need to be accompanied by service improvements on already stretched public transport routes.

**Finding 5.3****Road pricing is the most effective way of tackling road congestion**

Road user charging is the most direct means of addressing congestion because it can target congested routes at the right times. It promotes rather than inhibits walking and cycling, consistent with governments' policies. It would encourage more use of public transport and allow peak public transport prices to rise, with greater cost recovery, better targeting of those able to pay, and better incentives for people to shift to off-peak public transport and alternative travel modes.

The Australian Government's Future Fuels and Vehicles Strategy, aimed at promoting the uptake of electric vehicles, gives added importance to the adoption of road pricing.

**Finding 5.4****Well-designed car parking levies can partly relieve road congestion**

Car parking levies in congested city hubs can reduce traffic flows but should be lower for off-peak arrival and departure times.

Levies provide only a partial solution, particularly where congestion reflects through traffic in city centres.

Social and equity goals

**Finding 6.1****Reforms to make prices more efficient would generally also be consistent with equity goals**

Reforms to pricing structures and levels of public transport are broadly consistent with both equity and efficiency.

- Governments have largely achieved their primary goal of making public transport affordable, and existing fares are a very low share of low-income households' budgets.
- Modal pricing that made buses less expensive than trains would tend to favour lower-income users, who more frequently use buses.
- Peak use of transport largely serves employed people with higher incomes, justifying a significant margin between peak and off-peak pricing.

The availability, accessibility and frequency of public transport services can be more effective than lower fares in meeting the needs of public transport users, including those experiencing financial disadvantage. Service quality improvements will be at risk if governments do not stabilise mounting financial losses on public transport.



Finding 6.2

There is scope for better targeting of concessions

Concession fare eligibility could be better targeted in all jurisdictions.

Some people with low incomes pay full fares and some with high income or net wealth receive substantial fare discounts.

The most notable groups are seniors (for whom there is no means testing) and people on low incomes (either on Centrelink benefits or low-income workers).

State and Territory Governments should review public transport concession eligibility criteria to better target concessions to those who most need them.



Finding 6.3

Fare discounts can disadvantage lower-income users

Fare discounts that are based on travel volume may mean less frequent users of public transport, such as part-time workers, miss out. Likewise, fare discounts conditional on upfront fare payments may exclude public transport users who do not have the cashflow to buy such tickets.

Governments should investigate alternative ticketing products and technology that can improve the availability of fare discounts for concession card holders.

Technological progress and fares



Finding 7.1

Investing in ticketing to improve pricing

Account-based ticketing facilitates:

- improved convenience through the use of credit cards and/or smartphone applications in lieu of dedicated transport card media
- the use of more complex fare structures and 'best fare' technology to help match people to the fares that suit them
- the use of travel credits to create behavioural incentives for passengers and performance incentives for operators.

Given the fixed costs of advanced ticketing and that its benefits are more likely to arise in larger cities, major ticketing upgrades look less attractive for smaller jurisdictions in the medium run.



Finding 7.2

Using technology to better inform consumer choice

Smartphone applications already help passengers to better plan and make transport decisions, resulting in reduced travel times and lowering the effective 'cost' of transport. The provision of additional information could yield further benefits.

- All jurisdictions should ensure the availability of timetabling and real-time vehicle location information for passengers as this can reduce effective waiting times.
- The inclusion of pricing information within planning apps — or alternatively, in-app ticketing — could improve responsiveness to fare structures. It would improve the salience of fares, including of peak differentials or discounts, and would allow price comparisons between public transport and ridesharing.
- Jurisdictions that face significant crowding at peak times could consider following the examples of Victoria and New South Wales by providing passengers with real-time crowding information. This would allow self-selection into less crowded services, improving the effectiveness of peak pricing and in the short run provide some reassurance about using public transport as the pandemic retreats.
- The potential for Mobility as a Service can only be realised through comprehensive app-based information on fares, scheduling, and trip duration across alternative modes, including ridesharing and other last mile services.



Finding 7.3

Fares in a mobility-as-a-service context

The main attraction of Mobility as a Service (MaaS) is its potential to attract more commuters to public transport by improving the efficient use of multi-modal journeys and resolving first and last mile issues.

While its viability remains unproven, early trials show that pricing will be a key driver of its adoption. Fully integrated subscription fares will present the strongest incentive for passengers to use MaaS, but at the same time, would present potential inconsistencies with other incentive structures including peak and modal pricing.

The transition to MaaS with integrated pricing is non-trivial. It would involve the regulation of both digital platforms and business-to-business data-sharing arrangements, neither of which are traditionally core tasks for most public transport authorities. There may be a role for national regulatory frameworks.

The pursuit of MaaS with fully integrated pricing should be considered as experimental — worthy of trials, with net benefits as yet unproven. Governments should consider, as a more immediate step, taking a cost-benefit led approach to integrated, app-based ticketing, account-based ticketing, and improved planning apps.



Finding 7.4
Novel modes of transport

Improved first and last mile services reduce the implicit price of public transport as travel costs to catch buses and trains have costs that can exceed the monetary fare. Novel modes of transport — such as micromobility and microtransit — could make further incremental improvements as feeder-services to mass transit routes but neither are transformative.

If the regulatory, technological and social obstacles are overcome, autonomous vehicles could be an attractive option for many end-to-end journeys. The key policy challenge for governments would be determining the scale and nature of a residual mass transit public transport network, the role of government in subsidising or providing autonomous vehicle services as part of a public transport network, and managing the negative externalities of vehicle use in larger cities.

Getting prices right



Finding 8.1
Status quo fare setting institutions

Current arrangements in fare setting in most jurisdictions are characterised by minimal review processes, unclear objectives and a lack of transparency.

Most jurisdictions suffer from policy inertia; fare structures appear to be historical artifacts rather than based on a coherent long-run fare setting approach. Real fare levels have fallen in some jurisdictions and remained stagnant in others over the past few years, despite rising real operating costs.



Finding 8.2
Independence in fare setting

Independent fare regulators may help to overcome many of the issues inherent in other institutional approaches to fare setting.

While already operational in New South Wales, the involvement of an independent agency in fare setting could be valuable to other jurisdictions. Specifically, social marginal cost modelling or cost benefit analysis by an independent agency could help overcome structural policy inertia and fare stagnation.

1. Pressure points on public transport pricing

Key points

- * **The challenges facing public transport pricing today can be traced to the unprecedented effects on transport of the takeup of affordable and versatile cars.**
 - In just the 25 years from 1945, the share of motorised passenger travel of public transport fell from 70 per cent to less than 20 per cent and then stabilised at about 10 per cent by the late 1970s (and was at 10.7 per cent in 2018-19).
 - While public transport made profits in the first four decades after Federation when it was the main way of moving people rapidly around our cities, subsequent flagging demand and the incapacity to reflect cost pressures in fare increases, led to substantial losses. Just before the COVID-19 pandemic, ticket prices for urban public transport covered only between about 10 and 30 per cent of operating costs, depending on the state and territory.
 - In recent years, this trend has partly reflected the default pricing policy of jurisdictions to raise fares by the consumer price index, if that. COVID-19 has decimated patronage and revenue without equal cost reductions.
- * **Once its dominance in urban transport vanished, the provision and pricing of public transport has mainly rested on grounds that legitimately accept that full cost recovery is neither possible nor desirable.**
 - Public transport must be affordable and accessible because it is a human service as much as it is an investment in the efficient movement of people.
 - There are compelling efficiency arguments for subsidies to meet capital spending, and to account for the external costs and benefits of public transport, such as its marginal benefits in reducing road congestion.
- * **However, the net subsidies to public transport are large. For Transport for New South Wales alone, they were about \$3 billion in 2017-18. Such spending must be financed by giving up other public services, like healthcare, or by raising taxes, both of which impose costs on the community.**
- * **The risk of under pricing is under funding of service quality, like frequency, room to sit, journey speed and accessibility. Quality affects demand as much, or more than, fare levels. Small decreases in quality are a hidden price that can easily be equivalent to more than double the posted fare: hence 'Erode quality at your peril'.**
- * **Fare setting should generally recover a sustainable share of costs, recognising that well-structured fares — like peak pricing — may help to do that without undermining the fundamental purposes of public transport.**
- * **Fare setting must be nuanced at the jurisdiction level because public transport serves different roles in different Australian cities, with varying patterns of car use, and different modal options.**
- * **Notwithstanding 'public transport despair', the destructive effects of COVID-19 on public transport patronage will not endure. A shift to free prices to accelerate recovery will be ineffectual and just magnify losses in the interim.**

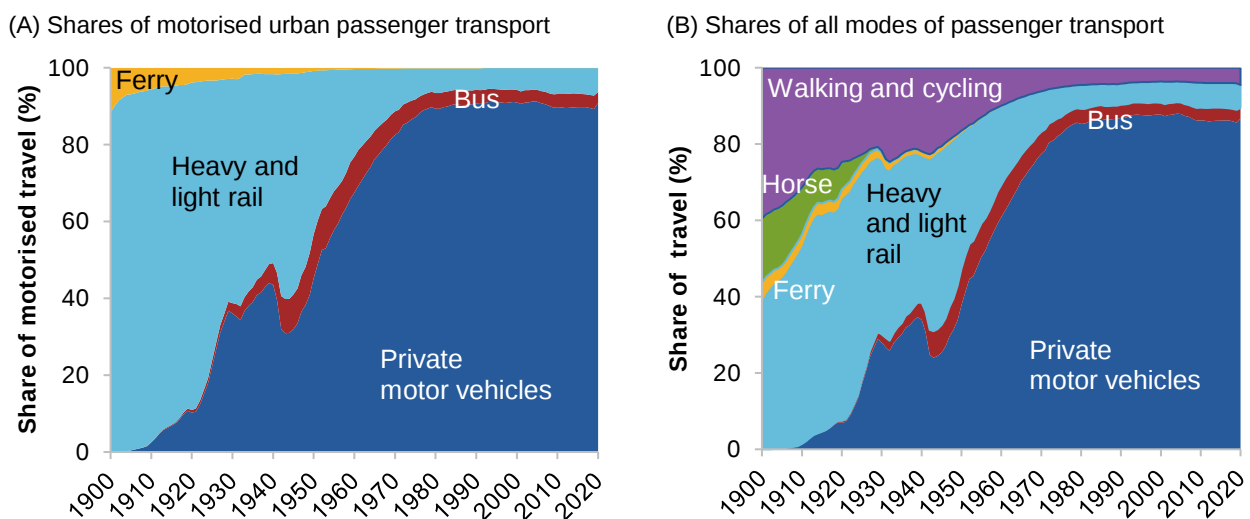
1.1 Context

Public transport in Australia is under stress, much of it precipitated by the impact of COVID-19 on patronage and revenue recovery. While the debilitating effects of COVID-19 on demand are likely to resolve, some underlying structural flaws will remain without policy adaptation. Among these are pricing arrangements — the subject of this report.

The challenges facing, and the role played, by public transport pricing today stem not so much from the inherent features of public transport, so much as the ascendancy of its primary competitor — the private motor vehicle. Initially, the car was a niche ‘toy for the rich’ (Fouquet 2012). Even after a surge in their numbers, there were only 1.5 motor vehicles per 100 people in 1921. But 100 years later there were 57.8 per 100 — a nearly 40 times increase.¹ Accompanying this, the share of public transport in total motorised transport services (measured as passenger kilometres) fell from 90 per cent in 1921 to less than 20 per cent in 1970. Much of this decline occurred in the 25-year period from 1945 (figure 1.1). If walking and cycling is included, this further reduces the relative role of public transport. For instance, kilometres travelled by walking and cycling are about the same as buses.

Figure 1.1 – How the car nearly killed public mass transit

Modal shares of passenger kilometres, 1899-1900 to 2019-20, all capital cities^a



a. The data relate to Australia's eight capital cities. The data from 1976-77 are from the accompanying statistical tables to BITRE (2020), with data from 1899-1900 to 1975-76 derived by applying the percentage growth rates from the corresponding data in BITRE (2014). The data for walking and cycling used in the construction of chart B involved extrapolation of past trends for the years 2014-15 to 2019-20.

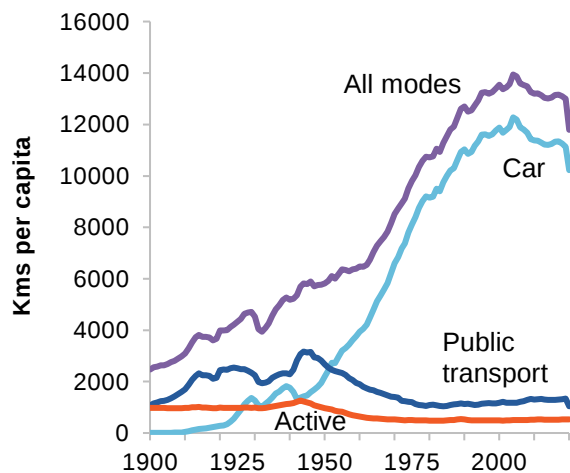
A host of factors led to this massive historical shift from mass transit to private transit in the 20th century — higher incomes, the reduction in the cost of owning and operating cars, and the convenience and freedom of movement they offer. Cars are not constrained by fixed routes, the radiality of train services (more about this later), service frequency, crowding, waiting times, travel time to the originating public transport service, or the ability to carry luggage and belongings. Kilometres travelled per person in Australia's capital cities grew by 400 per cent between 1901 and 2020, mostly through use of the private car (figure 1.2). This pattern partly reflects the increasing distance from home to work and other destinations as Australia's cities grew. This

¹ ABS (1951, p. 193, 2021c).

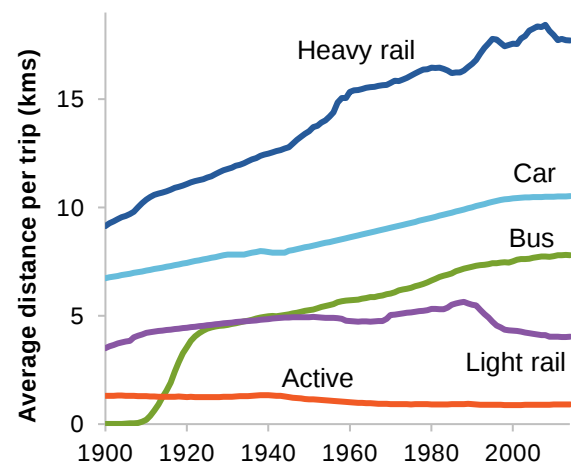
affected all transport modes except for active travel (walking/cycling) but gave cars a particular advantage. In turn, the long-term decline in public transport patronage reduced economies of scale — adding further pressures on costs, which have partly been reflected in fares. From the 1950s, urban transport fares have grown above inflation in Australian cities, though prices have not increased much in recent years (figure 1.3, table 1.1).

Figure 1.2 – The demand for mobility

City dwellers are travelling more ...
1900–2020

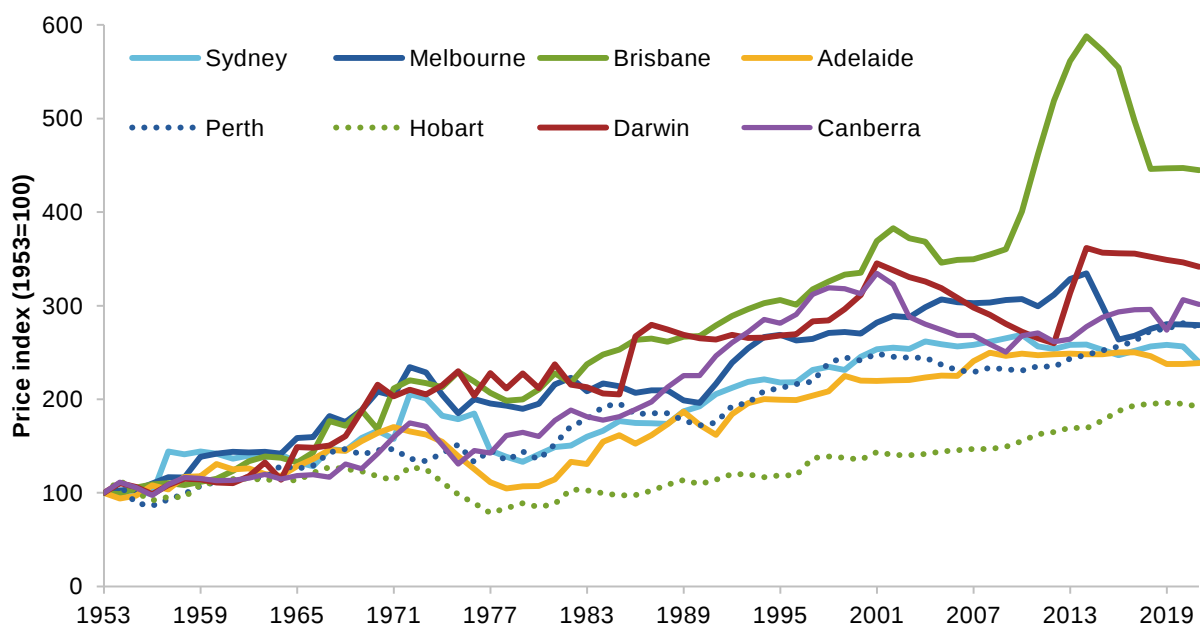


... and the distance travelled per trip has grown
1900–2014



Source: BITRE (2014, 2020) and ABS (2019c, 2019a, 2020b, 2021e).

Figure 1.3 – Real public transport prices across jurisdictions have generally grown^a



a. Based on combining BITRE and unpublished ABS price data, deflated by the consumer price index for each capital city for the fiscal years year ending 1953 to 2021. Quarterly data for real prices over the last 20 years are in chapter 8.

Source: Unpublished ABS data, ABS (2021a, tables 1 and 2) and BITRE (2017).

Table 1.1 – For most of the last 70 years, public transport prices have exceeded inflation
Trend growth rates (real), End June 1953 to end June 2021^a

Jurisdiction	1953 to 1966	1966 to 2000	2000-2021	1953 to 2020
	%	%	%	%
Sydney	2.5	1.3	-0.1	1.3
Melbourne	3.8	1.1	-0.2	1.4
Brisbane	2.9	2.0	2.0	2.4
Adelaide	2.5	1.3	0.6	1.4
Perth	2.6	1.7	0.7	1.6
Hobart	1.5	0.4	2.0	0.9
Darwin	2.5	1.6	0.5	1.8
Canberra	1.2	2.9	-0.1	1.8
All capitals	2.9	1.3	0.3	1.5

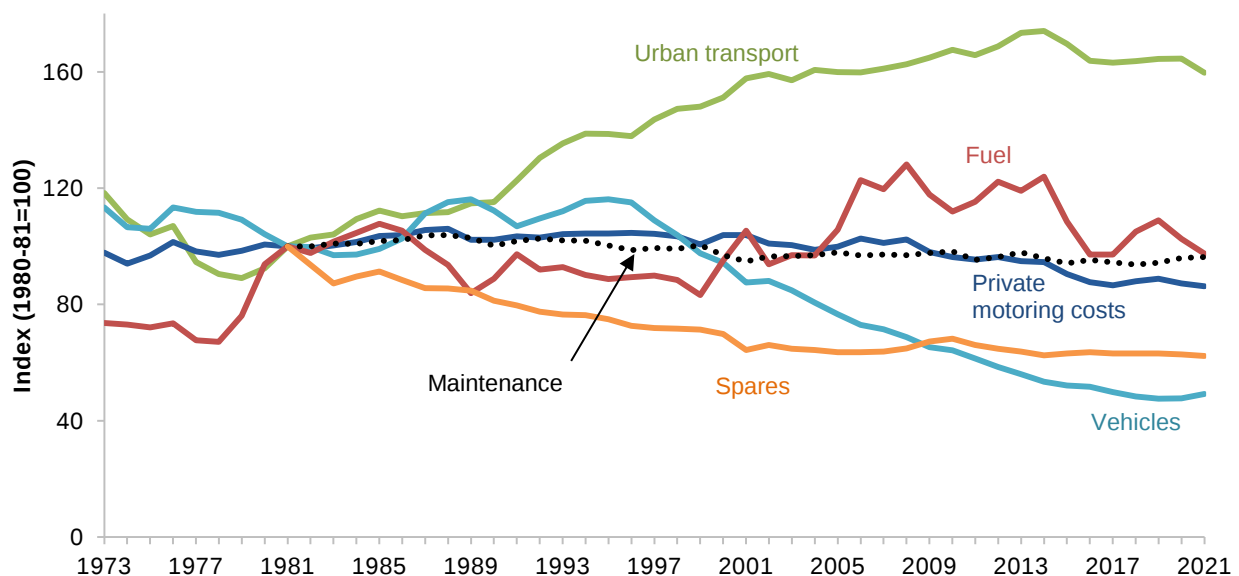
a. The public transport data from 2000 are based on unpublished ABS data and previous data are from BITRE (spliced on the basis of growth rates). Both datasets exclude taxis, which are usually included in the ABS definition of urban transport. Growth rates are based on the logarithmic trend rate. Nominal public transport prices were deflated by the consumer price index corresponding to the jurisdiction.

Source: Unpublished ABS data, ABS (2021a, tables 1 and 2) and BITRE (2017).

While governments have not always passed costs onto fares, over the longer term, public transport fares have increased compared with the ‘price’ of private vehicle mobility, which will have further discouraged patronage (figure 1.4). In part, the widening gap in price trends reflects differential cost pressures. Real wages have risen in Australia and public transport network costs are heavily affected by labour costs. For example, labour costs account for about 70-75 per cent of bus network costs in Tasmania and the ACT, with driver costs comprising a substantial share of these (MetroTas 2020, p. 34; MRCagney 2015b, p. 39). Private vehicles have the cost advantage over public transport that the driver does not require wages to provide transportation services to themselves or their passengers. This means that private motoring costs have faced downward pressure due to steeply decreasing prices of vehicles and spare parts, and muted maintenance cost changes. (Fuel costs have sometimes partly negated these downward trends, but not enough to change the overall picture.)

Notwithstanding the emerging stresses on the demand for public transport, fares provided sufficient revenue to approximately meet costs until about 1970s, before steep declines in cost recovery after that (Kerin 1987). While there are insufficient data on long-term trends in cost recovery rates, the most recent evidence shows both low and declining rates in capital cities (figure 1.5). This partly reflects that growth in fares have been subdued and sometimes negative from 2001 to 2020 — table 1.1 and chapter 8), driven less by a coherent pricing policy, and more by inertia, political imperatives and non-targeted approaches to meeting affordability goals. This approach has left governments susceptible to setting fares that are too low for users who have a high ability to pay for services and who benefit strongly from public transport subsidies, which reduces the fairness and efficiency of public transport services. The introduction of the Free Tram Zone in Melbourne and the decision to reverse price increases in Queensland are particularly notable. Most recently, the impacts of COVID-19 on patronage has further reduced revenue without offsetting reductions in costs, though this effect will probably be transitory.

Figure 1.4 – The relative consumer cost of mobility
Real prices, 1972-73 to 2020-21^a



a. For this measure of prices, urban transport includes taxis as well as public transport, but the estimates are close to the ABS unpublished series for public transport where the series overlap. All prices are relative to the all-groups consumer price index and relate to the average of the 8 capital cities. Motoring prices include the prices of vehicle purchase cost, fuel, maintenance, spares and other private vehicle services.

Source: ABS 2021 (*Consumer Price Index, Australia, June*, table 9, Cat. no. 6401.0).

The result is that the funding gap between revenue and costs is large, with minimal recovery of fares, exemplified by Darwin, Canberra and South-East Queensland. Even in those jurisdictions with higher cost recovery rates, the budget spending (including capital spending) is large — for example, an estimated \$4900 per household in 2018-19 (IPART 2020c, p. 4).²

Inefficiency may be adding to cost pressures

While cost-recovery rates appear low compared with international jurisdictions (as suggested by TTF 2016), there are idiosyncratic characteristics of Australian public transport networks that reduce cost recovery — low urban density, the greater geographical coverage of Australian public transport networks (especially in comparison to North American and European public transport networks), as well as high levels of car ownership.

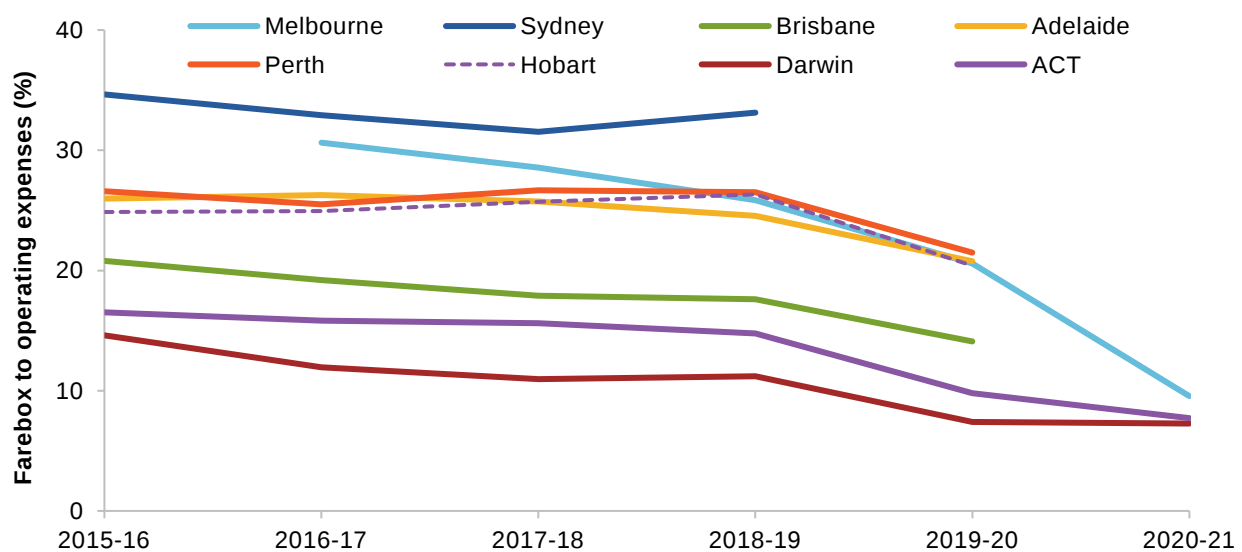
Relative efficiency levels may also play a role. However, given the focus of this report, we do not address the cost efficiency of public transport services in any detail, though there appears scope for some jurisdictions to reduce costs without a deterioration of overall service quality. The Independent Pricing and Regulatory Tribunal (IPART 2015, p. 2) estimated, for instance, costs in Sydney's public transport network were about 15 per cent higher than their efficient level. In 2012-13 and 2013-14, Canberra's bus costs per service kilometre were about 30 per cent higher than Perth or Adelaide and 50 per cent higher in terms of costs per service hour (MRCagney 2015b, p. 254). Increased cost pressures (and lower cost recovery rates) in subsequent years suggest this is unlikely to have improved significantly. The adoption of franchising models in jurisdictions not currently using them could also produce gains, with some suggesting this would realise

² This is for all New South Wales, not just greater Sydney.

long-term savings in costs of between about 17.5 to 25 per cent for rail and about 30 per cent for bus services (PwC 2017). However, recent Australian experiences with franchising suggests that these may overstate the gains (Donaldson 2017).

Regardless, looking for cost savings would allow subsidies to be directed at the fare and service settings that led to the best outcomes for consumers.

Figure 1.5 – Fares as a share of operating expenses
Metropolitan cities, 2015-16 to 2020-21^a



a. In some cases, it was difficult to separate unregulated income and expenses (for example, associated with commercial advertising), but these values are small. *Sydney* — in addition to metropolitan services, this includes regional NSW TrainLink data for costs and revenue, and outer metropolitan bus services. *Melbourne* — based on farebox revenue and operating cost subsidies to providers. *Brisbane* — this is the fare revenue as a percentage of direct operator costs for South-East Queensland. The costs for those operators that do not collect passenger farebox revenue are not included, which will lead to overstatement of cost recovery rates. *Hobart* — sourced from Metro Tasmania Annual Reports. *Darwin* — this includes bus costs and revenue for Darwin and Alice Springs only. *ACT* — data for buses only. Operating cost excludes Flexible Transport & Charter Services, which is consistent with Transport Canberra accountability indicators.

Source: Unpublished data from jurisdictions and annual reports of transport authorities.

1.2 With sufficient subsidies, public transport still plays a major role

Cars have not destroyed public transport. The public transport share of motorised transport services stabilised between 9 to 10 per cent from the late 1970s. Indeed, just before the pandemic it was edging towards 11 per cent, the highest it had been since the late 1970s.

The continued role of public transport reflects the subsidies provided to it and the basic economics of cities. Land for car parking is scarce. Cars are flexible and convenient, but can be slower than rail for longer urban commutes. So, for some trips, the time costs of travelling by car — which has a monetary equivalent — outweighs its other benefits. More generally, for all modes of travel, the increased travel times and distances travelled associated with bigger cities have a limit once the benefits of access to jobs are outweighed by the adverse impacts on wellbeing of time in transit. City structures and people's decisions about where to live

and work change so that average one-way commutes tend to finally hover around 35 minutes (BITRE 2016). The car and public transport are closer to equals in that equilibrium.

Subsidies are strongly justified

It is widely recognised that fares should not be set to recover the full costs of supplying public transport as government, acting on behalf of the community as a whole, is a superior purchaser of some of its outputs.

Government plays a role in meeting the transport needs of people with lower incomes (chapter 6). Public transport promotes the economic participation and social inclusion of those for whom the use of alternative ways of travelling are unaffordable, impractical, or not possible, some of whom are the most vulnerable and isolated in the community. Not everyone owns cars, can afford to use them much, or is eligible for a driver's license. Accordingly, whereas once public transport was essentially a commercial activity, it is now more like a human service. Public transport can only meet the goal of ubiquitous access if it is reasonably priced and provides sufficient spatial coverage and service frequency. This alone requires large public subsidies given Australia's low-density cities.

There are also compelling efficiency reasons for subsidies. Taxpayer-funded subsidies can be a more efficient way of recovering the high fixed costs of public transport and of encouraging higher frequency services — which can help realise economies of scale and generate cost efficiencies.

Public transport also provides a relief valve for the congestion caused by cars (chapter 5). Drivers with an intolerance for the cost of congestion will decide public transport is better. But the congestion that remains is still not optimal as any individual driver still on the road does not pay for the congestion costs they impose on others. Every driver is engaged in an involuntary exchange of bads. In the absence of road pricing, providing subsidies to public transport can partly remedy those 'externalities'. The environmental costs of cars — air pollution, noise and greenhouse gas emissions — are also relevant, though the Independent Pricing and Regulatory Tribunal (IPART) finds them to be less than 20 per cent of the congestion costs per passenger kilometre (IPART 2020d, p. 4).³ Accident costs not already covered by insurance are relatively small at about one cent per passenger kilometre (p. 19), but still provide grounds for an additional subsidy for public transport.

The implication of these efficiency objectives is that, subject to equity goals, prices should not relate to average costs, but to the *incremental* costs and benefits of providing services (so called 'social marginal costs'). The framework for social marginal costs is set out in detail in chapter 2 and applied in chapters 3 (peak pricing), 4 (distance and modal pricing) and 5 (road congestion). Depending on the price that is determined using such an approach, prices may have to be further lowered to meet the goal of affordability, including through targeted concessions for those in need (chapter 6). While social marginal cost pricing is not the dominant framework in Australia, it is accepted by Infrastructure Victoria and the NSW Government (where it is operationalised by IPART), and could usefully play a bigger role in the determination of prices and subsidies.

The essential point is that the dominance of the car has meant that pricing policy for public transport has pivoted away from the provision of a commercially viable service to completely different purposes that emphasise its (marginal) social and efficiency benefits.

The changing role of pricing also means that the regulatory approach that might otherwise be applied to a utility service is not applicable despite the obvious similarities with other essential services. Just like them, public transport requires large investments, has peaks that can lead to choke points in supply, there are network externalities and economies of scale, and customers have varying degrees of responsiveness to prices. Reliability of services are central to the value of the network, as in water, electricity, and

³ Another argument sometimes put to justify public transport subsidies is that roads also get subsidies.

telecommunications. Governments play an influential role in provision and oversight. However, while there may be only one supplier of rail in a city — a monopoly of sorts — the relevant market is mobility. There are many substitutes for public transport — motor vehicle travel, walking, and cycling — which makes it impractical to recover the high fixed costs of the network through two-part tariffs or through elaborate forms of price discrimination. Standard utility pricing that aimed at full cost recovery would not be achievable in public transport and would be inconsistent with its purposes. Regulatory advice on maximum prices should not have the goal of preventing excess profits, but in ensuring that prices do not exceed social marginal costs or, if it is the binding constraint, thresholds for acceptable affordability (chapter 8).

But taxes are more than transfers

Pricing and its associated subsidy settings need to recognise that any incremental subsidy to public transport must be raised through higher taxes, which have their own efficiency and equity effects, or involve giving up other valuable public services, like health care. If governments get their fare structures and levels wrong, it risks accumulating unsustainable subsidies, an issue that governments are acutely aware of (for example, NSW Government 2018, pp. 157–160).

In turn, budgetary pressures may lead to under-funding, and a reduction in service quality, which can be as, or even more, influential in reducing demand and people's willingness to pay as the visible monetary cost of fares. Service quality includes waiting times, service frequency, travel time, crowding and, as accentuated by COVID-19, safety. If funding constraints lower quality, it amounts to an invisible price increase that further reduces patronage (box 1.1).

Prices should not be directed at minimising car use

This report avoids the view that public transport is an *inherently* superior mode of travel than motor vehicles, and that the goal of pricing should be to maximise use of public transport. It cannot reproduce the convenience and flexibility of motor vehicles (and over shorter distances, walking and cycling). Indeed, one of the benefits of public transport is that by lowering road congestion, it improves the useability of roads to the benefits of car users. Accordingly, public transport and its pricing serve the needs of road users too. Moreover, like other human services, subsidisation of public transport must be constrained by its displacement of other options for government spending, limits on the acceptability of additional taxes and the fact that, at some point, the incremental benefits of further reducing road use externalities are not worth their incremental costs. Prices may also have to adapt to technological and economic developments, such as autonomous vehicles, which may increase or decrease congestion (chapter 7) and direct road pricing (chapter 5).

1.3 Understanding the public transport system

Pricing necessarily must consider the specifics of demand and supply of transport services across Australia's major cities. City size, design and geographical constraints are pivotal, as are the different social goals of governments.

Box 1.1 – ‘Invisible’ prices play a major role in determining the demand for public transport

A government can lower the effective price of public transport by increasing the frequency of service, comfort levels, customer safety, speed, and accessibility. For instance, based on empirical estimates of the value of such quality attributes (ATAPSC 2021; Douglas 2021), it is estimated that in 2021, the implicit cost addition to a train fare of \$4.55 for a 30 minute trip, 20 minutes of which is spent standing is \$21 or 4.6 times the observed cost. (This scenario makes assumptions about other aspects of the trip, such as waiting times.) If service quality were to rise so that people spent no time standing and the trip duration was reduced by just five minutes, the additional cost would be \$15.60. In this instance, the fare for the lower quality service that would make the average customer as well off as taking the higher quality service would need to be minus 85 cents — that is, they would need to be paid to travel. The example shows how the implicit price of quality can readily be as or more important to consumers as fares. Whether it is best to use fares or service quality as the basis for increasing demand will depend on the costs of augmenting any given aspect of service quality.

Similar issues arise when considering the relative role of fares and service quality in stimulating patronage, and the implications for subsidies. In the scenario above, a 10 per cent increase in fares raises the overall effective cost of travelling to the customer by only 1.8 per cent. Patronage is more responsive to improved service quality than to lower fares given small average demand fare elasticities. And patronage is even more responsive to additional services. Accordingly, lowering fares have only modest impacts on patronage, especially at peak times. In some circumstances, optimal pricing may involve increasing fares while investing in better service quality. This can still involve a higher subsidy rate as the effect of higher fares in lowering subsidies may be offset by the costs of improving services.

The implication is that the relationship between fare levels and subsidy rates is context-dependent and that there can be a sound basis for simultaneously setting higher fares and higher subsidy rates.

Results of the kind above rely on the reliability of the parameters, most of which originate from asking people about what they prefer (stated preferences) rather than observing their behaviour as they confront different options (revealed preferences). The major concern with stated preference studies is that the behaviour people assert they would have (such as a willingness to pay for a faster service) is not tested in real life, with the concern that they tend to overestimate costs and benefits. However, properly conducted stated preference approaches may produce valid results. Notably, in the transport planning guidelines, the two revealed preference studies on cost of access/egress walking times gave higher estimates of their implicit costs than stated preference methods (Douglas 2021, p. 5).

State and territory governments are the main architects of Australia's public transport services. They fund infrastructure and services (sometimes through franchise agreements with commercial parties), plan and coordinate services, regulate, sometimes directly supply services, and above all, set fares. States typically set fares through the budget process, giving great weight to historical government fare policies, including those arising from election commitments (chapter 8). There is some involvement in public transport by other

levels of government — the Federal Government provides investment funding for selected public transport projects while local governments engage in urban planning and in rare cases, service provision.⁴

Urban public transport services in Australia include trains, buses, ferries, and trams/light rail (table 1.2). Depending on the State and Territory and mode of public transport, urban public transport services are either provided by public providers or by private providers that have franchising or other funding agreements with State governments.

Table 1.2 – Public transport networks in Australian capital cities^a

City	Modal forms	Public transport coordinator	Operator type
Sydney	Train, bus, ferry, light rail	Transport for NSW	Mixed
Melbourne	Train, bus, light rail	Department of Transport	Private
Brisbane	Train, bus, ferry	Translink	Mixed
Adelaide	Train, bus, light rail	South Australia Public Transport Authority	Private
Perth	Train, bus, ferry	Public Transport Authority of Western Australia	Mixed
Hobart	Bus	Department of State Growth	Public
Darwin	Bus, ferry	Department of Infrastructure, Planning and Logistics	Private
Canberra	Bus, light rail	Transport Canberra	Mixed

a. Excludes regional/intercity and interstate forms of mass transit and community transport services. The ferry in Darwin is privately-owned although it receives funding from the Northern Territory government.

Source: Various official State and Territory public transport websites.

In the five major capital cities, public transport is characterised as comprising a radial suburban rail network connecting the suburban corridors to the CBD area akin to a hub-and-spoke, alongside tram and/or bus networks (Dodson et al. 2011). In these cities, bus and tram networks often serve to expand public transport coverage as complementary services in areas where there is little rail coverage, at times acting as feeder services for rail. In rare cases they compete directly against rail services (Clifton and Mulley 2016). The remaining capital cities (Hobart, Darwin, and Canberra) are largely reliant on bus services. Darwin also has a private ferry network that is subsidised by the Northern Territory government. Canberra has a developing light rail network that coexists with frequent bus services along the same routes — one of the exceptional instances where government funds two mass transit systems providing similar services.

The differential role of mixed services means that modal pricing — to the extent desirable — will only be relevant to a few jurisdictions. This underlines the point that there can be no universal guidance on optimal pricing.

Historical planning decisions and city design influence public transport performance for different trip characteristics

In most industries, the combination of demand, costs and feasible prices — and therefore relative returns — determine where, when and to what degree investment and associated services are provided. In contrast, public transport is a victim of historical investments and the constraints posed by existing city design. The link between prices and costs is largely absent.

⁴ For example, Brisbane City Council is a bus service delivery partner for Translink, a public transport agency under Queensland's Department of Transport and Main Roads.

This reflects both the social purpose of public transport and that Australia's public transport networks are the product of successive urban and transport planning decisions in states and territories. Our cities have grown outwards over time and at a faster pace than accompanying public transport infrastructure. As a result, public transport performance — service frequency and service coverage — is strongest in the inner suburbs and CBD areas (in addition to a few major suburban corridors) despite only a third of Australian jobs being in these areas (Infrastructure Australia 2019a).

This is reinforced by the layout of public transport in Australian cities. Public transport is designed principally to move people towards the CBD ('radial' trips) or to multiple city centres in the few polycentric Australian cities — Canberra and to a lesser extent, Sydney (Loader 2019a). Such radial trips make up a large proportion of trips within Australia's public transport network across all Australian cities. The radiality of public transport means that multiple routes converge together to bolster service frequency and accessibility in inner city zones (Infrastructure Australia 2018). While 96 per cent of inner suburb residents live within walking distance of medium-to-high frequency public transport,⁵ this falls to 81 per cent and 44 per cent for those residing in middle and outer suburbs respectively (Infrastructure Australia 2018, p. 28).

However, the focus of public transport on moving people to city centres has a drawback because many people also want to move laterally to workplaces and other activities, a task that is often more readily achieved through private vehicle transport. While bus services partly accommodate non-radial trips, it is possible that new models of services, particularly mobility as a service and subscription pricing (chapter 7) may overcome the rigidities of traditional models of public transport network designs and associated pricing.

Patterns of use of public transport

Most Australians use public transport at least several times a year

In early 2020, just before the pandemic, about 23 per cent of Australian adults — some 4.5 million people — used public transport one or more times a week and about 55 per cent of Australian adults used public transport at least several times a year (table 8 from ABS 2021d, table 3.1 from 2021b).⁶ About one in three Australians never or hardly ever used public transport. Usage varies by jurisdiction — a reflection of the size, layout, history and transport infrastructure of different Australian cities (figure 1.6).

Reliance is much greater in the two states with the largest cities, such that the share of adults making frequent use of public transport is about three times higher in Victoria than the average for the three smallest jurisdictions. (The ratio is even greater when comparing the shares who travel all or most days on public transport.) The impacts and the purposes of transport pricing will therefore vary across different jurisdictions.

Reflecting the role of public transport for getting to work, about 16 per cent of people with a job used public transport all or most days a week compared with less than 9 per cent of those without a job (ABS 2021b). Nevertheless, about one in three jobless adults used public transport at least monthly. Australians aged 65 years or more — who are mostly outside the labour force — used public transport much less often than those aged 15-34 years (10.4 per cent at least weekly compared with about 34 per cent), a pattern reinforced by the much

⁵ Defined as living within 800 metres of a train station or within 400 metres of other public transport service, where during the morning peak there are four or more services.

⁶ There is no detailed ongoing national survey of public transport use in Australia, with most data based on information collected at the state and territory level, or through intermittent national surveys. Detailed data at the national level have been collected for public (and other forms of) transport in the periodic population census for journeys to work, but not for other purposes. Nonetheless, collectively the evidence is sufficient to assess patterns of use of public transport and its alternatives. We have buttressed existing evidence with data requested from state and territory governments.

lower share of younger people holding motor vehicle licenses. Even in those jurisdictions where public transport is most often used, private cars dominate as the prime transport choice in all jurisdictions (figure 1.7).

Figure 1.6 – Frequent public transport use is highest in Victoria and New South Wales March 2020 (before COVID-19 restrictions)^a



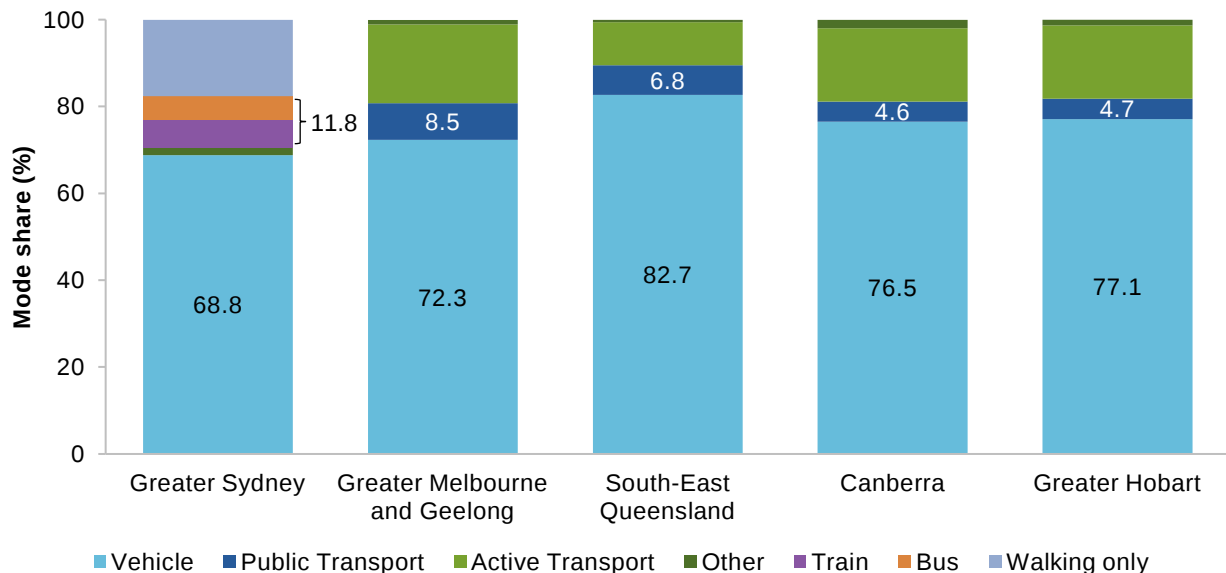
a. Frequent public transport use is defined as using public transport 'all or more days' or 'at least once a week'. Respondents were aged 18 or more years. Other includes the ACT, Northern Territory and Tasmania.

Source: ABS (*Household Impacts of COVID-19, March 2021*, table 3.1, Cat. No. 4940.0).

Walking and cycling ('active' transport) is also more frequently used than public transport because it and cars are often better suited for short trips. (The data in figure 1.7 relate to trips for all purposes at any time of day, including social and recreational trips and shopping.) Incremental changes in public transport pricing are unlikely to affect the prevalence of walking because the distances travelled are so short. For instance, in Sydney in 2018-19, the average distance travelled for walking (without any mode change) was 800 metres compared with average distances for trips by train of 18.3 kilometres, bus of 7.8 kilometres and cars of 9.4 kilometres (TfNSW 2020b).⁷ That said, the experiences of cities that have introduced free fares is that, at that extreme end of the pricing continuum, they displace active transport (as discussed in chapter 5) — often seen as a perverse impact of low fares given the health benefits of physical activity.

⁷ Car distance is a weighted average of distances by a driver and a vehicle passenger. The data here and in figure 1.7 exclude walking that involves a mode change (so-called 'walk-linked' travel) because the intention is to gauge the relative importance of exclusive transport modes. The distances (in Sydney) of walk-linked trips are only a bit shorter (600 metres) than walking only trips, which means that walk-linked trips will generally involve a mix of a short walk and a longer-distance public transport trip. Otherwise, people may as well have walked exclusively from their originating point to the final destination (though free CBD services can discourage even short walks).

Figure 1.7 – Most trips involve vehicle or active transport
Mode share by transport mode for all travel purposes (%)^a



a. Modes disaggregated for Transport for NSW due to data availability (marked as *). Walking for getting to another mode of transport is excluded. Figures may not sum to 100 due to rounding. Active transport comprises walking/cycling.

Source: Transport for NSW, *Household Travel Survey* (2020b), Department of Transport, *Victorian Integrated Survey of Travel and Activity* (2018), Department of Transport and Main Roads, *Queensland Travel Survey* (2020b), Department of State Growth, *Greater Hobart Household Travel Survey* (2019), Transport Canberra & City Services, *ACT and Queanbeyan-Palerang Household Travel Survey*.

Public transport use varies by trip purpose

Public transport use is highest for travel to work and education compared with recreation, shopping, and other trip purposes, partly reflecting the radial design of the network (figure 1.8). Once children attending school are excluded, public transport was the most common method to travel to educational institutions, representing 50 per cent of (weekday) journeys in 2018. These transport patterns are for Victoria but are likely to be broadly representative of patterns in other jurisdictions.

Further evidence of the strong association between use of public transport and commuting shows up in periodically collected detailed population census data on household commuting, which as a census, provides the most accurate picture of use of public transport for that purpose. Public transport serves a much bigger role as a transport mode for getting people to work (figure 1.9) compared with the limited use of public transport for all purposes (figure 1.7), indicating its relative efficiency of carrying workers at reasonable speeds to the parts of cities where employment is most concentrated.

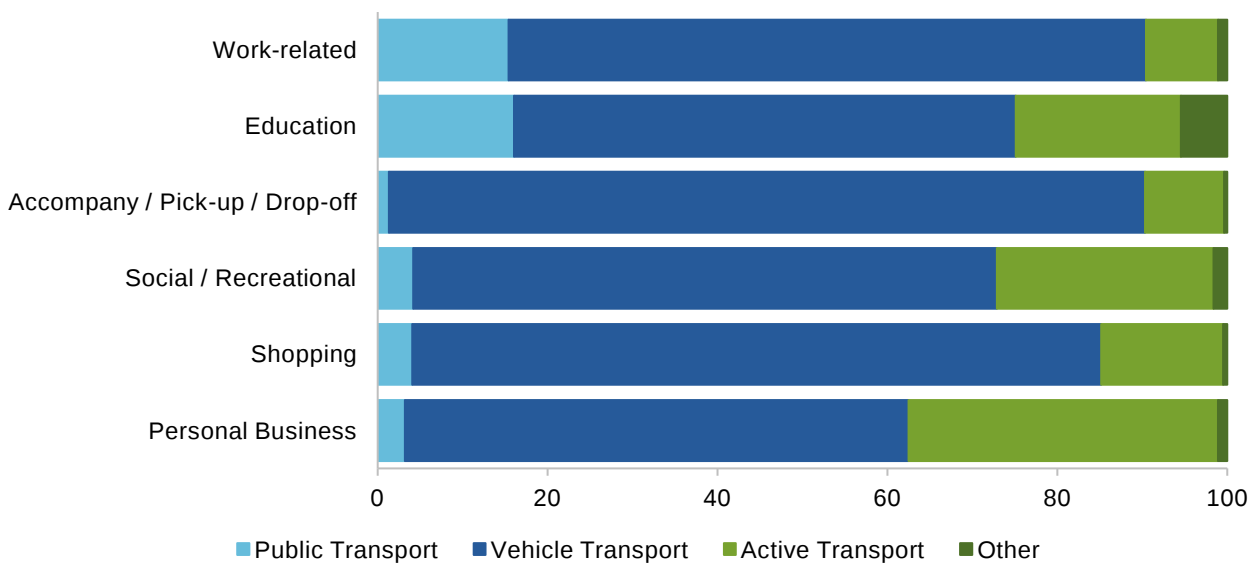
As is the case for trips for any purpose, the public transport commuting mode share is highest in Sydney and Melbourne, and in turn for those living in inner suburbs compared with outer suburbs. For residents of Australia's five major capital cities, the public transport mode share for journeys to work was highest for those residing in inner suburbs at 31 per cent, followed by middle suburbs at 22 per cent and outer suburbs at 12 per cent (Infrastructure Australia 2018).

Most public transport trips to work involve just one mode of public transport. However, in three cities — Perth, Melbourne, and Sydney — multi-mode trips are important, which is relevant to inter-modal pricing

(figure 1.10 and chapter 4). As light rail develops in Canberra, inter-modal pricing will also become relevant in that jurisdiction.

Figure 1.8 – Public transport mode share is highest for work and education-related trips in Victoria^a

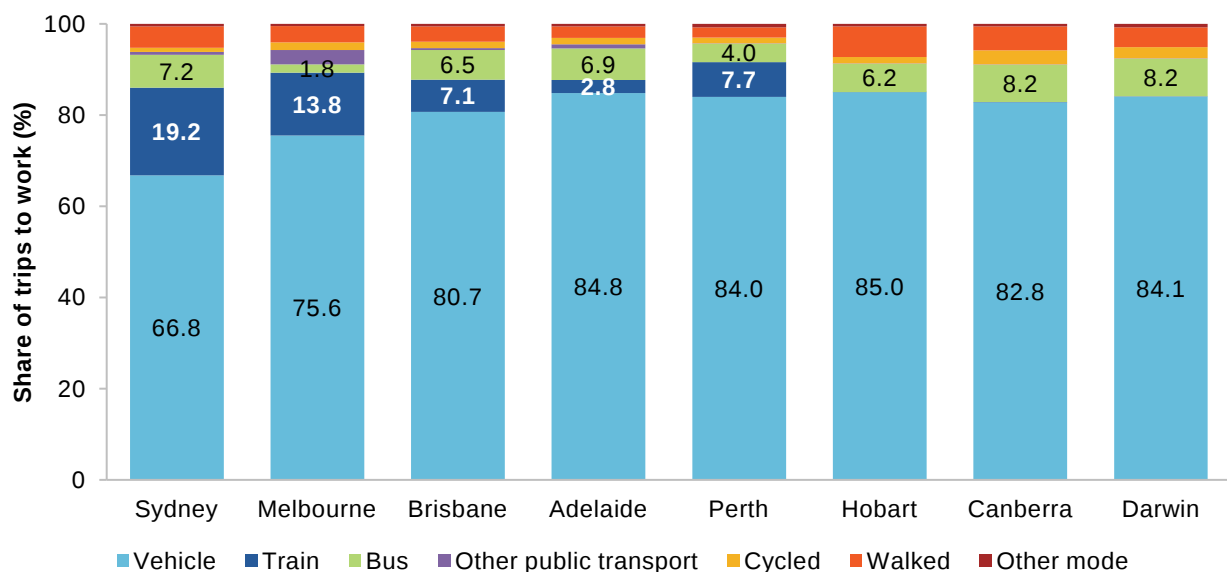
Mode share by trip purpose



a. For education, 'other' includes use of private buses for school children.

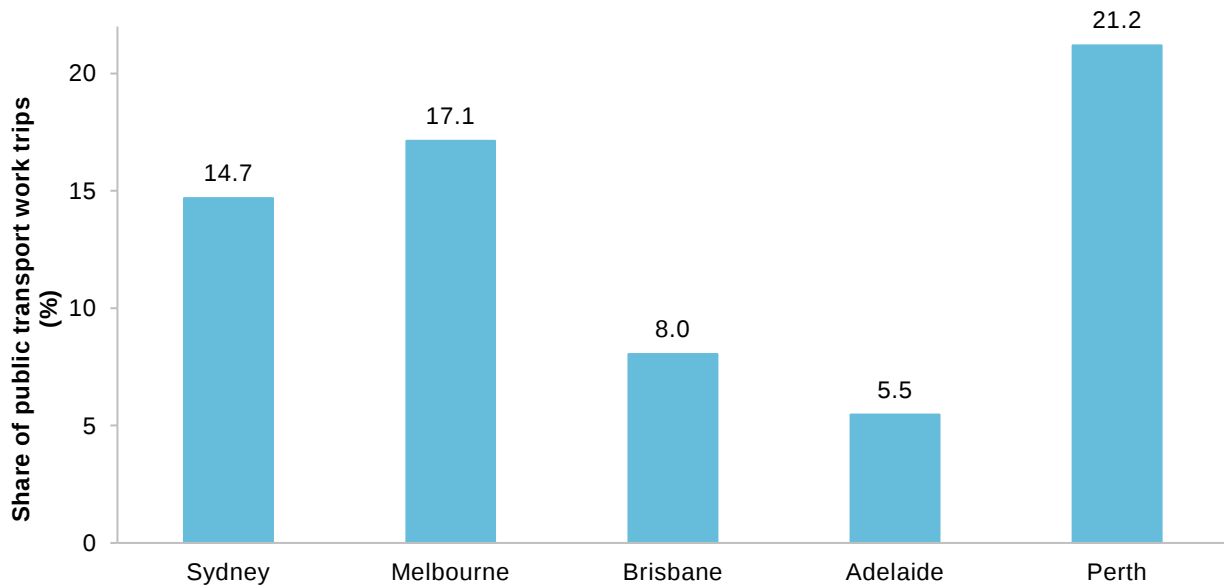
Source: Victorian Integrated Survey of Travel and Activity 2018.

Figure 1.9 – Public transport is more important for commuting^a



a. Mode share for greater capital cities. Walking is walking only. Where people use a variety of modes (such as a train, a bus and walking), the trip is allocated to the dominant mode.

Source: ABS 2018 (*Census of Population and Housing: Commuting to Work - More Stories from the Census, 2016*, Cat. no. 2071.0.55.001).

Figure 1.10 – Some public transport trips involve more than one mode of public transport^a

a. Multimode public transport trips are those where at least two modes of public transport are used.

Source: ABS 2018 (*Census of Population and Housing*).

Customer spending

People's transport spending depends on people's travel patterns, fare levels, city design and household characteristics. Overall, household spending on public transport in Australia's capital cities was estimated to be about \$2.2 billion in 2015-16 (of which Sydney accounted for 45 per cent), though this masks the true value of consumption costs to the community of public transport given low cost-recovery rates (table 1.3).

And just as the share accounted for by public transport in total transport trips is low, so too is the share of public transport spending in total consumer transport spending. Across all capital cities, spending on motor vehicle costs was more than 25 times that on public transport. In the smallest cities, where the motor vehicle is overwhelmingly the dominant mode of travel, spending on private motoring was between 60 and 140 times greater than public transport. The implication, drawn out further in chapter 6, is that household budgets are much more sensitive to private motoring prices, which places the affordability concerns about public transport pricing in context.

While average weekly spending per household is modest, the highly skewed distribution of public transport use means that spending will often be more than ten times the average. For example, in 2021, two full fare-paying adults in a household would pay \$90 for a 7-day weekly pass for travel in Melbourne (myki) and would have fares capped at \$100 weekly in Sydney (Opal).

**Table 1.3 – Consumer spending on public and private transport
2015-16^a**

	Public transport average household spending	Private motoring average household spending	Public transport spending	Private motoring vehicle spending	Total transport spending	Public transport share of transport spending
	Weekly (\$)	Weekly (\$)	Annual (\$m)	Annual (\$m)	Annual (\$m)	%
Sydney	11.58	211.51	1 056	19 283	21 860	4.8
Melbourne	7.69	205.13	671	17 906	19 677	3.4
Brisbane	6.51	193.34	287	8 512	9 171	3.1
Adelaide	4.19	150.05	114	4 073	4 319	2.6
Perth	4.35	170.41	169	6 637	7 002	2.4
Hobart	4.47	183.29	21	864	928	2.3
Darwin	1.37	188.71	4	490	502	0.7
Canberra	3.66	209.41	28	1 619	1 740	1.6
Capitals	7.75	195.21	2 349	59 180	65 025	3.6

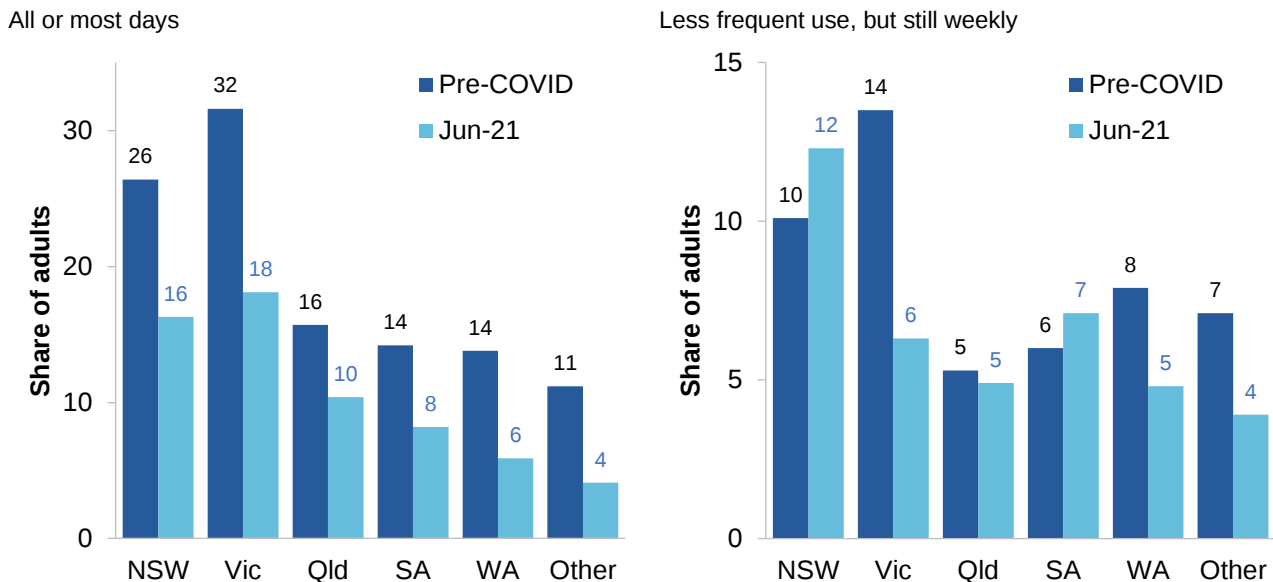
a. The total values of spending by city are estimated by as 52 times the number of classifiable households times average weekly household spending. As the *Household Expenditure Survey* will be subject to sampling errors and misreporting, these are estimates only, though they correspond closely to farebox collected for those jurisdictions where that value is available for 2015-16 at the same geographical level. Private motor vehicle costs include purchase, servicing, and fuel among other costs, but excludes taxis and other 3rd party motor vehicle services. Total transport spending also includes other transport (not shown), such as air travel and bicycles.

Source: ABS 2017 (*Household Expenditure Survey, Australia: Summary of Results, 2015-16*, Cat. no. 6530, tables 13.2 and 13.3A).

1.4 Is COVID-19 a game changer that affects the desirable framing of transport fares?

The disruption in demand associated with the COVID-19 pandemic outbreak in Australia in early 2020 represented a major structural shift with potentially enduring impacts that could shape governments' pricing decisions (figure 1.11). The collapse in patronage has devastated revenue. Unlike most other services, transport operators cannot manage lower revenues through corresponding cost cuts. Much of the capital is sunk, and there is still a need to have sufficient services to meet the accessibility functions of public transport.

Figure 1.11 – In the midst of the pandemic, public transport use was well below pre-pandemic levels



a. The ABS categorises use of public transport by varying frequencies, including 'all or most days' and 'at least once a week'. The latter does *not* include 'all or most days', but to avoid confusion, this has been re-labelled as 'less frequent use, but still weekly'. Data relate to people aged 18 or more years.

Source: ABS (*Household Impacts of COVID-19, March 2021*, table 3.1, Cat. no. 4940.0) and ABS (*Household Impacts of COVID-19, June 2021*, table 25.1, Cat. no. 4940.0).

The demand response in cities reflected a confluence of factors. Many people did not need to commute because places of work and education were not open, so people worked or studied at home (if at all). Borders were shut to tourists, temporary migrants, and international students. And people switched travel modes to avoid public transport because of infection risk and because of the potential for costly enforced quarantining if they were identified as a close contact (Beck and Hensher 2020; Tirachini and Cats 2020). The safe distancing restrictions that governments imposed on public transport — a supply-side constraint — also limited patronage. For example, after the spread of the delta variant in mid-2021, the NSW Government imposed a limit of 12 people for a two-door city bus, which is about 14 per cent of full capacity (which has now been removed).

All other major cities around the world have been similarly affected — for example, demand in Toronto, New York City, Lyon, San Francisco and Washington fell by about 80-95 per cent — with all studies showing large reductions in general mobility, particularly public transport, at the country level (Gkiotsalitis and Cats 2021; Politis et al. 2021). The only positive aspect of the universality of this collapse in demand is that there will abundant global experimentation that should help guide Australia's transport policy responses.

Several factors will drive the future trajectory of public transport use.

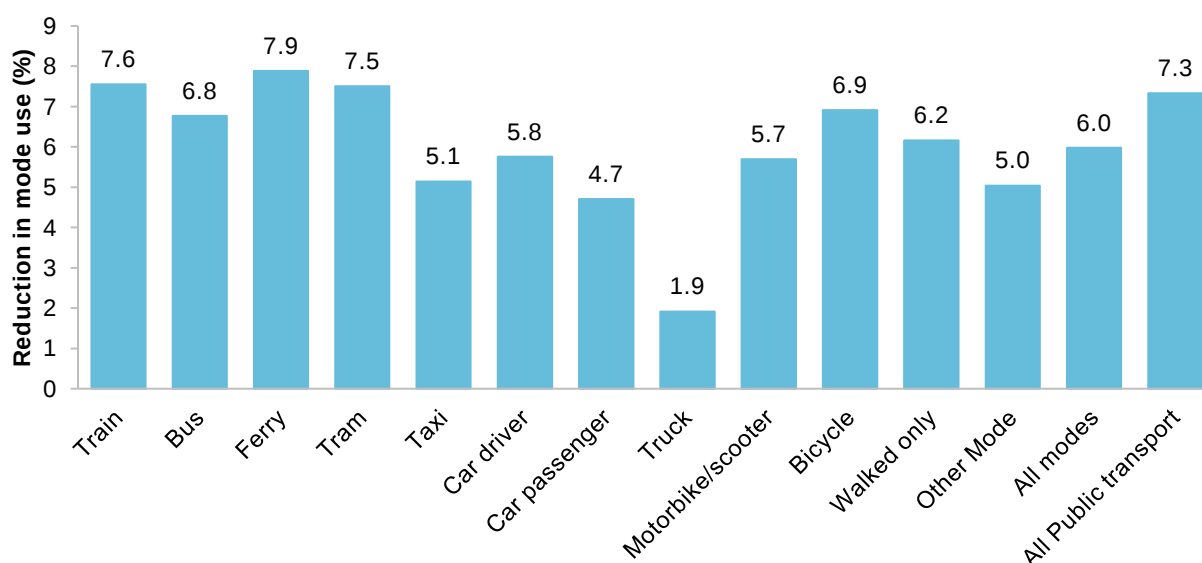
More working from home will be sustained

There will be a permanent shift to more working from home for those occupations where that is possible — largely managers, professionals and clerical and administrative workers — which will lead to a reduction in all modes of transport to work (PC 2021a). Compared with other modes, public transport will be disproportionately affected given that the occupations that are most able to work from home — professionals and clerical and administrative workers — have historically had higher usage rates of public transport. Overall, working from home gives large numbers of people formerly using public transport the scope to make large savings in travel time and fare costs.

(In the short to medium term, it also addresses some of the health concerns from proximity on public transport that will persist for some time even after widespread vaccination for COVID-19, as discussed below).

Estimating the effects of COVID-19 on public transport demand from working from home relies on a mixture of judgment, an assortment of assumptions and questionably reliable survey information. But our best judgment, informed by the available evidence, is that the long-run uptake of working from home will reduce public transport use by just over 7 per cent below counterfactual levels (figure 1.12).

Figure 1.12 – Projected effects of working from home on use of transport for commuting



a. The analysis uses data on transport mode use for travelling to work by main occupational classifications from the ABS 2016 Population Census for greater capital city areas. By the nature of their tasks, different occupations have varying potential to work from home (PC 2021a, p. 13). Estimates of the potential rates of working from home are applied to the 2016 transport mode use by occupation to provide an estimate of the number of people by occupation who could work from home after the pandemic. Those who already work from home are then netted out of that number. Then two adjustments are made. First, it is assumed that 70 per cent of employees whose job can be effectively undertaken at home are given the *opportunity* for doing this, noting that not all employers will allow working from home even if it is feasible. Second, it is assumed that 25 per cent of that group's current days at work are switched to working from home. The fact that some people will work from home for part of a day, but still go to work every day is ignored. This sequence of calculations gives an estimate of the change in use of transport by mode for journeys to and from work. The results are different from those in the Commission's analysis of working from home (PC 2021a, p. 69) because those numbers related to the potential maximum, whereas these relate to the expected change.

Source: ABS (*Census of Population and Housing 2016*, TableBuilder) on method of transport to work by one digit occupation by greater capital city area, based on counts of persons by place of residence.

This is less than might be supposed from the seismic shift towards working from home. It reflects that not all of those with the potential to work from home will take it up, most employers will place limits on the number of days that employees can work from home,⁸ and many employees will prefer to use less than the number of days of work from home allowable by their employers.⁹ Based on different assumptions, TfNSW have

⁸ And for the large number of part-time workers, this would be less days allowable than for full-time workers.

⁹ Of those employees' who would like to work from home sometimes, a significant share say they prefer relatively few days at home. One found that of those wanting to work from home 18.6 per cent, wanted to work less than one day and

undertaken estimates of the impact of working from home for New South Wales that imply a similar 7 per cent reduction in public transport demand due to working from home in Sydney (TfNSW 2021b, p. 13). In its modelling of COVID-19 impacts, Infrastructure Victoria's core assumption was that working from home would reduce commuter travel by 10 per cent compared with the counterfactual levels (IV 2021, p. 14).¹⁰

The power of fear

Initially after the start of the pandemic in 2020, patronage had recovered by as much as 85-90 per cent of baseline levels in those jurisdictions that had managed to control COVID-19 (ABS 2021b; Infrastructure Australia and L.E.K. Consulting 2020; ITLS 2021; Roy Morgan 2021).¹¹ Patronage then plummeted in 2021 with the emergence of the Delta variant because it re-triggered the demand and supply responses to the initial impact of COVID-19 in 2020.

While COVID-19 has also affected car use, the effects on public transport have been greater and recovery rates slower when governments have lifted restrictions (figure 1. 13 and 1.14).¹² These patterns also hold in jurisdictions, like Western Australia, where lockdowns have been sporadic and brief, and where people had often returned to their physical workplaces. This suggests that fear and new travelling habits may be contributing to the only gradual convergence in trips by car and public transport. Fear drives up the effective price of public transport use. In pre-COVID-19 times, people already assigned a high price to crowding on buses and trains, an implicit price that has soared with concerns about health risks.¹³

In theory, higher fares and associated booking arrangements for public transport could reduce the infection risks of crowding more efficiently than regulated capacity limits (Horchner, Singh and Graham 2021). People would, in effect, be paying a premium for the relative emptiness of a bus or train carriage, and space would be allocated to those who most value it. This approach would also raise more revenue than if old fares were maintained (or as it has actually happened, even reduced). Notably, Infrastructure Victoria suggested removing the free tram zone in Melbourne in response to the pandemic as it would reduce crowding on trams and encourage walking and cycling (IV 2021, p. 47). However, there were already good reasons for ceasing the Free Tram Zone. Overall, pricing does play a role in addressing costly crowding, but it is questionable whether it should be used as a temporary instrument for addressing COVID-19 transmission risks and fears.

a further 15.1 per cent preferred 1 to 2 days (NSWIPC 2020). Another survey found 13.1 per cent preferred one day at home and 17.9 per cent two days (Mattey et al. 2020).

¹⁰ The Victorian Government's May 2021 Budget forecast was more aspirational, with target public transport patronage numbers for 2021-22 being at their 2018-19 pre pandemic level.

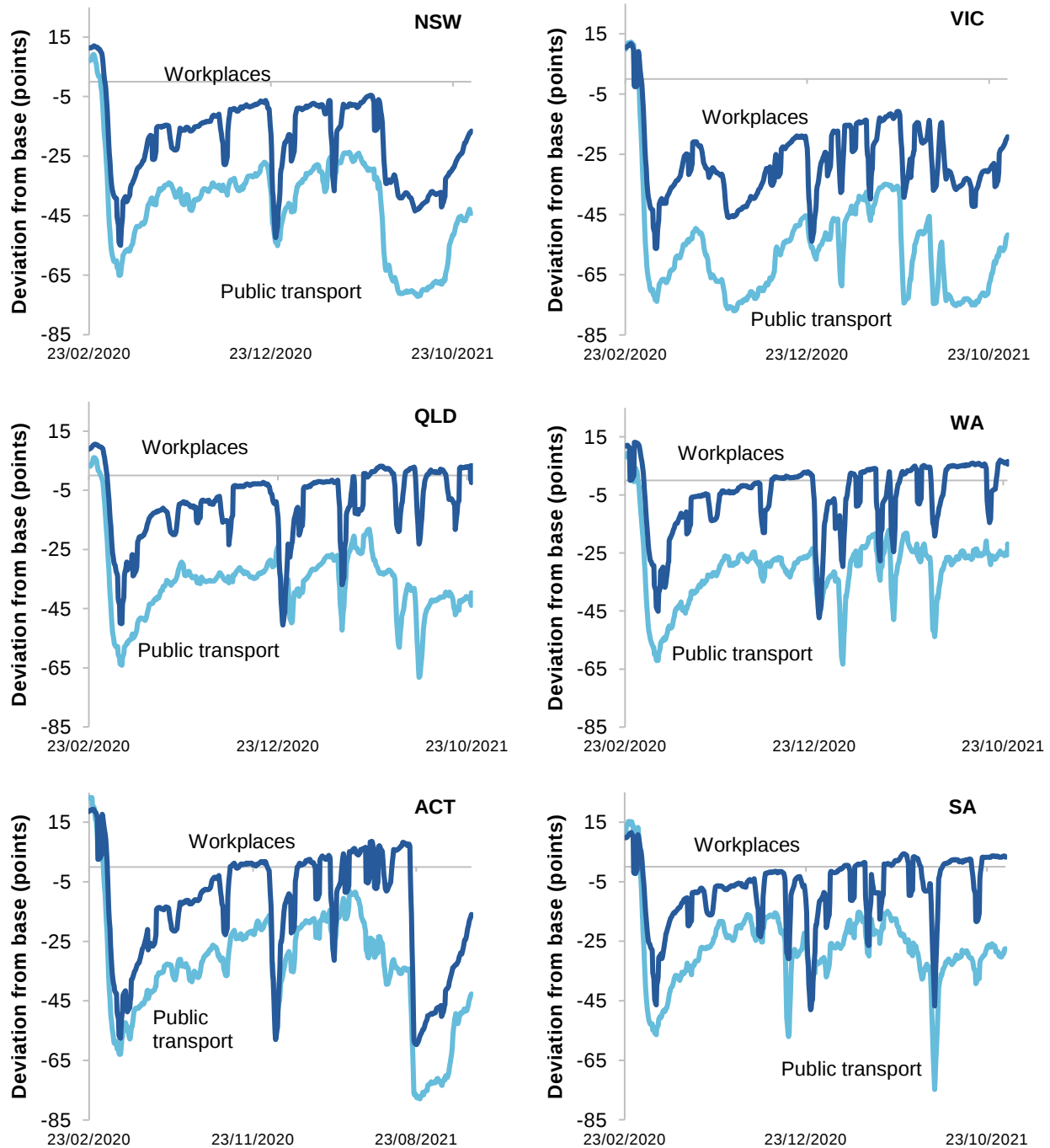
¹¹ The estimates vary according to the source of data (such as phone data or use of ticketing systems), the definition of the geographical area, averaging methods, base periods, and public transport mode. For instance, in the latter case, metro Sydney Opal card use had recovered to 85% of pre-COVID-19 levels in May 2021 and fell to as little as 11% of pre-COVID-19 times in August 2021. For Sydney buses, the comparable numbers were 63% and 17% (based on TfNSW data).

¹² A significant share of those who cannot work from home — people in trades for example — cannot undertake their job without a vehicle.

¹³ For example, in pre-COVID-19 times, the cost for a passenger taking a 30 minute metro trip with only a 50 per cent chance of getting a seat was estimated to be about \$3 (Hensher, Rose and Collins 2011).

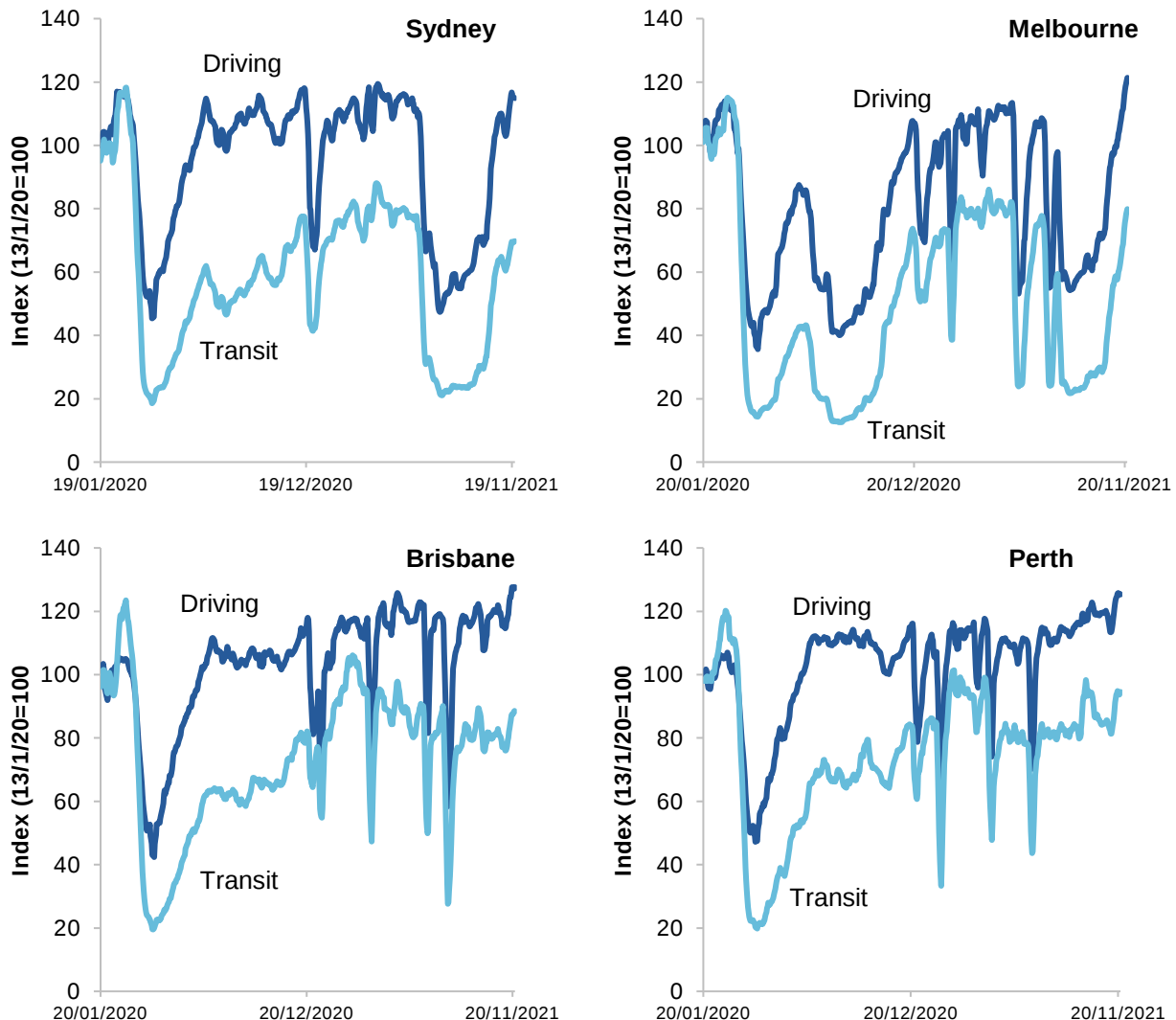
Figure 1.13 – Public transport is particularly responsive to COVID-19

Selected jurisdictions, February 2020 to November 2021



Source: Google LLC, *Google COVID-19 Community Mobility Reports* (www.google.com/covid19/mobility/) (7 day moving average of trips by destination 23/02/2020 to 23/11/2021).

Figure 1.14 – Modal choices have favoured driving
Selected jurisdictions^a



a. The charts are from the 7-day moving average of Apple Maps app direction requests by mode from 18 January 2020 to 24 November 2021. Baselines relate to 13/01/2020 (pre COVID). Some jurisdictions were removed because of incongruous results that suggest database errors.

Source: Apple mobility data from <https://covid19.apple.com/mobility>.

A key question is the degree to which fear will continue to contribute to low patronage. Of those who used public transport prior to COVID-19, more than 25 per cent said they would only return to its use when they or their household had been vaccinated (ITLS 2021, p. 13). About 15 per cent said that regardless, they would not use public transport in the near future (1-2 years), though people's statements about their future demand are likely to give excessive weight to current fears and might abate as circumstances change.

Is road congestion going to get worse?

Part of the function of public transport and its pricing is to reduce road congestion. As public transport has been less responsive to easing of restrictions than car travel, road congestion has sometimes risen above its pre-pandemic levels in Australia's capital cities.

However, the evidence suggests that rush hour traffic flows, which is when congestion is most costly, have still been below pre-pandemic periods, albeit with some exceptions.¹⁴ If nothing else, this reflects that only a relatively small share of trips are taken by public transport and so even large percentage reductions in journeys on public transport do not add much to car traffic. Indeed, the dampening effect of working from home on car traffic can more than offset the positive effects of diversion from public transport, especially for jurisdictions that have low public transport modal shares. For example, using the estimate of the effects on working from home on total commuting trips (6 per cent) and a modal share of 8.4 per cent for commuter public transport (as in Canberra), then the percentage reduction in public transport patronage levels from fear and capacity restrictions alone would need to be 70 per cent for COVID-19 to worsen congestion.¹⁵ In Sydney and Melbourne, the likelihood of congestion induced by lack of confidence in public transport is significantly greater.

Longer-term effects of COVID-19 on public transport demand

A broader question is how long the current subdued demand for public transport will persist, and the implications that might have for service quality (such as frequency of services), pricing, desirable subsidies and the resulting cost recovery outcomes.

The pace at which public transport patronage reaches pre-pandemic levels is dependent on the changes to the *propensity* of any given group to use public transport and the *number* of people in those groups. By the end of 2021, the jurisdictions that had experienced the most severe outbreaks and longest lockdowns had all vaccinated much of their adult population, and other jurisdictions look on track to achieve similar outcomes. This suggests that the contribution of the fear factor to the propensity to take public transport will likely dissipate for many people over the coming months so long as the pandemic does not re-emerge with new dangerous variants. That implies that the most important medium-term drivers of the propensity to use public transport will be the permanent uptake of working from home, offset partly by a slow upward pressure reflecting people's aversion to growing road congestion.

The impact of city growth will play a decisive role in boosting longer-run patronage. While low immigration during the pandemic significantly reduced population growth, net overseas migration is expected to recover, and with it, a resumption of growth. Melbourne is expected to grow by about 2 per cent per year from 2023-24 to 2030-31 (to more than 6 million people) and Sydney by about 1.3 per cent per year (to 5.9 million) over the same period (Centre for Population 2020, pp. 71–73). For these two cities alone, that amounts to about 1.4 million more people — with inevitable impacts on-demand for public transport. International students will contribute to increases in migration inflows and will often not have driving licenses. We project that public transport patronage will have returned to pre-COVID-19 levels by about 2027-28. Recovery may be earlier if policy counter-measures to encourage public transport usage have proved effective, or delayed if there are future outbreaks of new strains and inadequate uptake of booster vaccinations.

Notably, the national trend up until the pandemic was for rising demand for public transport for work trips, with single mode use of public transport usage up 71.4 per cent between 2001 and 2016 (or 3.7 per cent per annum), while all public transport use (which also includes the joint use of other modes) was up by 64.4 per cent (3.4 per cent per annum). These usage rates exceeded population growth rates. These growth rates in public transport far eclipse those of all other modes of getting to work (BITRE 2020, p. 97). So, while the

¹⁴ Based on data from TomTom with comparisons between AM and PM rush hour traffic flows for each month in 2020 compared with the corresponding month in 2019 (www.tomtom.com/en_gb/traffic-index/australia-country-traffic/). Similarly, road usage data from TfNSW for the busiest roads in Sydney show that weekday peak traffic flows were on average a little lower between 2019 (pre-COVID) and 2021 (before the mid-year lockdown).

¹⁵ In addition, if fear and restrictions limit commuting to workplaces (therefore accentuating the effect of voluntary working from home), then it displacement of public transport would be even more unlikely to aggravate congestion.

level of public transport use has dropped, there is no reason to believe that the factors that impelled its historical growth rates will abate, suggesting the recent stark downturn will eventually disappear.

There also does not appear to be any significant increase in car ownership per household, which might have led to more enduring substitution to car travel (ABS 2021c).

So what?

As the health impacts of COVID-19 recede with high vaccination rates, the remaining safety concerns may best be addressed through information provision and actions that re-assure travellers, such as rules about mask wearing, adequate ventilation, cleaning, and advice not to travel if unwell.¹⁶

The types of price changes floated in this report should be seen in the context of the more normal world to which public transport will probably return.

Nevertheless, the hangovers from the pandemic may be relevant to some pricing decisions: The benefits of shifting demand between peak and non-peak periods (chapter 3) may be greater to the extent that it partly reduces crowding and the residual health care concerns that this may have for customers. And, as noted earlier, unless patronage levels rise quickly in Sydney and Melbourne, road congestion may grow more rapidly than otherwise. A combination of measures will limit road congestion. These include direct road pricing and well-structured car parking levels (chapter 5), off-peak public transport pricing changes, increasing the convenience of public transport, including new ticketing and data provision to customers (chapter 7), and initiatives to restore confidence in public transport (such as increased cleaning).

There is one ‘do not do’. Attempts to revive public transport through across-the-board price reductions are unlikely to trump current safety concerns for many would-be customers while providing windfall gains to those who are willing to travel regardless. Universally free fares, which are sometimes advocated (chapter 5), would go well beyond the legitimate efficiency and equity grounds for subsidies and massively reduce a source of funding for service improvement. That said, innovations in marketing public transport, such as the lottery for free transport for a year offered recently in Western Australia, may be a low-cost approach to stimulating demand.

1.5 Balancing goals

This report is about how governments might reset the way they determine public transport fares, while taking into account the wider context of the disruption caused by COVID-19, pressures on Australian cities and technological developments.

¹⁶ For example, face mask enforcement and hand sanitisation was found to be highly effective in improving passenger confidence in Bangkok (Vichiensan, Hayashi and Kamnerdsap 2021). However, whether these actions significantly reduce transmission risk is uncertain, especially if people face high risks of infection anyway due to the wider opening up of society. Public transport may not be the weak link in efforts to control the COVID-19 health risks that will still remain after the crisis is over. Nevertheless, as pointed out by Beck and Hensher (2020), ‘overt demonstration’ of actions like deep cleaning that reduce public concerns about health risks may instil greater confidence in public transport.

Governments should ask fares to play multiple roles. They should set prices that:

- reflect benefits and costs at the margin, such as road congestion, public transport crowding, and the incremental economic costs of funding additional subsidies — in line with the principles of social marginal costs (chapters 2 to 5)
- meet affordability goals for the people most in need (chapter 6), taking into account that the taxes used to raise the revenue for subsidies have independent distributional impacts and need to be publicly acceptable
- recognise that a stable and reasonable degree of cost recovery is likely to emerge from using good pricing principles. Ever-diminishing cost recovery rates is a ‘canary in the cage’ for flaws in pricing and may, if budget constraints are reached, limit funding to maintain service quality
- are not so complex as to bewilder consumers and not so simple as to forgo the opportunity for fare structures that allow for peak pricing, concessions, some price discrimination, and the potential for distance and modal pricing.

Without suggesting that there is an obvious Goldilocks solution to these sometime clashing goals, this report’s purpose is to shed light on the *longer-term* pricing options that may best meet the objectives of public transport, recognising the disruption of the COVID-19 pandemic provides a breathing space to re-imagine public transport.

The report also considers future influences on fares (chapter 7). Ticketing technologies are developing, autonomous vehicles are on the way, public acceptance of demand-driven services has grown, and patterns of working and commuting are changing (brought into relief by the enduring consequences of the COVID-19 pandemic). The concept of Mobility as a Service (MaaS) — which brings together all transport options (vehicle, rideshare, taxis, bikeshare, demand-driven buses and conventional public transport) into an integrated system — poses challenges for pricing and ticketing. In MaaS, some services are provided by commercial operators, which have greater discretion to set their fares (and may try to cost shift to government). In MaaS trials, the ticketing systems used in public transport are incorporated into subscription services (like mobile phone plans) that also cover other transport modes that add value to the network.

Institutional reforms would help governments in setting prices using a coherent framework, while recognising their ultimate decision-making powers (chapter 8).

What is not covered?

The pricing of regional and remote public transport services and community transport services is largely outside of the scope of this report, reflecting the different product and consumer characteristics that should be considered in pricing services. And many intercity services could arguably just be left to markets given that the objectives that underpin pricing decisions and subsidies for urban public transport are largely irrelevant. (However, there may be lessons from urban transport pricing and service quality for regional Australia.)

2. An economic lens on pricing

Key points

- * **Public transport fares — the cost of providing public transport services minus government subsidies — are an important lever to improve the efficient operation of transport networks, manage crowding, reduce road congestion, and ultimately, support network financial sustainability.**
- * **Taxpayer-funded subsidies are generally the most efficient way of recovering the large fixed costs of public transport networks, as the pricing options available for most other large networks like electricity and water are not feasible. A combination of fares and additional subsidies need to meet the remaining operational costs.**
- * **The best practical approach is to equate prices with their net incremental social and economic costs ('social marginal costs'), as used by the Independent Pricing and Regulatory Tribunal of NSW (IPART). Under this approach, prices are set to:**
 - the operating costs of running a service, for example, the fuel and driver costs of a bus for a given trip or kilometre of travel
 - *less* the incremental benefits of reducing road congestion, recognising that an increase in fares can make some people drive, which at the margin, decreases traffic flows and increases trip duration for all motorists
 - *less* the gains from more frequent services, recognising that cheaper fares encourage more patronage, which allows more buses or trains on a route, thereby increasing service frequency to the benefit of all customers
 - *plus* the costs of overcrowding on public transport, recognising that people do not like standing or being jostled on public transport so that prices should be higher at times where this occurs, typically peak travel
 - *plus* the efficiency losses from the taxes used to fund the subsidies to public transport — the 'marginal excess burden' of taxation, which recognises that taxes distort consumption, investment and labour supply and demand.
- * **Other factors like equity, simplicity and ease of implementation also need to be taken into account in fare setting, alongside social marginal cost pricing.**
- * **More granular fare differentiation — through peak, modal and distance pricing — would improve efficiency by better reflecting these social marginal costs of public transport.**

Like other public utilities, public transport provides an essential service: helping people get to the places they want to go. Pricing decisions can help or hinder the efficient delivery of essential services, and sectors like water and electricity provide some guidance about efficient pricing and investment. As is the case for these utilities, public transport has high fixed costs, network effects, economies of scale, and benefits from central planning of networks and investments — all potential natural monopoly characteristics. Yet there are differences that set public transport apart. Public transport is not a natural monopoly given competition from 'wheels and legs', though it often entails supply by only one or two suppliers with few risks of exit. There is

also no expectation of cost recovery in a service where affordability and accessibility are key goals (chapter 6), and where there are economic benefits (and costs) that extend beyond the individual consumer, such as addressing road congestion (chapter 5). These differences mean that a distinct pricing approach is required, alongside the need for good performance indicators to provide incentives for service quality and strong scrutiny of the prudence of the massive investments that are sometimes involved.

The concept of social marginal cost (SMC) pricing (section 2.1) is an overarching and useful framework to consider both the orthodox requirements for efficiency in an industry, as well as the significant external costs and benefits peculiar to public transport. It has implications for peak pricing and demand management (chapter 3), modal and distance-based pricing (chapter 4), and addressing the congestion costs associated with road use (chapter 5).

2.1 What is social marginal cost pricing and what does it mean for efficient fares?

SMC is the prevailing benchmark for the efficient pricing of public transport services in the public transport literature. (SMC pricing is not a special theory for public transport. It applies to all goods and services, but in most cases the social and private marginal costs are similar.) SMC pricing theory determines the economically efficient price, recognising that governments may also set prices below SMC because of equity and other considerations (figure 2.1). But without a measure to assess an efficient price, it is hard for governments to make good decisions about their equity goals since there will often (though not always) be a trade-off. In this respect, an SMC benchmark can help governments make decisions about equity informed by their efficiency consequences.

Figure 2.1 – What is included when calculating the social marginal cost?

Fare based on:	Costs and benefits captured under social marginal cost (SMC)	Other factors not captured under SMC pricing
Efficient cost of supply	- Financial cost of service delivery	Long-run costs of infrastructure investment
	- Social cost of public funds (deadweight loss of tax)	Technological feasibility (e.g. ticketing system constraints)
Efficient use of public transport networks	- Social cost of crowding	Equity and accessibility
	+ Social benefits of reduced road congestion, accident and environmental costs	Behavioural pre-conditions for fare responsiveness
	+ Social benefits of frequent services ('Mohring' effect)	Service quality and frequency

Typically, SMC pricing takes into account:

- service delivery costs — as is typical in marginal cost pricing generally, efficient fares should reflect the financial cost of service delivery. Whether network capacity is fixed or variable — and therefore the selected time horizon and extent of included fixed costs — greatly affects the estimated social marginal

cost, particularly for infrastructure-intensive modes like rail. Many theoretical models in the transport pricing literature make simplifying assumptions in this regard, for example, that major infrastructure investments are sunk costs (discussed further in section 2.2). Modelling in reviews by both the Independent Pricing and Regulatory Tribunal (IPART) of NSW and Infrastructure Victoria (IV) estimate marginal costs for both the short and long-run. This captures the additional capacity costs associated with increased passengers and services.

- the social cost of public funds, given that government funding for public transport involves a cost borne by society. Though the presence of positive externalities associated with public transport use justify subsidies for service provision, these benefits are weighed against the cost of the subsidies funded by taxation: the efficiency loss associated with raising additional funds
- the external costs and benefits of a users' travel decisions — unlike traditional marginal cost pricing, SMC considers factors beyond financial costs, and incorporates social costs and benefits: the externalities associated with public transport provision and use. This is an important distinction, because unlike other traditional utilities where full cost recovery is the norm, fares based only on the financial cost are unlikely to be efficient. The social benefits associated with public transport imply that efficient fares are therefore less than the full financial cost of provision. The social costs (and benefits) of additional public transport use include:
 - costs associated with crowding, such as decreased comfort and overall passenger experience, which particularly occur during peak periods
 - benefits from reduced road congestion, where additional public transport trips reduce private car use, thereby reducing road congestion (discussed further in chapter 5), accident and environmental costs
 - improvements to service frequency that come with greater public transport use, known as the 'Mohring effect' (box 2.1)
 - agglomeration benefits that can arise from the concentration of businesses and people in a geographical area. These benefits are difficult to measure and are not typically included in SMC analysis, despite their in-principle significance to pricing (box 2.2).

Box 2.1 – The Mohring effect: estimating the scale benefits of additional service frequency

Mohring (1972) observed that there can be a virtuous cycle where increased patronage and investment to expand capacity results in higher service frequency, reducing waiting times and the effective cost to users of travelling. Conversely, Mohring (1972, p. 591) observed that declining demand can lead to less frequent services, resulting in even less demand given increased wait times — a unique consequence of declining demand for a service with increasing returns to scale. Mohring's observations of these scale economies (known as the 'Mohring effect') along with various models that extend this logic, have long been used to justify subsidies to increase patronage and generate external benefits for users.¹⁷

In practice, quantifying the Mohring effect is complicated, as it relies on assumptions about investing in additional capacity and demand. For example, the Independent Pricing and Regulatory Tribunal of NSW (IPART) estimates the Mohring effect based on assumptions about how changes in fares affect user demand

¹⁷ Though generally accepted, the concept does not have universal backing. Van Reeve (2008) found that under some circumstances, an unregulated monopolist would provide a socially optimal frequency of trips, and hence the Mohring effect would not justify a subsidy. However, subsequent work has questioned several assumptions underpinning this result — instead finding further support for Mohring's work (Basso and Jara-Díaz 2010; Gomez-Lobo 2011).

Box 2.1 – The Mohring effect: estimating the scale benefits of additional service frequency

(the own-price elasticity) and the estimated value of waiting time compared with in-vehicle time. Using this method, IPART found, for example, that a 5 per cent increase in demand would reduce wait times by 4.8 per cent. IPART then adjusts for the extent that governments add additional capacity, based on historical data on the percentage change in service frequency from a percentage change in demand. There were no scale benefits for rail services as additional services were unable to be added to cater to additional demand, and zero benefits for ferry services, as scheduled services declined between 2016 to 2019.

IPART's 2019 estimates of scale benefits by this method are contained in the table below.

Scale benefits (\$2019)	Bus	Light rail
Benefits per passenger trip	1.32	1.11
Benefits per passenger km	0.12	0.10

Source: IPART (2020d, pp. 12–13).

Box 2.2 – Economies of agglomeration may be important, but public transport fares are likely to play only a modest role in stimulating them

Agglomeration benefits are the cost savings from the proximity and density of related activities and explains the formation of cities. For instance, greater labour specialisation and improved matching of skills to jobs is easier in dense labour markets, as is worker mobility between businesses, which is a vehicle for knowledge transfers that enhance innovation.

As cities grow, governments play a role in realising agglomeration benefits through planning, zoning and investments (such as designing an efficient transport network, setting aside transport corridors for major roads and rail lines, and facilitating the creation of universities to encourage knowledge spillovers and the acquisition of skills). Nevertheless, many agglomeration benefits are realised without government interventions because the gains can be internalised (for example, by an industrial park owner). Even where there are externalities, there may be sufficient private benefits from businesses and people being near to each other that the marginal benefits of government intervention are low. As cities grow, the benefits from agglomeration reduce and may even become negative, for example, if there is significant congestion.

In principle, public transport supports agglomeration to the extent that it provides cost-effective access to a hub of activity more efficiently than alternative transport modes (primarily private vehicles). How much it does so depends on public transport policy settings, such as access to destination points, convenience, the frequency and quality of services, and price. In the latter case, the premise is that lower public transport prices encourage greater ease of access to the dense part of cities, realising some marginal agglomeration benefits. Some models suggest that agglomeration externalities justify large public transport price reductions (Horcher et al. 2020).

However, the significance of public transport pricing to stimulating agglomeration benefits is doubtful. The models suggesting large gains are sensitive to parameter and other assumptions, and are not well

Box 2.2 – Economies of agglomeration may be important, but public transport fares are likely to play only a modest role in stimulating them

anchored by accepted evidence. In this respect, the literature on agglomeration economies is vast, with results that vary markedly by location and industry (Faggio, Silva and Strange 2020; Melo, Graham and Noland 2009). There are, therefore, no obvious off-the-shelf estimates of agglomeration externalities that can credibly be used to set public transport prices. It is unlikely, for example, that public transport plays a major role in contributing to agglomeration benefits in car-dominated Australian cities experiencing little road congestion (such as Canberra and Darwin). This is reinforced by low substitutability between car and public transport use.

Since agglomeration benefits arise fundamentally from reduced transactions costs, alternative ways of decreasing these may lower the returns from agglomeration. While the internet and associated technologies have not led to the ‘death of distance’ (Giuliano, Kang and Yuan 2019), the experiment in remote working afforded by COVID-19, and the likely persistence of greater remote working might affect where and how agglomeration effects arise. Businesses themselves will likely adapt their work-from-home policies and the use of technology to retain agglomeration benefits, making it hard to draw conclusions about the ‘right’ transport pricing policies to support agglomeration, especially as fares are already significantly discounted. Decisions about where to locate transport services, their speed and frequency are more direct approaches to realising agglomeration benefits, and in the case of buses, more responsive to changing and local needs.

SMC pricing therefore supports efficient network capacity (a supply-side concern) and network utilisation (a demand-side concern). If prices are set above efficient levels some users will not use services even though the benefits would outweigh the economic costs associated with their travel. Prices below efficient prices may sometimes entail overuse of services and crowding without necessarily being offset by equity benefits.

Experiments by IPART and IV to operationalise social marginal cost — with explicit accounting for externalities — through parameterised fare optimisation models have been helpful advances. These models estimate the external costs and benefits, but also incorporate the expected response of users to changes in fares: the elasticity of demand. Public transport demand is relatively inelastic, with a meta-analysis of fare elasticities finding the average fare elasticity to be -0.395 (Hensher 2020a, p. 258). This means that *on average* a 10 per cent increase in fares would reduce demand by about four per cent. That said, the actual change in demand will depend on a range of factors such as the level of existing prices and the magnitude of the change, the mode, distance travelled, time of day, concession, as well as a person’s income, reason for travel and available substitutes. Elasticities can also inform how a fare change will affect externalities: for example, the extent of substitution between public transport usage and other modes like car travel (cross-price elasticity) will have implications for road congestion.

SMC pricing helps governments to balance external costs and benefits

As a benchmark for efficient fares, SMC pricing has two key implications for governments that go beyond traditional notions of efficient pricing for network infrastructure like utilities.

- The positive social benefits of public transport (like reduced road congestion and environmental costs) means that the efficient cost of providing public transport is not equal to the total financial cost, and pricing

at this level would result in under provision. These social benefits provide a strong rationale for the subsidisation of public transport.

- Managing efficient network use requires careful balancing of externalities. As a network approaches capacity, there is a trade-off for governments between the scale benefits of the Mohring effect (a positive externality) and the costs of overcrowding (a negative externality), which particularly affects cities where there are significant capacity constraints on rail during peak periods. Balancing these externalities must also be weighed against the marginal cost of public funds incurred with government subsidies (the dead-weight loss of taxation).

On the latter point, governments' fare setting decisions (and the resultant external costs and benefits) are intertwined with choices about service frequency. While additional or more frequent services can result in additional scale benefits and reduced crowding, they also come at an additional financial cost (figure 2.2), which can be particularly significant if infrastructure investment is required to overcome network constraints (as would often be the case for rail services).

SMC modelling supports analysis of these trade-offs. For example, in estimating the SMC of public transport in Victoria, analysis commissioned by IV modelled two scenarios:

- no increase in services in response to a fare decrease. This would not add financial costs to delivery but could result in additional crowding costs for users
- an increase in services to cater for the increased demand associated with a lower fare. While this increases the cost of delivery, it also provides frequency benefits for users (the Mohring effect) (CIE 2020a, p. 20).

The preferred scenario will depend on the magnitude of these effects, which will vary depending on different demand, network and city characteristics.

Figure 2.2 – A stylised example of the trade-offs in managing efficient network frequency and use

		 Low service frequency	 High service frequency
 Low service utilisation	Off-peak optimal result <i>(Lower cost; no crowding or Mohring effect)</i>	Financially costly	
 High service utilisation	Risk of overcrowding	Peak optimal result <i>(Balanced externalities with benefit of Mohring effect)</i>	

Indeed, Jansson (1993, pp. 45–46) concluded that after accounting for the effect of crowding on travel times, there may be more than one optimal set of prices, subsidies, and frequency:

- there may be one low-frequency/low deficit per passenger optimum, and another high-frequency/high-deficit per passenger optimum;
- infrequent urban, rural and inter-regional services, and extraordinarily frequent urban services, have small optimal deficits;
- typical frequent urban services have large optimal deficits;
- for most urban public transport, it should be endogenously determined whether price should be high and deficit low or vice versa ...

An understanding of the magnitude of these factors — as quantified through SMC modelling — therefore provides governments with better information on how fare decisions support optimal network use, taking into account all of the relevant external costs and benefits.

Differentiated fares can improve overall social welfare

As a general principle, it is efficient to have multiple fare levels, each set to take account of the variations in the social marginal costs of public transport travel across time, location, route, mode, passenger type, city, and network structure. Moreover, targeted fare setting measures can also have greater effectiveness, particularly for managing congestion problems. A review of demand management policies by Henn et al. (2010, p. 7) concluded that:

The less measures discriminate on the basis of time and location of travel, as well as user groups ... the less effective they are from a congestion management perspective.

But the extent of differentiation should be considered in step with other important factors like equity concerns, the salience of fares and how users respond to fare differentiation, and the feasibility for ticketing systems, as discussed further below. Indeed, the lack of precision of social marginal cost estimates themselves should also factor into decisions about the desirable granularity of fares (chapter 8).

2.2 Other factors important for fare setting

While a SMC approach is a useful benchmark for economically efficient fares, there are other aspects of fare setting that SMC pricing does not capture. These are relevant for the design of pricing tools and are important complements to an SMC approach (figure 2.1 above).

Long-run infrastructure costs are omitted under social marginal cost

Public transport, and particularly rail services, have high fixed costs that are not recovered through SMC pricing, leaving them to be funded through taxpayer-funded subsidies. The logic is that average cost pricing would be an inefficient way of recovering such fixed costs as it would lead to underutilisation of sunk assets. The problem is unique to public transport as similar networks like electricity and urban water are able to price discriminate (using two-part tariffs and Ramsey-Boiteux pricing) to efficiently recover fixed costs. This is by dint of their monopoly characteristics, which allows them to use these pricing structures without the associated revenue being bid away by competitors. In contrast, public transport faces competition from private alternatives, especially cars (chapter 1).

Taxpayer funding of the fixed costs of public transport, ideally through non-distorting lump sum taxes, is an alternative with an established pedigree in utility pricing going back about 80 years (Hotelling 1939). While the dearth of such efficient taxes means that, in practice, such a funding approach will still involve some inefficiencies, it is the only realistic funding source for public transport. (The prospects of high or complete cost recovery are better in dense cities like Hong Kong where there are also good prospects for value capture.)

Such subsidisation is also consistent with the objective of providing an affordable service to a significant share of the population. Even assuming no change in patronage, full cost recovery of operating and capital costs would involve ticket prices that are about four to ten times higher than current averages, as suggested by the small farebox recovery rates (chapter 1). For example, estimated farebox cost recovery from *total* costs in 2018-19 was about 10 per cent in the Northern Territory, 11 per cent in South-East Queensland, 15 per cent in Victoria and the Australian Capital Territory, 17 per cent in Adelaide, 19 per cent in Perth, and 24 per cent in Hobart and

25 per cent for metropolitan Sydney (in the previous year).¹⁸ Were cost reflective prices to be set for thin markets (such as outer metropolitan areas), ticket prices would be even higher than implied by the above estimates.

The main benefits of using marginal cost pricing — compared with average cost — is that it focuses on efficient use and provision *at the margin*, which helps to manage under or overuse of network capacity. As noted by IV (2020b, p. 8):

It is also the *change* in trips that causes additional costs and benefits in public transport and roads (the existing network is already built and paid for) and it is these changes that fares are best able to influence. ... an overused network with crowded train carriages should be priced higher to reduce over-crowding and help fund new infrastructure to be installed to allow for more trips (i.e. the social cost of adding extra trips is high), while an underused network with empty trains should be priced low to encourage greater use of the existing network (i.e. the social cost of adding extra trips is very low).

In theory, there could be some benefits from price discrimination, in which fares are set to take account of the price sensitivity of different groups of people and for different trip frequencies. This can increase cost recovery rates and reduce the inefficiencies associated with taxpayer-funded subsidies. There are widespread concessions (such as for children) and quantity discounts in public transport. In the latter case, most jurisdictions allow for free or discounted travel after a certain level of expenditure is reached over a given period (usually daily or weekly). For example, there is a weekly cap of \$50 for public transport fares in Sydney, so that the marginal fare is zero when the cap is reached. In Adelaide, a 14-day pass provides unlimited trips for \$63.20. In Brisbane, travel after the 8th journey in a week are charged at half price. However, whether these forms of price discrimination have the effect of raising additional revenue is moot. As discussed in chapter 6 (box 6.6), even ‘full fare’ pricing for public transport is highly subsidised given social marginal cost principles (such as addressing congestion externalities), so further discounts based on price discrimination may not be able to produce additional revenue.

Despite the incapacity for, and undesirability of, pricing to raise sufficient ticketing revenue to recover the full costs of public transport, there are grounds for more assessment of long-run costs.

First, they are the best benchmark against which to assess whether the investments in public transport produce sufficient social and economic benefits. While cost-benefit analysis undertaken before project commencement can assess whether large investments are *likely* to be economically justifiable, divulgence of the actual outcomes verifies whether these assessments are accurate. Optimism bias — underestimation of costs and, project times and overestimation of patronage — is endemic in public infrastructure (PC 2014, p. 685). (The Myki ticketing system is a recent example — chapter 7). Addressing such bias requires an understanding of why it occurred and how to mitigate it. Currently, there is little consistent reporting of the long-run costs of public transport, which could be addressed without abandoning SMC as the primary framework for gauging and, where possible, setting efficient prices.

Second, two-part tariffs may still be useful as a tool for partial cost recovery if new pricing models — such as subscriptions for mobility as a service — are implemented (chapter 7).

An important question remains as to the use of medium-run or long-run estimates for social marginal cost. Though IPART have helpfully modelled long-run SMC, the reliability of long-run estimates (coupled with the

¹⁸ These are estimates provided by State and Territory Governments and from various budget papers and annual reports. They are not fully consistent given accounting arrangements vary between jurisdictions, but give a reasonable idea of the extent of cost recovery of total costs. Chapter 1 has estimates of recovery of operating costs alone for a span of years, which are higher given no account is taken of recovery of fixed costs.

significant gap between long-run SMC estimates and current fares) casts some doubt about their direct applicability as a benchmark for fares.

Technological feasibility

Current ticketing systems may constrain pricing options generally (including fare options that might better reflect the social marginal cost of trips), though these constraints may become less relevant as contracts for ticketing systems expire and newer technology becomes available (chapter 7). Still, technological feasibility under current ticketing systems is a barrier to reform in the near term, and may require trade-offs with features that would otherwise be desirable in the design of fare structures. For example, IPART accommodated the technical limitations of the original Opal ticketing technology in its final 2016 recommendations, as current systems were unable to support IPART's more integrated fare table for multi-modal trips.¹⁹ IPART's original proposal was to calculate the multimodal trip fare as if taken on a single mode, but it instead recommended a \$2 rebate to be redeemed on a different journey. In its 2020 review, IPART updated its advice, given the ability to support integrated multimodal fares through the new Opal Connect travel passes (IPART 2016b, p. 49, 2020c, p. 17).

Equity implications

Although some fare structures are consistent with both efficiency and equity objectives, as noted above, improvements in economic efficiency can sometimes come at the cost of equity goals: a tension that is explored primarily in chapter 6 and in analysis of different pricing tools (chapters 3 and 4).

People do not behave the way elasticities tell them they should

SMC pricing assumes behavioural responses to prices based on various estimated demand elasticities, which may not always capture how people behave in contexts outside those in which the elasticities were originally measured. In particular, uncertainty and complexity are relevant to people's demand responses, as are the interactions between visible prices and their invisible counterparts (service quality). In this regard, fares should:

- be simple to comprehend — fare structures should be understood by users if the aim is to elicit a behavioural response. However, not all fare schedules need to be simple. Users typically use mental shortcuts and general rules of thumb to process more complex pricing information (for example, that travelling longer distances imply a higher fare), and travel patterns are typically repeated (such as a daily commute to work) that together mean that users are able to adjust to complexity over time. While users should have a clear idea of the end fare paid, this does not necessarily imply a need to understand the calculations for fare determination (as exemplified by dynamic pricing used for ride-share services or airfares)
- be predictable and trusted — some level of fare predictability, especially in the short to medium term, helps users plan their budgets and travel patterns. Though predictability may not necessarily require a precise point estimate of fares (again as evidenced by dynamic pricing for ride-share or other services), fare patterns that are too unstable may result in users opting out of the network. The maintenance of user trust in fare structures, and in public transport systems generally, is therefore required for fares to have their intended effect. Users' toleration of changes to fare structures may also increase if the timing is predictable, for example with annual changes
- take account of any changes in the less visible costs of travel. As discussed in chapter 1, many attributes of travel — crowding, time waiting for a service, time to get to a service, and journey time — can all be

¹⁹ Fare integration refers to the degree that fares should be invariant to different modes, distances, and trip combinations.

valued in dollars. The posted fare is just one price, and the degree of responsiveness to the fare depends on whether all of the other 'prices' have stayed the same. For example, the COVID-19 pandemic has increased the implicit price of sharing space with other customers in public transport, meaning that a given change in fares will elicit a different response to that prior to the pandemic. As noted in chapter 1, when fear is at its highest, even free travel would be unlikely to elicit a significant demand response.

Service quality and service frequency

SMC pricing takes existing service provision as given and does not consider what is an efficient level of service quality or frequency, both of which are critical determinants of passenger experience and cost. In contrast, price regulation of other utilities often involves assessment of prudent investments. This reflects that such utilities are natural monopolies that could otherwise gold plate to increase their overall rate of return (as occurred in electricity networks in Australia). While monopoly pricing is an unlikely problem for public transport, the fact remains that pricing and efficient investments should generally be determined jointly to get the best outcome. To give an example, a bus service may be more efficient as an investment than a new high-cost rail investment given its flexibility to service different routes, but SMC just relates to the costs and benefits of operating a service. When considered jointly, pricing decisions might also turn up questions of optimal service frequency or investments to improve user experience. So where a regulator makes pricing recommendations, it may be sensible for it to also provide advice (not recommendations) about the frequency or quality of services, where it sees prospects for lower cost provision.

3. Peak pricing and demand management

Key points

- * Peak pricing can help to spread demand and reduce crowding, when well designed. Peak fares can encourage some users to change travel timing at the margin, with even a modest effect helping to delay costly capacity investments.
- * The timing of peak periods has implications for user behaviour. There are grounds for morning peak periods that start later and end sooner to better match peak demand. For example, the NSW peak period currently ends at 10 am, which is too late to encourage office workers to shift their travel times very much.
- * Afternoon peaks may desirably begin with school closure times to encourage non students to shift their demand for bus services to less congested periods. Reflecting that demand peaks occur later for trains, so too might the commencement of peak pricing, suggesting that differential peak pricing by mode may be justified in some jurisdictions.
- * Larger price differentials would improve the effectiveness of peak pricing to shift users' travel times.
- * While 'peak and shoulder' pricing appears to be an attractive approach for flattening highly peaky demand in networks with significant crowding, there are several practical limitations that suggest that changes to peak/off-peak pricing and duration should be undertaken first.
- * In the jurisdictions where crowding on public transport is limited, the timing and level of peak pricing should be driven by cost recovery and affordability considerations until capacity constraints start to emerge.
- * Greater working from home and flexible start and finish times would also maximise the behavioural response to peak fares and reduce network load generally.

3.1 The benefits of peak pricing

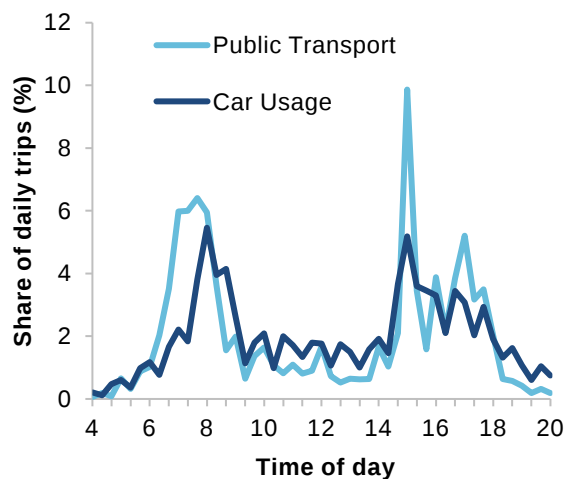
Why use peak pricing?

Demand for public transport is characterised by large peaks in the morning and late afternoon, reflecting the typical starting and finishing times for work and school (figure 3.1). At these times, alternatives to public transport — primarily private vehicles using roads — are also often highly congested. While service

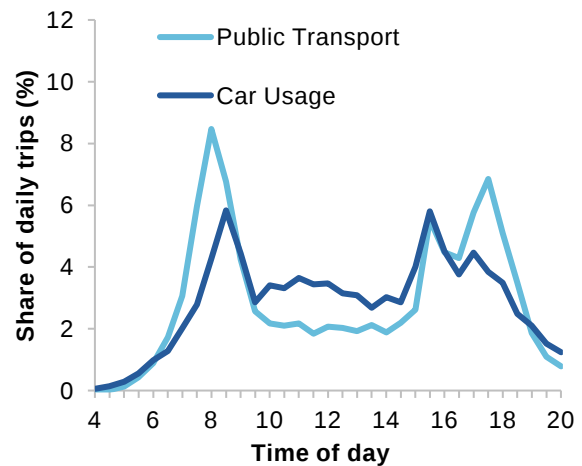
frequency and capacity rise during peaks, public transport can still be crowded at these times (figure 3.2). The costs of crowding for users' travel experience can, in effect, exceed that of fares, when considering the full costs of a trip incurred by passengers — not just the financial cost (the fare). According to the Australian Transport Assessment and Planning (ATAP) guidelines, the costs of the discomfort associated with standing during a trip are estimated at 1.65 times the in-vehicle time cost, while standing during an overcrowded trip is estimated at 2.1 times the in-vehicle time cost (ATAPSC 2021, p. 50).²⁰ Based on these estimates, the non-financial costs of 20 minutes of standing for a train trip of average length in Sydney could be nearly double the financial cost of the fare at current levels.

Figure 3.1 – Peak travel patterns persist for private and public transport
Road and public transport use by time of day

(A) South East Queensland, 2017-18^a



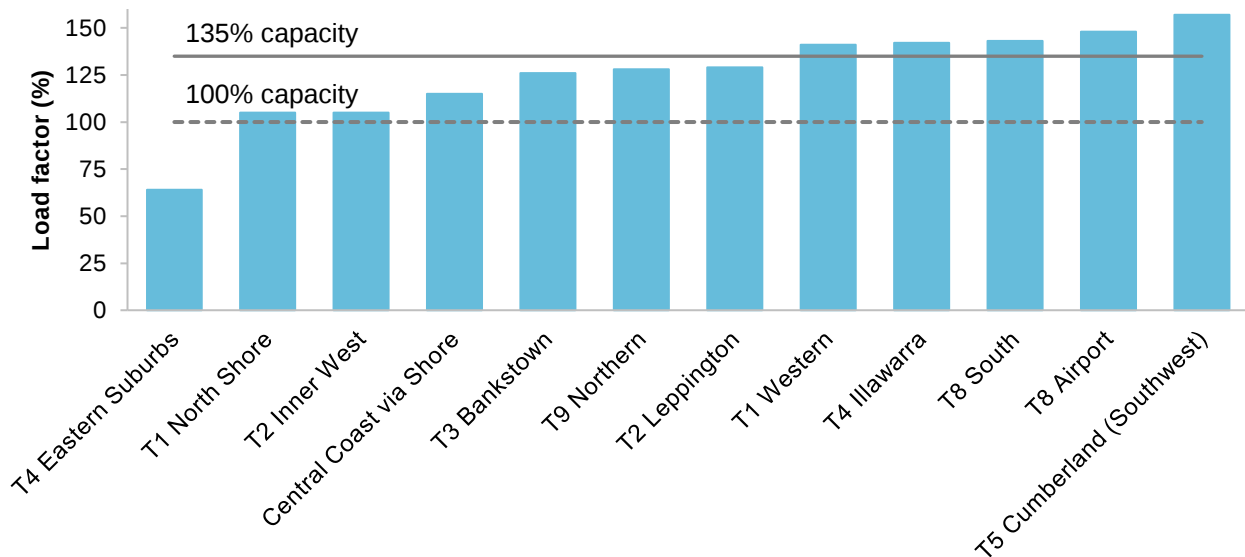
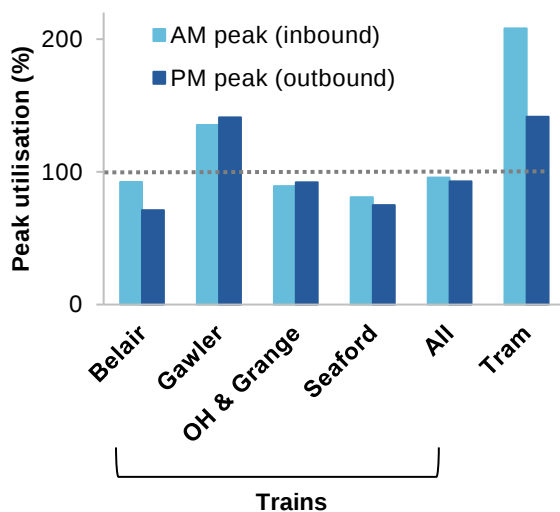
(B) Melbourne, 2017-18



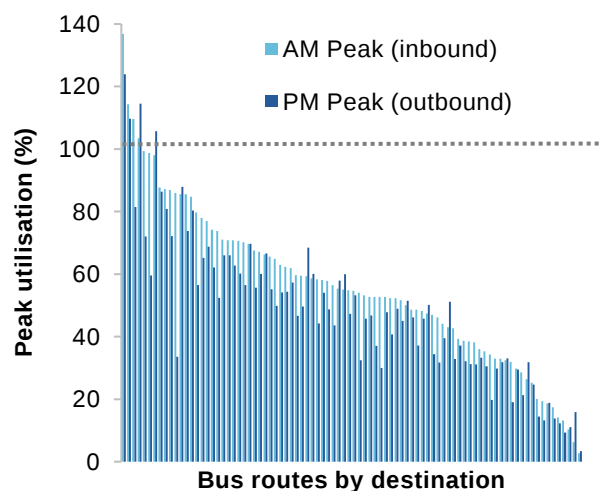
a. The spike in public transport trips at 3 pm is attributable primarily to school bus services. The magnitude of this peak may be the result of how travel times were reported, rather than the precise times of travel.

Data sources: Commission analysis of the Queensland Department of Transport and Main Roads (2020b) Queensland Transport Survey and the Victorian Department of Transport (2018), Victorian Integrated Survey of Travel and Activity (VISTA).

²⁰ Under the ATAP guidelines methodology, the full economic cost of a trip is based on a standard measure of the value of travel time, derived from surveys that estimate the financial value of public transport travel time. A multiplier is applied to the travel time to account for additional travel convenience factors like the cost of waiting time, or transfers for multi-mode trips to estimate the full economic cost. Multipliers to estimate crowding costs based on Australian survey evidence are broadly in line with OECD estimates.

Figure 3.2 – Some networks are at or over capacity on certain peak lines(A) Sydney train line morning peak average load factor, September 2019^a(B) Adelaide train and tram peak utilisation, August 2019^b

(C) Adelaide bus peak utilisation, August 2019



a. All services captured for 04 September 2019 arriving at Central Station approximately between 8am and 9am. Services measured at CBD cordon, with the exception of the T5 Cumberland line, which is measured at Harris Park. Average load factor = the number of passengers / the number of seats. A load factor of 100 per cent means there is a seat for each customer. At 135 per cent, an additional 5 people are standing on each level and 15 in each vestibule (TfNSW 2020d). **b.** OH denotes Outer Harbour.

Data sources: TfNSW (2020d) Train Loads Summary — September 2019; unpublished South Australian Government data (2021).

Alleviating crowding on public transport is a balancing act. On the one hand, consumers' strongest preferences for public transport arise at peak times because mass transit is often a fast way of getting to work. It is therefore important to provide capacity to help meet those preferences without excessive crowding. On the other hand, expanding capacity for the peak is costly when that capacity is underutilised outside peak times, as little revenue would be generated from services at that time.

Ultimately some level of crowding is desirable given the trade-off between consumer preferences for sufficiently frequent services and adequate space, and the costs of meeting these preferences.

Cost-reflective fares at peak times takes account of the incremental costs of expanding capacity — more akin to long-run incremental costs — while off-peak pricing considers operating costs as the most important consideration for pricing.²¹ The differential costs are high, with the financial costs of peak services exceeding off-peak services for all modes, primarily due to the additional capital costs required to expand capacity at these times (table 3.1).²²

Table 3.1 – Public transport services cost more to run in peak periods
Marginal financial cost estimates by mode^a

Sydney Opal network, 2016^b

		Rail	Bus	Ferry	Light Rail
Peak	\$ per trip	5.28	2.15	6.87	3.54
	\$ per kilometre	0.61	0.60	0.93	0.67
Off-peak	\$ per trip	1.90	0.47	0.55	0.35
	\$ per kilometre	0.19	0.50	0.93	0.59

Melbourne public transport network, 2020^c

		Rail	Tram	Express Bus	Bus
Peak	Usage cost (\$)	1.41	1.31	0.84	0.84
	Capacity cost (\$)	12.34	2.55	3.21	1.72
	Total	13.75	3.87	4.05	2.56
Off-peak	Usage cost (\$)	1.41	1.31	0.38	0.38
	Capacity cost (\$)	0.12	0.1	0.13	0.05
Total		1.53	1.41	0.51	0.42

a. Marginal financial costs are costs incurred with an additional trip taken. They are estimated based on incremental operating costs, as well as the incremental cost of capacity expansion (which is mostly capital costs allocated to peak periods — capacity costs are negligible in off-peak periods as the network is underutilised at these times). **b.** Under the method used by IPART for the Sydney Opal network, the peak period marginal financial cost is the incremental cost of capacity plus the usage cost. In the off-peak period, the marginal financial cost is the usage cost only. Both capacity and usage costs comprise costs that are allocated on a per journey and per kilometre basis, depending on cost type. For example, fuel costs are considered as per kilometre costs, as are the wages of drivers for the time taken to travel a kilometre, whereas staff at stations are per trip costs. **c.** Estimates are per trip. Usage costs per trip are estimated based on no change to capacity. Capacity costs are additional financial costs incurred when network capacity — including infrastructure — can be expanded.

Data sources: IPART (2016a, p. 3) and CIE (2020a, pp. 40–41).

And where network expansions do occur, these can be costly. For example, providing additional capacity to the Sydney Metro in the medium to longer term will come at an expected cost of up to \$16.8 billion (O'Sullivan 2021). As a result, even small changes in peak usage can avoid or defer significant costs. A report for the Western Australian Public Transport Authority estimated that a 10 per cent reallocation of peak demand could defer the need to invest in new capacity for three years (PwC 2015).

²¹ When there are large fluctuations in demand over a day, an efficient price would impose the cost of the additional capacity on one period only, or equalise the quantity demanded across the two periods (Boiteux 1960).

²² Buses have much lower marginal costs during peaks because the incremental capital costs are much lower.

Full cost reflective pricing is not feasible or optimal at any time of day, because of the affordability goals of public transport and the benefit that is derived from some subsidisation of peak period services to reduce road congestion (chapters 2, 5 and 6). Nevertheless, governments still have good grounds for differential fares between peak and non-peak periods to shift demand, even if these prices are not fully anchored by the costs of supply. The differential between peak and off-peak prices should still reflect the differences in costs to provide these services.

Peak pricing better manages ‘peaky’ demand if users can shift their travel time

Peak pricing should recognise the lower responsiveness to fares of those who travel at peak times (that is, lower price elasticities of demand). Peak users are more likely to be commuting for non-discretionary activities like work and education, and demand at these times is more inelastic than at off-peak times. Average elasticities observed for peak public transport use are about -0.25, compared with -0.5 in the off-peak period (ATAPSC 2021, p. 7). This broadly accords with more recent elasticity estimates using Sydney electronic ticketing data, which suggests that a ten per cent increase in fares would reduce weekday train journeys by less than 2 per cent in the peak period, compared with a reduction of over 5 per cent in the off-peak period (IPART 2020e, p. 4). Accordingly, on price discrimination grounds alone, this justifies higher peak prices even if there is no substitution between peak and off-peak travel.²³

Nevertheless, some commuters do have more capacity to shift their time of travel, such as those with flexible work schedules (and therefore are more responsive to the differential between peak and off-peak fares). More than 50 per cent of surveyed Victorian public transport users say that they would be able to shift their work travel time (Infrastructure Victoria 2020a, p. 24). Concerns about the link between COVID-19 transmission risks and crowding may also increase the responsiveness of people to peak pricing (box 3.1).

Box 3.1 – COVID-19 may change the desired trade-off between peak and off-peak fares

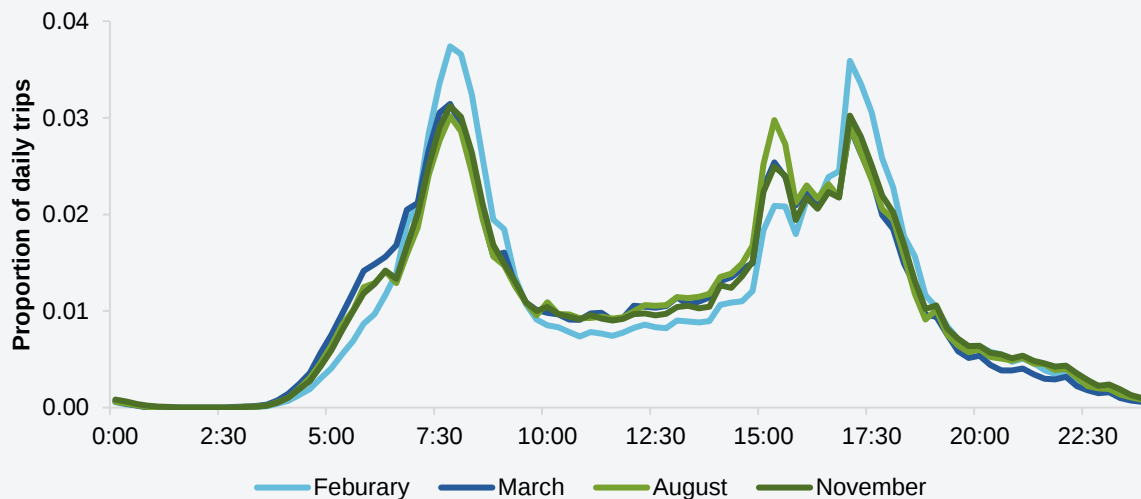
COVID-19 has disrupted travelling behaviour through enforced lockdowns, a greater share of people working from home and regulated limits on the numbers of people on public transport (chapter 1 and PC 2021a). This has flattened peak demand (figure below). As regulation and fear of transmission recedes with mass vaccination, people will be returning to workplaces but perhaps with greater scope to work from home on some days. Higher commuting prices — which largely apply at peak times — would encourage more people to take advantage of this. While unlikely to affect non-peak demand, this will reduce crowding at peak periods, and so partially alleviate the residual fears that some people may have about travel on public transport. And for businesses, the move to working from home has been accompanied by a greater acceptance of working hour flexibility, making users more likely to travel in off-peak periods. Higher peak prices in a post-pandemic world would probably also reinforce this behaviour.

²³ While full cost-reflective fares during peak times would not be justified because of equity concerns, peak users are also more likely to be employed full-time and therefore have higher average incomes (chapter 6). While segmenting transport users based on peak use is a rather blunt division from an equity perspective, the greater proportion of employed users nonetheless suggests that peak users have a higher willingness to pay, indicating a sound basis to efficiently price discriminate, and that higher peak prices can achieve efficiency and vertical equity objectives.

Box 3.1 – COVID-19 may change the desired trade-off between peak and off-peak fares

Peak periods have flattened in Sydney since COVID-19

Train use by time of day (measured by time tapped on), Sydney 2020

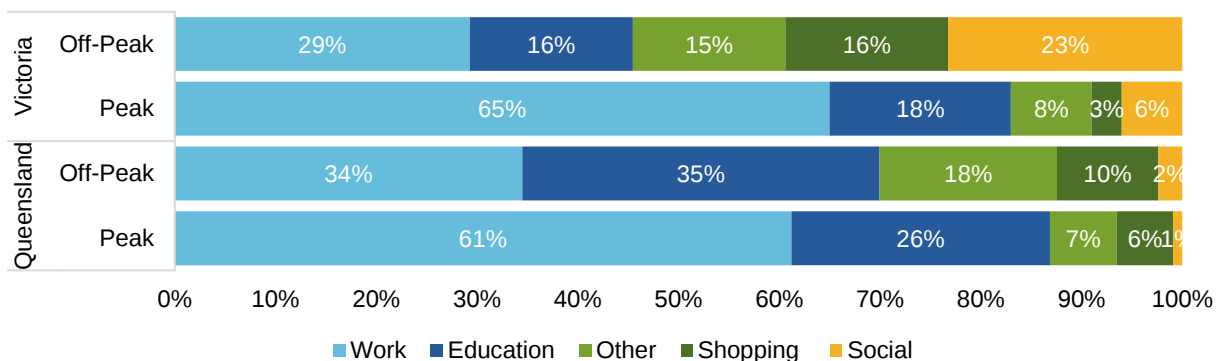


Data source: Commission analysis of TfNSW (2020c) Opal patronage data.

In addition, those travelling for discretionary purposes (such as shoppers or those travelling for a social reason) are not as time sensitive compared with those travelling for work or education purposes. Discretionary users are unlikely to value travel during the peak periods as highly as someone travelling to work. Jurisdictional data indicate that the share of discretionary travel varies by time of day (and by mode — chapter 4) (figure 3.3).

Figure 3.3 – Some travel during peak times is discretionary

Share of public transport trips by purpose, Victoria and Queensland^a



a. Other travel includes trips taken to accompany someone, for pickup or drop-off, personal business, or recreation.

Data sources: Commission analysis of the Queensland Department of Transport and Main Roads (2020b) Queensland Transport Survey and the Victorian Department of Transport (2018) Victorian Integrated Survey of Travel and Activity (VISTA).

Empirical evidence from global studies (in addition to elasticity studies more generally) do not find consistent degrees of responsiveness to peak/off-peak price differentials, suggesting that different designs that create the same price relativity can elicit different demand responses (table 3.2). (This is why behavioural economics and the marketing literature is an important adjunct to price setting.)

The Australian evidence tends to point to relatively low responsiveness. For example, in 2008, a fare discount trial known as ‘SmartSaver’ was offered on certain train lines in Sydney, with a 50 per cent discount on trains arriving in the CBD before 7:15 am, and between 9:15 am and 10:15 am (Henn, Karpouzis and Sloan 2010, pp. 11–12). The SmartSaver initiative was abandoned after the 10 week trial due to low take up. Only 2 per cent of users switched completely from peak travel for five days a week (Henn, Karpouzis and Sloan 2010, p. 13). The small effect may partly reflect the short duration of the trial and various restrictions on return tickets.

Likewise, the estimated cross-price elasticities between off-peak and peak periods tend to be small. For example, in Sydney, for a train trip of 3-8 kilometres, a 10 per cent decrease in post-peak period train fares from their current levels (an increased off-peak discount) decreases peak train trips by 0.24 per cent (CEPA & HGroup 2018). The comparable figure is 0.81 per cent for 8-20 kilometre train trips.

A common finding across several studies of pre-peak discounts — known as early bird discounts — is that those most likely to shift are those peak travellers closest to the end of the pre-peak discount period, in other words, for whom the change in travel time is smallest. For example, though Anupriya et al. (2020, p. 30) identified a modest increase in pre-peak travel in Hong Kong following the introduction of a 25 per cent discount for early morning trips, the policy did not change behaviour at the peak of the peak, which is critical to reducing the need for costly capacity investments.

Table 3.2 – Off-peak discounts can (modestly) affect travel times

Selected studies examining off-peak discounts and rewards

Study	Location	Form of peak pricing	Time horizon of analysis (post-implementation)	Estimated effect on demand
Anupriya et al. (2020); Halvorsen et al. (2019; 2016)	Hong Kong	25 per cent discount on trips terminating before 8:15am at designated stations on weekdays	2 months; 12 months	3 per cent decrease in the proportion of eligible peak trips between 7:00-9:30am. The arrival time of regular commuters who used the discount was 25 seconds less.
Zou et al. (2019)	Beijing, China	50 per cent discount on morning pre-peak trips	1 month 6 months	Peak hour ridership decreased by 2.5 per cent in the short term and 5 per cent in the medium term.
Peer et al. (016)	Netherlands	Travel distance-based monetary rewards between 1.5-4.5 euros for off-peak travel	4 months 6 months	22 per cent decrease in the relative share of peak trips during reward period, and by 10 per cent towards the end of the reward period.
Pluntke and Prabhakar (2013)	Singapore	Travel distance-based reward with credits for peak travel or triple credits if used off-peak	4 weeks	Estimated 7.5 per cent overall decrease in the percentage of peak trips.
Currie (2010)	Melbourne, Australia	Free trips if completed before 7:00am	1 year	1.2 to 1.5 per cent reduction in previous level of peak-hour demand.
McCollom and Pratt (2004)	Denver, Colorado and Trenton, New Jersey, USA	Free inter-peak fares in CBD and universities	Short-term	Reduced share of peak ridership by 20 percentage points in Denver (from 50 to 30 per cent) and by 13 per cent in Trenton (from 68 per cent to 50 per cent).

Source: based on Anupriya (2020, p. 18).

This behaviour reflects that most patrons' have relatively little scope or preference for changing their travel times by much. This is driven by rigidities of everyday life — such as the inflexibility of school commencement times and business requirements for the timing of employees' arrival at work. People are often reluctant to give up sleep for a discount on an earlier commute (Adnan et al. 2020, p. 138; Henn, Douglas and Sloan 2011, p. 8), and in any case, being very early for many jobs is wasted time, and represents a cost greater than the benefit of a modest reduction in transport fares. This is evident in surveys of preferences. Of the 50 per cent of Victorian public transport users travelling for work with some capacity to change their time of travel, 54 per cent said they were able to shift their time of travel by only up to 15 minutes, and a further 38 per cent could shift timing by up to half an hour (Infrastructure Victoria 2020a, p. 47). Relatively few people could shift travel times outside this range, with 24 per cent up to an hour and 13 per cent more than one hour. Similarly in Sydney, 15 per cent of peak hour passengers said they were willing to travel 30 minutes earlier or later with a 30 per cent discount, but this fell to 4 per cent for moving travel more than an hour earlier or later (Henn, Douglas and Sloan 2011, p. 14).

Spreading the load can reduce crowding

The negative effect of crowding on a user's satisfaction is already partly factored into their travelling choices. However, the *social* costs of crowding take into account that any given person's contribution to crowding is not just costly for themselves, but increases others' discomfort. Under a social marginal cost framework, the negative externality generated by an additional user's contribution to crowding should be estimated and captured in fare setting. This is an implication of focussing on the efficient *marginal* use: once capacity is exceeded, flat fares will not provide a sufficient incentive to spread demand, particularly to less busy times of day (and potentially to other less crowded modes). And a fare that averages costs irrespective of the time of day would result in overcrowding at peak times and underutilisation at off-peak times.²⁴

One way to address overcrowding is to add more services to a network. However, for rail networks in particular, additional services cannot be added without network extension, which comes with high costs (table 3.1 above). For example, IPART (2020d, p. 13) notes in relation to Sydney's train network that '... there is limited capacity to make services more frequent due to constraints on the network at this point in time', meaning that additional demand would only result in increased crowding. Similarly, IV (2020a, p. 34) indicated that the Melbourne Free Tram Zone '... includes the busiest tram corridor on the largest tram network in the world — a corridor that is already at capacity — running a service in each direction every 60 seconds at most times of the day'.

By bringing forward or delaying the travel of some users at peak times, peak pricing can reduce overcrowding of services and increase traveller amenity while also deferring expensive infrastructure expansion.

What about cities without crowding?

While peak pricing during busy times of the transport network is common, there are four jurisdictions that have little or no differentiation of fares by the degree of network use — Victoria,²⁵ Western Australia, Tasmania and the Northern Territory. The latter three jurisdictions are not currently facing capacity or crowding issues on their transport networks and are ranked as having the least congested road networks among capital cities (Infrastructure Australia 2019b). Accordingly, peak pricing is not justified as a way of

²⁴ In modelling social marginal cost, IPART and IV differ in their treatment of crowding. IV explicitly models crowding (or lack thereof), but IPART instead argues that crowding is more related to underlying population growth levels, and is therefore unlikely to be affected by changes in fares (IPART 2020d, p. 15).

²⁵ Victoria abandoned off-peak fares during the day in 2021, though it retains free early bird train travel until 7.15 am. During daytime periods there is no fare difference regardless of demand so that, in effect, there is no genuine peak pricing.

shifting demand between peak and off-peak times or for allocating scarce capacity for those who value peak use the most (such as commuters compared to shoppers).

However, that does not exclude some price differential between peak and off-peak periods. A potential advantage of lower relative off-peak fares is that demand may be fare sensitive during this period such that the increase in demand could have less than proportional revenue impacts, while also providing (blunt) assistance to groups who tend to have lower income (chapter 6). In contrast, demand during peaks is relatively unresponsive to higher fares at current prices, which should further widen the price differential and entail greater cost recovery during peak periods.

How users respond to peak pricing also informs the degree of cost recovery, but is contingent on how peak pricing is implemented in the fare structure, including the level of fares and the differentials between peak and off-peak. Peak pricing — alongside modal and distance-based pricing — is another tool available to governments to improve cost recovery, depending on how it is implemented (discussed in section 3.2 below).

3.2 Features of effective peak pricing design

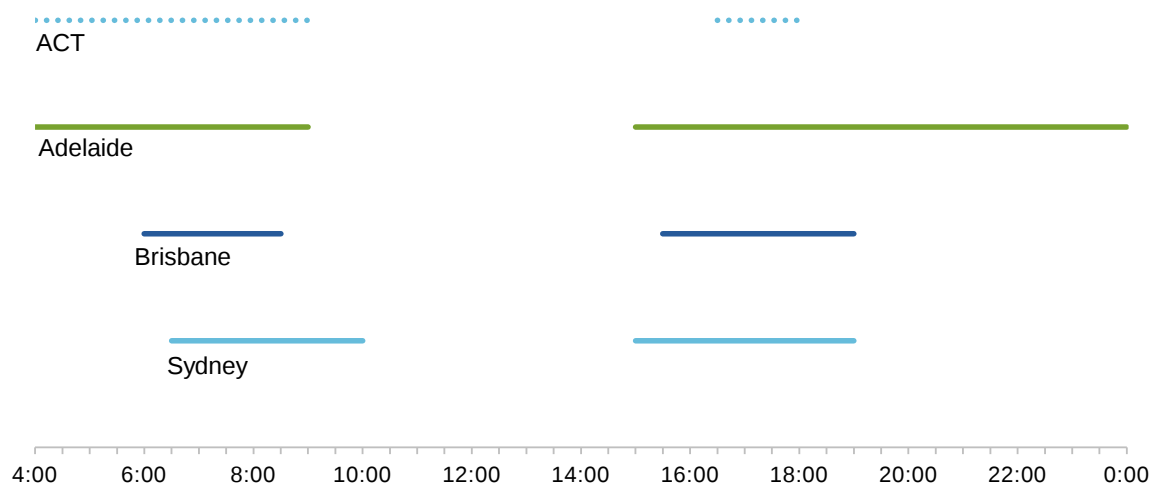
In Australia's cities where the costs of crowding and capacity on public transport are significant, peak periods could be better designed to target behavioural change, potentially without materially compromising cost recovery.

Shorter peak periods should align with users' likelihood of shifting travel times

Jurisdictions' use of peak pricing varies with the types of tickets and customer types they apply to, and their timing (figure 3.4).

The timing of off-peak (and therefore peak) periods should reflect the degree to which they:

- encourage shifts from crowded to less crowded times
- contribute to cost recovery. Charging peak prices during parts of the day when users are highly responsive to fare levels results in lower patronage and reduced cost recovery. On the other hand, charging low off-peak fares for those customers who would have been willing to travel at a peak price in a less busy period provides them with windfall gains, cannibalising revenue and requiring distorting taxes to fund the shortfall. (In this sense, price discrimination that offers better price deals for readily identifiable and price responsive people in off-peak periods than for others in the same period is often sensible — such as family saver tickets available at off-peak times, as in Victoria).

Figure 3.4 – Peak period lengths vary by jurisdiction^a

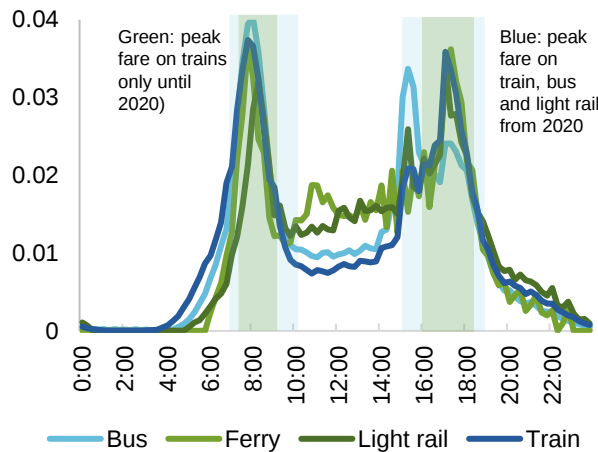
a. Peak fares across jurisdictions only apply on weekdays. Though Western Australia does not apply peak periods for *all* users, there are conditions of use on all-day travel fares that apply at certain times of day on weekdays, effectively encouraging off-peak use. For example, the standard DayRider ticket provides unlimited travel, but is only available after 9 am. Similarly, the concession DayRider ticket is only available before 7:15am and after 9am for zones 1 to 4, and before 7.15 am and after 8.30 am for zones 5 to 9. Similarly in Tasmania, daily caps only apply for travel at certain times of day, such that the weekday cap is \$9.60 if the first boarding is before 9 am, and \$4.80 if the first boarding is after 9 am. Caps also apply to adult concession fares, at \$5.80 and \$3.10, respectively. Student ticket caps do not vary by time of day. In Victoria, there is an ‘early bird’ discount for Myki users, which provides free train travel before 7:15 am — in effect, there are no peak charges for the busiest times. A trial of off-peak fares was introduced and ended in 2021.

Source: based on pricing information published on jurisdictions’ websites.

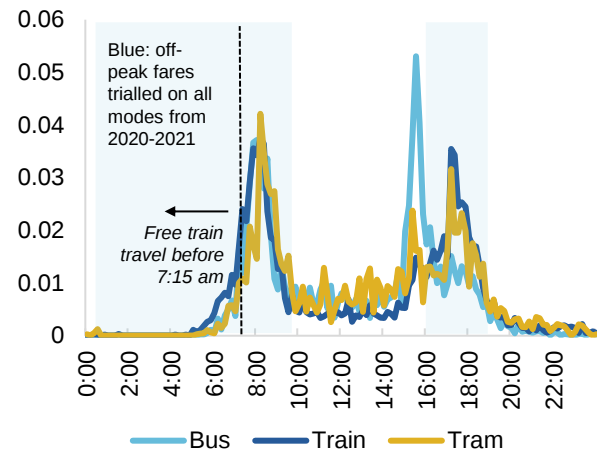
As noted earlier, peak periods of demand are quite narrow and hard to move by much given people’s preferences about the time of travel, school opening and closing hours, and employer needs. This suggests that peak charges should be closely aligned with peak demand to maximise the prospects of shifting demand away from peaks. There are opportunities to better align the two in some jurisdictions (figure 3.5). To give an example, commencing peak prices at 6.30 am, when most demand is low, will not shift much demand to a time earlier than 6.30 am (‘sleep matters’), while commencing it at 7 am will be more likely to encourage some people to travel in the period between 6.30 to 7 am, flattening the demand peak.

Figure 3.5 – Alignment of patronage and the timing of peak periods
Share of weekday patronage by time of day, peak periods highlighted^a

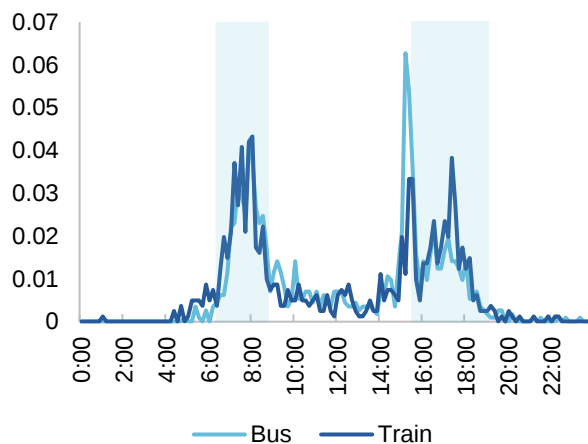
(A) Sydney (February 2020)^b



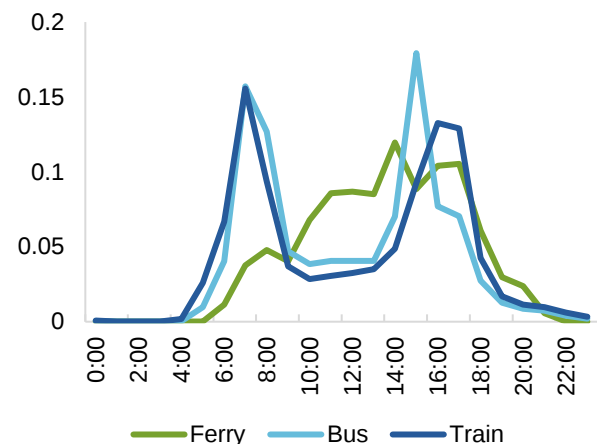
(B) Melbourne (2017–2018)^{c,d}



(C) South East Queensland (2017–2018)^d



(D) Perth (June 2019)



a. Share of daily trips on each mode. School bus services have been included where they are routed services provided by public transport operators. **b.** Sydney introduced off-peak pricing for buses and light rail in July 2020 and extended the length of the peak period for trains. Therefore, peak pricing would have only applied to train patronage at this time. Off-peak discounts would not have applied to bus and light rail patronage in February 2020. **c.** Victoria introduced off-peak discounts on a temporary basis from January to August 2021. Therefore, only the ‘early bird’ discount on pre-peak train journeys would have applied at this time. Off-peak discounts would not have applied to bus and light rail patronage. **d.** These charts draw on survey data, rather than actual patronage figures. The spike in public transport trips at 3 pm is attributable primarily to school bus services. The magnitude of this peak may be the result of how travel times were reported in surveys, rather than the precise times of travel.

Data sources: Commission analysis of TfNSW (2020c) Sydney Opal data, Victorian Department of Transport (2018) Victorian Integrated Survey of Travel Activity (VISTA), Queensland Department of Main Roads (2020b) Queensland Travel Survey, and unpublished data from Transperth (2019).

In practice, some jurisdictions have peak charges in place for much longer periods. The main rationale for this is that patronage and service frequency is so low that discounts would make little material difference to the numbers of patrons. Equally, if demand is relatively unresponsive to fares at times before or after the actual spikes in network usage, then extending the peaks to cover these periods would raise revenue while making

little difference to demand. In these jurisdictions, the determination of peak periods is led by cost-recovery motivations rather than spreading demand. The extension in 2020 of the Sydney morning peak period from 7-9 am to 6.30-10 am will likely raise revenue, but have only modest impacts on smoothing demand.

Similar considerations apply to the time of commencement of the peak period in the afternoon. The evening peak periods in some jurisdictions appear to be tied loosely to the end of the school day (usually 3 or 3:30 pm), which is when demand on the network lifts. This is likely to have the benefit of discouraging people who are neither school students nor commuting workers²⁶ from travelling after school closure times, thus reducing network pressures that time. Given that — at least in several jurisdictions — bus use peaks with school closing times, but train use does not, there may be potential justification for the commencement of a peak charge earlier for buses than trains. While that would lead to some intermodal substitution, it looks unlikely, in those jurisdictions at least, to lead to excess load factors on trains.

Overall, there appears scope for some jurisdictions to compress their existing peak periods and to better align their starting and finishing times with peak demand. While some peak periods are common across jurisdictions (like high use at the start and end of the working day), the degree of capacity constraints at peak vary. Where a network is rarely above capacity, the timing and level of peak pricing should be more driven by cost recovery and affordability considerations until capacity constraints start to emerge.

However, reducing the length of the peak period without adjustment to the fare differential would also reduce cost recovery, given peak fares would apply for shorter time periods in each day. To ameliorate these effects, other features of peak pricing should also be considered in tandem, like larger price differentials discussed below.

Larger price differentials applied as surcharges would improve effectiveness

Different sizes and approaches to price differentials affect user behaviour

Changes in user behaviour will depend on the cross-price elasticities between peak and off-peak travel. They also depend on how the differential is achieved. The same differential between off-peak and peak fares from any given starting set of prices can be achieved in three ways: off-peak prices can be lowered (off-peak discounts) or peak fares can be increased (a peak surcharge), or both can occur simultaneously.

The effects on peak travel are greater if the differential between peak and off-peak fares is achieved by a surcharge on existing peak fees, such as that introduced for the London Underground (TTF 2016, p. 44). This is because a fee surcharge provides a direct disincentive to travel at peak times (a finding also common in the empirical literature, such as Liu and Charles 2013, p. 30).²⁷ The Commission estimates that a 10 per cent increase in peak fares (from current levels) for all Sydney public transport services would increase non-peak journeys by about 3 per cent and reduce peak journeys by about 2 per cent (while also raising revenue).²⁸ While these effects are modest, they may still defer costly lumpy investments in capacity

²⁶ Neither workers nor students themselves could realistically change their movements prior to commencement of the peak or to travel after the peak period has finished given the inflexibilities in schools and most workplaces. The most responsive would be people who are shopping or engaged in recreational and social activities, whose timing is flexible.

²⁷ This arises because own-price peak elasticities are larger than cross-price peak to off-peak elasticities.

²⁸ These estimates are based on the own and cross-price elasticities and journey numbers specified in CEPA & HGroup (2018). Given the CEPA and HGroup report did not differentiate between peak and off-peak bus services, the calculations here

for networks with high load factors. It is also possible to jointly increase the off-peak discount and peak surcharges, which could elicit both demand spreading and higher revenue.

Evidence on the appropriate differential is scarce in public transport, and in the literature generally. Based on analysis of the Hong Kong transport system for example, Anupriya et al. (2020, p. 30), find that a '... simple fare incentive of 25 per cent does not seem strong enough to incentivise commuters to shift their travel timing by 30 minutes or more'. In 2016, IPART proposed increasing the off-peak discount from 30 to 40 per cent (though it was not adopted by the NSW Government) (IPART 2016c, p. 3). Stated preference surveys can sometime provide estimates of the responsiveness of people to different pricing models, though such methods should be interpreted carefully given significant differences between forecast and realised outcomes (box 3.2).

Box 3.2 – A warning about forecasts of demand responses to peak/off-peak pricing differentials

Given the multiple options for peak/off-peak pricing, it is often hard to use existing empirical evidence of people's behavioural responses as a reliable guide of their responses to new pricing approaches. For this reason, stated preference methods are frequently used in developing new pricing approaches as they can be tailored to a particular pricing approach.

However, stated preference methods do not always reliably forecast the actual response of people to fare changes. People's stated preferences about their behavioural responses indicate that off-peak fare discounts can sometimes make a significant difference to the timing of their travel. For example, one survey found that 37 per cent of people were willing to travel 30 minutes earlier for a 10 per cent fare discount (Henn, Douglas and Sloan 2011, p. 6). A discount of 30 per cent discount lifted willingness to travel earlier by more than 50 per cent. Yet the 'SmartSaver' trial in Sydney described above had much higher discounts than this, but had only a modest impact on spreading demand.

Alternative stated preference methods can provide more realistic forecasts of actual behaviour in response to price changes. A different approach to measuring stated preferences found that free travel before 7 am decreased peak hour demand by 2 per cent only and led to significant revenue losses (Douglas Economics 2012). This is closer to the actual results observed in the SmartSaver trial.

The implication is not to forgo stated preference methods, but to be aware that they can produce wildly different results. For peak pricing, there should be particular caution about stated preference results that show large demand responses unless there is other evidence consistent with that result.

Implications for pricing in Australian jurisdictions

The current price differential for peak and off-peak fares across Australian jurisdictions is commonly between 20 to 30 per cent (table 3.3). South Australia has the largest off-peak discount across the jurisdictions, at 45 per cent.

Australian jurisdictions have typically implemented peak pricing as an off-peak discount, rather than a peak surcharge. While this is likely to be more palatable for users, it also has greater likelihood of reducing cost

adopt the approach taken by IPART (2020e) to provide own-price elasticities for services these times, while judgment was used for most bus cross-price elasticities (taking into account the patterns apparent for train cross-price elasticities).

recovery over time given the bias towards keeping nominal fares under current institutional arrangements. Cost recovery effects could be improved through the concurrent implementation of a larger peak differential or a peak surcharge, and institutional arrangements to maintain real fares (chapter 8). This combination of policies would therefore improve the overall effectiveness of fares, improving user experience during peak periods through reduced crowding, and benefit the community overall.

Table 3.3 – Jurisdictions' off-peak discounts
2021 fare levels^a

Jurisdiction	Peak fare	Off-peak fare	Differential ^b
NSW	\$3.66 (train)	\$2.56 (train)	30% (train, bus, light rail)
	\$3.20 (bus)	\$2.24 (bus)	0 (ferry)
	\$3.20 (light rail)	\$2.24 (light rail)	
	\$6.21 (ferry)	\$6.21 (ferry)	
Vic (in place 2020-21 only)	\$4.50 (zone 1)	\$3.15 (all zones)	30% (zone 1)
	\$3.00 (zone 2)	'Free Train travel before 7am	0 ^c (zone 2)
Qld	\$3.37	\$2.70	20%
SA	\$3.95	\$2.20	45%
WA	Time-based discounts for unlimited daily pass.		-
Tas	Reduced fare cap based on time of travel for Adult ticket.		~50% reduced fare cap.
ACT	\$3.22	\$2.55	~21%
NT	-	-	No discount

a. Where fares vary by distance, the fare differential for the shortest trip is presented. New South Wales implemented a temporary, now expired, 50 per cent off-peak discount in 2020. **b.** Differential may not equal the exact discounts due to rounding. **c.** As zone 2 travel is cheaper than the off-peak fare, the myki will automatically charge \$3.00 (the zone 2 fare), with no discount. Victoria's off-peak discount was only in place from January to August 2021, but free train travel pre-7am remains in place.

Source: Based on pricing information published on jurisdictions' websites.

A shoulder and peak pricing model could be considered

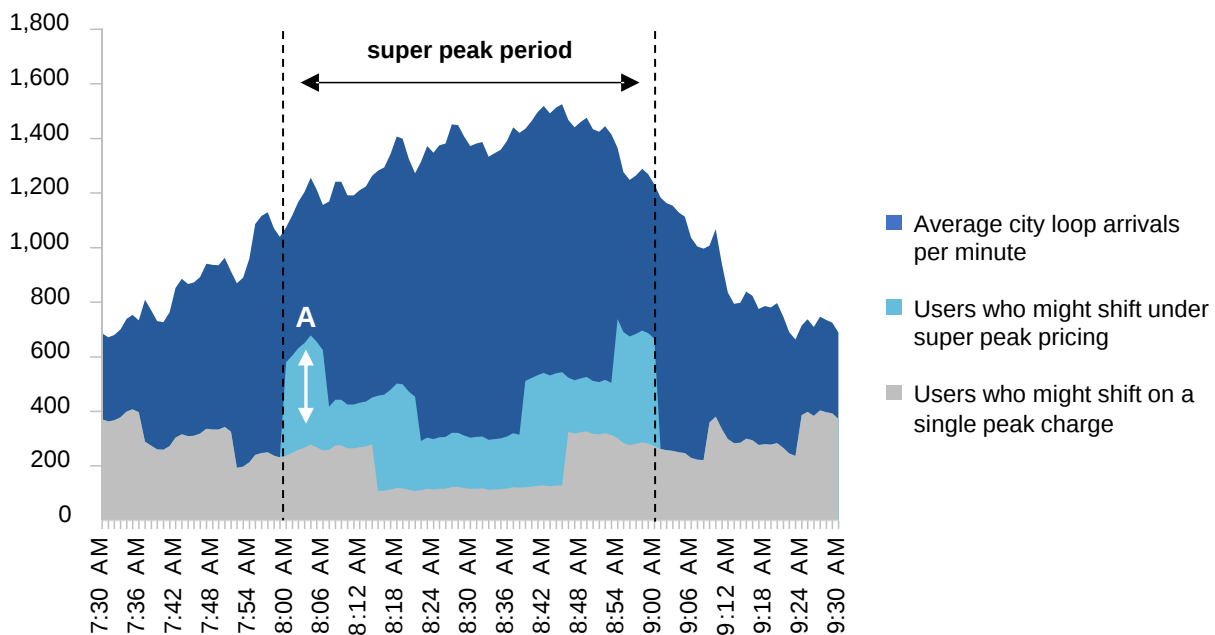
A 'shoulder and peak' model is a form of pricing used in other utilities like electricity, which could be adopted in jurisdictions experiencing crowding or capacity constraints on public transport. To the degree peak and shoulder pricing further smooths demand away from the time when the networks are most stressed, then it would lower the costs associated with crowding and the incremental network costs to service demand. Sydney and Melbourne have patterns of demand most amenable to shoulder pricing in that they have a 'peak of the peak' between 8 am and 9 am. An additional charge for these periods could encourage some 'super peak' users to shift their travel time to 'shoulder' periods on either side of the super peak, in addition to users who are encouraged to shift to the off-peak period, thereby spreading the peak load.

Infrastructure Victoria (2020b, p. 25) and the NSW Productivity Commission (2021, p. 338) have identified the potential for gains from shoulder pricing, though it would have practical challenges. Based on survey responses, IV (2020b, p. 25) estimated that over 50 per cent of City Loop users would have an incentive to change their trip timing in peak, compared with no peak pricing (figure 3.6). (Though as noted above, survey evidence sometimes overestimates the extent of actual behavioural shift.) Similarly, the NSW Productivity Commission (2021, p. 338) considered that IPART was best placed to examine the potential for a shoulder fare in addition to peak pricing. This would have the same effect as IV's model for pricing: superpeak users

have an incentive to shift their travel slightly earlier or later to the shoulder period, and those travelling in the shoulder have an incentive to shift to the off-peak period.

Figure 3.6 – A superpeak charge might further flatten peak load

IV estimates of City Loop users who would shift under superpeak pricing^a



a. Estimates based on analysis of a Victorian Department of Transport survey.

Source: Infrastructure Victoria (2020b, p. 25).

As with peak pricing, the fare differential — between the peak, shoulder and off-peak periods — is a critical design feature, as is managing any potential increase in congestion costs that would occur with substitution to driving by existing public transport users (chapter 5). Also, as is the case with any peak pricing, passengers must have a viable option to shift to, meaning that there needs to be sufficient service frequency during shoulder periods.

There are pitfalls of, and uncertainties about, shoulder pricing, which would need to be managed.

First, it could add complexity to pricing structures for users, recognising that any behavioural change is contingent on users' knowledge of the fare differences. On that basis, Infrastructure Victoria (2020b, p. 25) was ultimately reticent about its practical value. However, users' transport decisions — particularly commuters who make up the bulk of peak period activity — are typically repeated, which increases comprehension and reduces complexity over time. Moreover, many jurisdictions are moving towards account-based ticketing systems, which provide an online platform and clear price information for users. These platforms would also facilitate more complex pricing structures, for example, through a simple app interface, which could also build in behavioural nudges or real-time updates based on actual travel patterns and use (chapter 7). In addition, clear communication and public campaigns would assist with educating users about the shoulder/peak fare differential.

A second more significant concern is whether shoulder pricing would have its desired impacts. While the modelling undertaken by Infrastructure Victoria suggests scope for significant smoothing of demand, what people say about their behavioural responses to fare differentials can belie their actual responses, as exemplified by the Sydney SmartSaver Trial. The Commission is not aware of a shoulder pricing model globally that would provide guidance on the impacts on demand smoothing. The biggest risks are that shoulder prices would make little

difference to peak demand, but instead erode revenue compared with a simpler peak price (the same issue that can bedevil the timing of off-peak periods and discount levels).²⁹

Notwithstanding these concerns, the peak and shoulder model has promise for jurisdictions with growing congestion problems. Further jurisdictional-specific analysis of revenue, costs, and cross-price elasticities would be worthwhile to quantify the magnitude of costs and benefits of this proposal and to reduce the uncertainty about impacts. Moreover, jurisdictions' investments in improved ticketing technology provides an opportunity to consider new and more complex pricing models that would enhance overall network performance, whilst minimising customer impacts. Changes to improve the effectiveness of peak periods and existing peak/off-peak charges would be the best starting point, and then shoulder pricing trials considered.

3.3 Complementing peak pricing through other measures

The efficacy of peak pricing could also be improved through a combination of fare and other measures, such as the addition of express services, improved service frequency and other supporting infrastructure like sophisticated electronic ticketing systems. Certainly a minimum requirement for peak pricing to shift passenger travel time is sufficient excess capacity in shoulder periods to facilitate the shift (Liu and Charles 2013, p. 29). Designing the optimal combination of policies requires further detailed information about users' behavioural response to the mix of incentives, given their current travel preferences.

Changes in service frequency are also important complements to peak pricing reform, and can have larger effects on demand and overall social welfare than fare changes. For example, Börjesson, Fung and Proost (2016) model the optimal pricing, frequency, bus size and number of bus lanes for a transport corridor in Stockholm, finding that the benefits from changing fares are about 60 per cent of those associated with the additional service (table 3.4).³⁰

This example shows that there is value in jointly optimising fares, service frequency, and (where congestion is significant) road charging (chapter 5). Each one of these policies improves outcomes, and while best delivered as a whole, there are significant gains from each alone. For example, if fares are constrained, there can be considerable value in optimising frequency alone. For off-peak services, service frequencies should be lower than peak, as coverage and affordability objectives can be achieved at low service frequencies. This approach can be bolstered where technological solutions facilitate coordination between passengers and timetabled services (chapter 7).

²⁹ IPART (2016c, p. 5) also objected to the proposal on the basis that the external benefits of rail do not vary across the timing of the peak period. Yet, peaks in road use tend to correspond to peaks in transport peaks, suggesting that the magnitude of the congestion externality — the largest external benefit of public transport provision in peak periods — would vary by time of day (chapter 5). How much this benefit varies between the peak of the peak (typically 8-9am) and the shoulder periods depends on the estimated cross-price elasticities between public transport and car use at these times. In other words, how does a price change in public transport affect the number of car trips in the peak of the peak and the shoulder times? Granular hourly cross-price elasticity estimates required to assess this effect could be calculated in future using data obtained from travel smartcards.

³⁰ They show that compared with the reference case, the estimated welfare gain and subsidy level varies according to whether governments optimise fares, road-user charges (tolls), and/or bus frequency. From this example, when road use (i.e. congestion) is under-priced, this affects both optimal fares and bus frequency. As discussed in chapter 4, congestion externalities warrant some reduction in fares — to the extent that lower fares increase public transport use, greater service provision (i.e. frequency) may be required. Proost notes that this type of 'second best pricing' will generate a PT budget deficit, as there is a deliberate subsidy to lower fares below operational costs.

Further, there are a number of other factors that would help spread the peak network load. Increased working from home, flexible work policies that support greater variability in start and finish times, adjusted commercial opening hours, as well as more flexible start times for day care, schools and universities would also help to reduce the pressure on the network at peak times, particularly in the morning peak where transport demand is greatest across the entire network. Changes in flexible work practices that occurred because of the COVID-19 pandemic provide new possibilities for how non-fare changes could reduce network load, delay capacity investments, and support long-term network sustainability (provided demand does not remain permanently subdued due to perceptions of health risks of public transport).

Table 3.4 – Estimated effects of reform in Stockholm

Welfare and subsidy levels for different combinations of bus fare, road user charge and service frequency

	Road charge (peak)	Road charge (off-peak)	Bus fare (peak)	Bus fare (off-peak)	Frequency (peak)	Frequency (off-peak)	Financial deficit (subsidy)	Welfare gain ^a
	€ per trip	€ per trip	€ per trip	€ per trip	Buses per hour	Buses per hour	€000 per day	€000 per day
Reference	1.80	1.00	2.18	2.18	67	48	25.86	—
Optimal bus fare	1.80	1.00	4.50	0.00	67	48	26.54	12.58
Only change frequency	1.80	1.00	2.18	2.18	92	13	15.38	22.20
Optimal road charge, bus fare, and frequency	4.31	3.32	4.90	0.97	84	20	-2.95	36.97
Zero car toll and optimal bus fare	0.00	0.00	4.10	0.00	67	48	30.19	14.12

a. Welfare consists of the gross utility derived from car trips and public transport trips (in euros); the user cost of these trips; the cost of public transport supply; and the external costs other than congestion.

Source: Proost (2018) based on Börjesson et al (2016).



Finding 3.1

Peak periods could be more influential

Reducing the length of peak periods and increasing the fare differential using a peak surcharge would improve the effectiveness of peak pricing to shift users' travel times.

- There are grounds for morning peak periods that start later and end sooner to better match peak demand. The NSW peak period currently ends at 10 am, which is too late to encourage office workers to shift their travel times. In Victoria, off-peak discounts on all modes would encourage beneficial behavioural shifts and flatten peaks.
- Afternoon peaks may desirably start with school closure times to encourage non students to shift their demand for bus services to less congested periods. Reflecting that demand peaks occur later for trains, so too might the commencement of peak pricing, suggesting that modal peak pricing may be justified in some jurisdictions.
- In the jurisdictions where crowding on public transport is limited, the timing and level of peak pricing should be more driven by cost recovery and affordability considerations until capacity constraints start to emerge.

Peak and shoulder pricing also appears to be an attractive approach for further flattening highly peaky demand in jurisdictions experiencing significant network crowding. However, several practical limitations suggest that changes to peak/off-peak pricing and duration should be undertaken first, and then trials of shoulder pricing considered.

4. Modal and distance-based pricing

Key points

- ✱ **Relative to a flat pricing structure, modal fares — fares that differ by mode — better reflect the incremental cost of capacity expansion and that social benefits like reduced congestion vary by mode. They can also encourage more efficient future investment.**
 - However modal fares can penalise multimode trips. This can be ameliorated through fare structures that reduce the disincentive to use multiple modes to complete a journey.
 - While modal pricing can improve cost recovery and benefit those travelling on low-cost modes, it is not likely to alter travel behaviour much given low modal substitution. Low substitution also suggests it is unlikely to harm network efficiency.
- ✱ **Distance-based fares — used in many Australian jurisdictions through fare zones — are also more cost-reflective than flat fares, in capturing both capacity- and distance-related costs. Distance-based pricing is also more consistent with multimodal use.**
- ✱ **Applying a combination of peak, modal and distance-based pricing requires effective communication to help users easily navigate complex fare structures, for example through more informative smartphone applications.**
 - New South Wales is the only jurisdiction that has peak, modal and distance-based pricing. Other jurisdictions experiencing congestion or crowding problems would benefit from adopting a similar approach.
 - For other jurisdictions, careful consideration of the benefits of more differentiated fares must be weighed against the implementation costs of any technology upgrades required.

4.1 Modal pricing

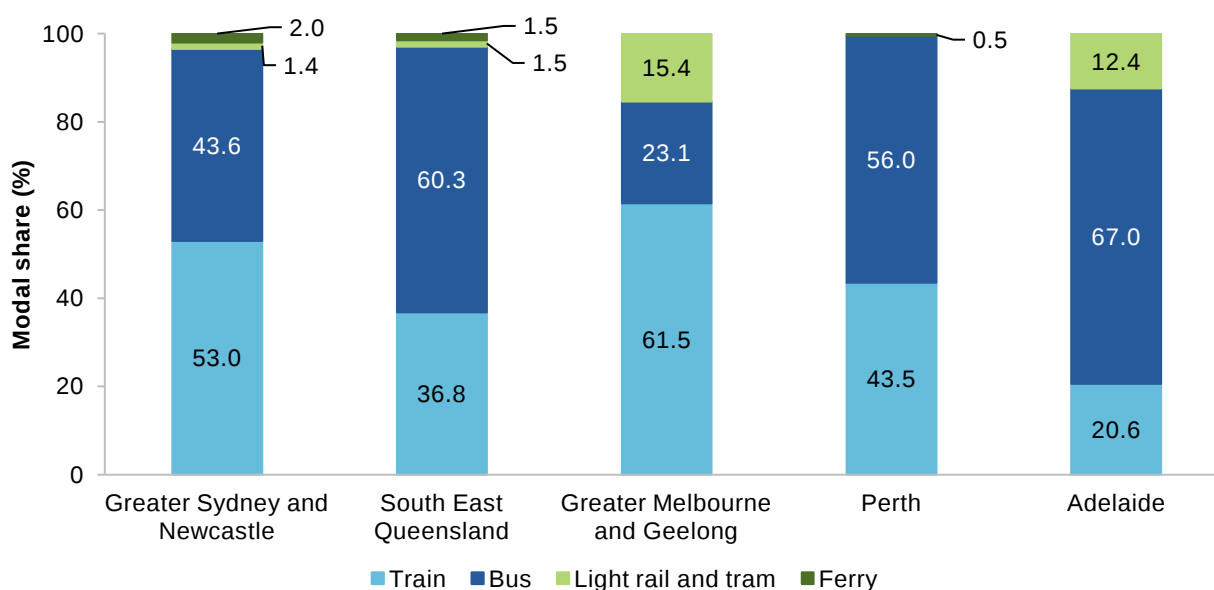
Bus services are typically the only form of public transport in smaller cities and regional areas (aside from some individual ferry services). In larger cities, multiple public transport networks act as both competing and complementary services. Modal patronage varies across jurisdictions (figure 4.1), as does the use of multimodal journeys. In Sydney, Melbourne and Perth, multimode trips make up between 14 and 21 per cent of all public transport work trips (chapter 1).

A challenge for governments is to encourage travel patterns across modes that improve network efficiency from an operational perspective. Another is to encourage cost efficient operation and investment through better asset utilisation. Pricing can be a useful lever, though its use is contested.

Modal pricing has two elements: price variation between modes for single trips, and price variation where multiple modes are taken as part of one overall journey. The latter multimode trips are similar in nature to transfers across multiple services on the same mode.

Views on modal pricing diverge — in 2020, Infrastructure Victoria (IV) advocated for the adoption of modal pricing in Victoria, while the Independent Pricing and Regulatory Tribunal of NSW (IPART) advocated that modal pricing be removed in NSW (Infrastructure Victoria 2020a; IPART 2020c). New South Wales is the only Australian jurisdiction to have implemented modal pricing, though it is more common internationally (TfF 2016). Modal pricing differentials applied internationally typically involve higher fares for rail (like London) or for light rail (like Manchester and San Francisco). Differences in approach may be appropriate, given jurisdiction-specific parameters. Ultimately, the benefit of modal pricing depends on whether it better reflects financial and social costs; the likely demand response; and interactions with other policy objectives.

Figure 4.1 – Public transport modal shares vary by jurisdiction
Share of total public transport trips, 2018-19



Sources: TfNSW (2020b) Household Travel Survey, Queensland Department of Transport and Main Roads (2020b) Queensland Travel Survey, Victorian Department of Transport (2018) Victorian Integrated Survey of Travel Activity (VISTA), unpublished data provided by Transperth (2021) and the South Australian government (2021).

Modal pricing can better reflect costs

The extent of benefits from modal pricing will depend on the financial and social costs associated with each mode of public transport.

Modal variations in costs

The marginal financial costs of different modes vary. This is shown by estimates of marginal financial costs for Sydney and Melbourne undertaken by IPART and IV respectively. Both analyses find that the cost of additional train trips is higher than that of buses, though the range of the potential cost estimate for trains is sensitive to

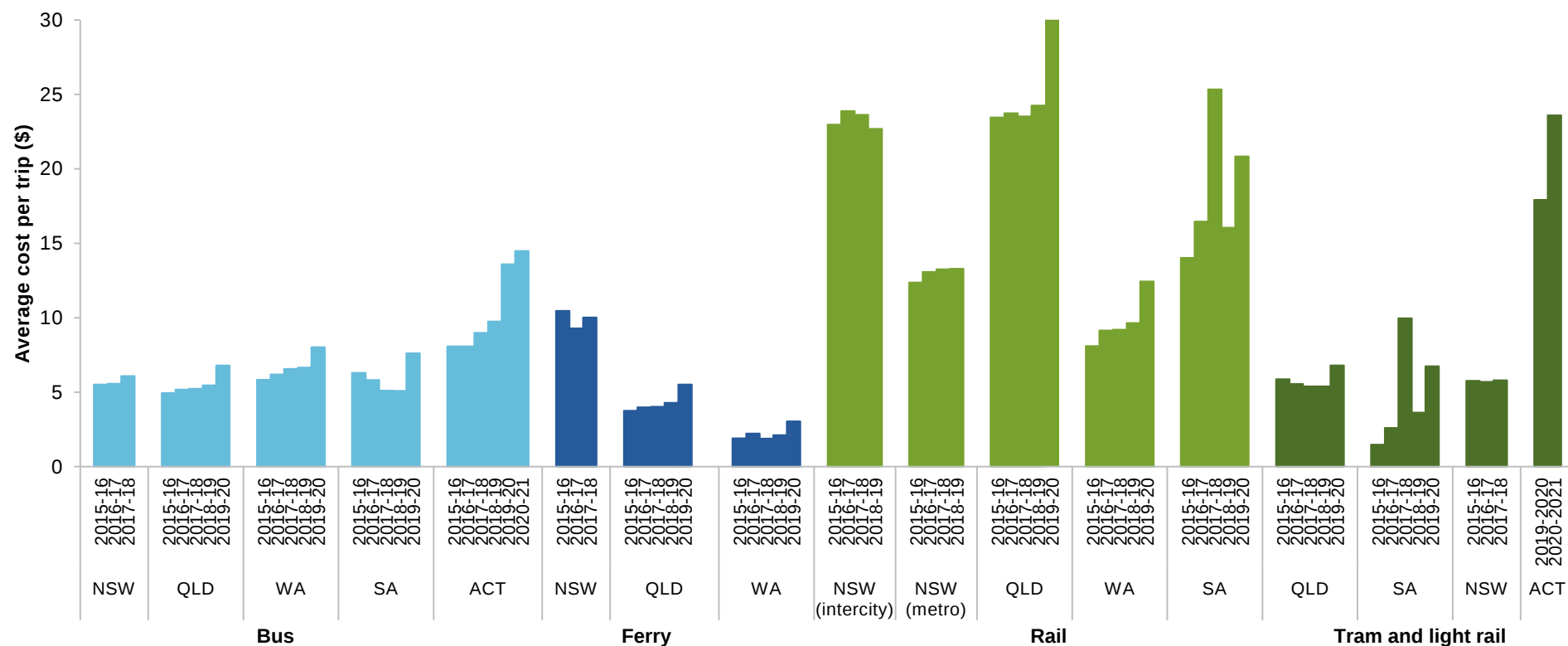
assumptions. In the case of the IV analysis, the point estimate of the additional financial cost per trip was \$13.75 for trains, \$3.87 for tram, \$4.05 for express bus and \$2.56 for metropolitan bus services (table 3.1 in chapter 3).

Historical average cost data suggest a similar story in other jurisdictions. The high capital costs of train networks mean that servicing an incremental train kilometre is much more expensive than an additional bus kilometre. In addition, average trip costs for trains are higher than buses (figure 4.2). This is a reflection of the longer distances travelled by trains for any given trip. In Victoria for example, the mean trip length is 14.7 kilometres for trains compared with 5.9 kilometres for buses and 2.6 kilometres for trams (CIE 2020a, p. 75). In Sydney, the average trip distance by train was 17.9 kilometres, compared with 7.5 kilometres by bus (TfNSW 2020b). Once total network kilometres travelled by mode over a given period is considered, average costs per kilometre are lower for trains than buses (figure 4.3). This reflects the purpose of trains as a fast way of moving people over longer distances in cities.

Whether capital costs are incorporated into fares will therefore have implications for whether modal fares should be higher for trains or buses. For example, the Australian Transport Assessment and Planning (ATAP) guidelines estimate that the typical annualised capital cost per passenger capacity of buses is \$2.86 per weekday, compared with \$8.47 per weekday for light rail and \$5.91 for heavy rail (ATAPSC 2021, p. 74).³¹ Yet, operating costs per kilometre travelled would imply that trains are more cost-effective, despite their much higher total costs.

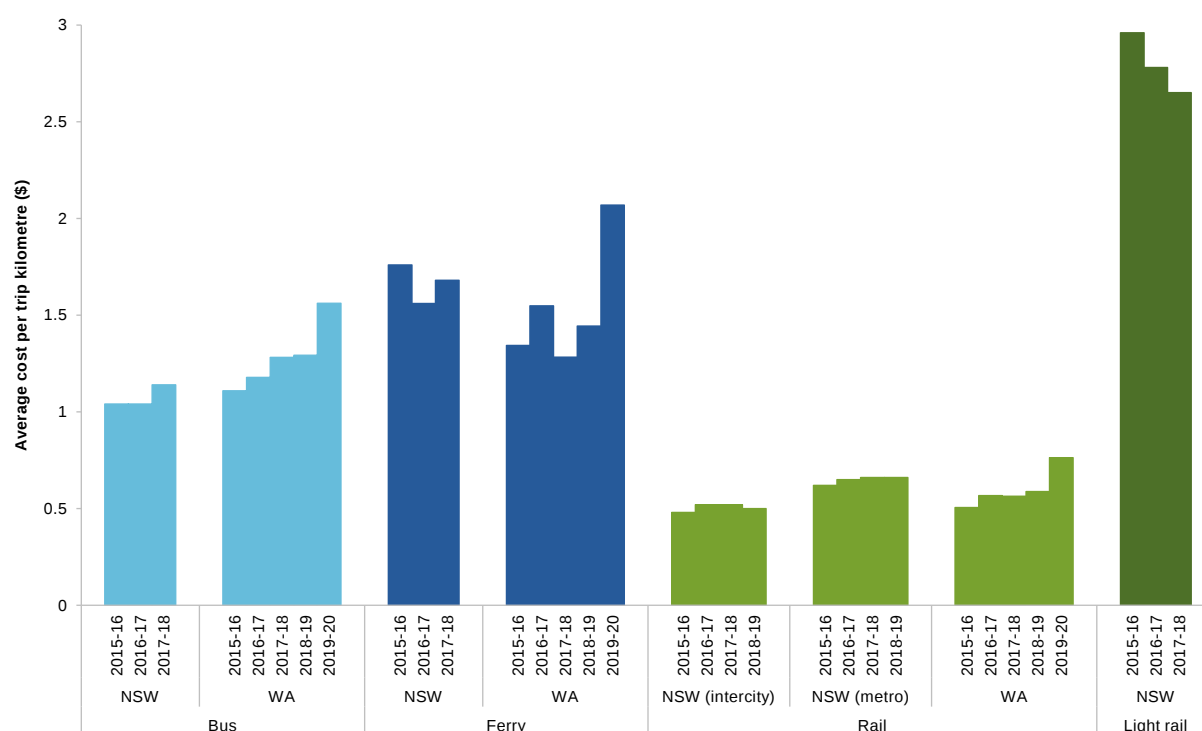
³¹ Annualised capital costs per passenger are estimated based on the one-off capital costs required to purchase an asset (considered on an annuity basis using a 7 per cent real discount rate), divided by the practical peak passenger capacity of the vehicles, which includes an addition of ten per cent to the costs per vehicle to account for the buffer of ten per cent spare vehicles required (ATAPSC 2021, p. 74).

Figure 4.2 – Average costs per trip vary by mode
Average cost per trip, by mode, year and jurisdiction



a. Note that average cost per trip has been calculated based on total costs divided by the total number of trips per mode in a given year. Total costs include both operating and capital costs, which are classified and counted differently across jurisdictions. For example, some jurisdictions allocate capital costs over the full life of the investment whereas others include the total capital costs incurred in a given year.

Source: Commission estimates based on CIE (2020b) unpublished data from jurisdictions.

Figure 4.3 – Average costs per kilometre vary by mode**Average cost per kilometre travelled by mode, year and jurisdiction**

a. Note that average cost per trip kilometre has been calculated based on total costs divided by the total of trip kilometres travelled per mode in a given year. Total costs include both operating and capital costs, which are classified and counted differently across jurisdictions. For example, some jurisdictions allocate capital costs over the full life of the investment whereas others consider the total capital costs incurred in a given year.

Source: Commission estimates based on CIE (2020b) and unpublished data from jurisdictions.

Modal variations in external benefits

The external costs and benefits associated with different modes also vary. Train trips are more likely to reduce road congestion, given train journeys are more frequently substitutes for private car travel. Based on IPART's estimates, if someone ceases taking a rail journey, 90 per cent of the time they substitute to cars, while if someone ceases taking a bus journey, 60 per cent of the time they substitute to cars (chapter 5). However, according to both IV and IPART analysis, avoided road congestion benefits only partly offset the marginal financial costs associated with rail.

In any case, buses still have a significant positive *net* impact on road congestion. Congestion costs in peak periods imposed by buses are 14 cents per trip and two cents per kilometre travelled, but avoid car congestion costs of \$2.22 per trip and forty cents per kilometre travelled (IPART 2020d, p. 12).

Where expanding the capacity of public transport services is feasible, the resultant scale benefits (the Mohring effect, discussed in chapter 2) incurred vary by mode. IPART (2020d, pp. 12–13) estimated the scale benefits associated with an additional bus trip to be \$1.32 (plus 12 cents per kilometre) compared with \$1.11 for light rail (plus 10 cents per kilometre) in 2019 dollars. In IPART's methodology, the Mohring effect was estimated only for bus and light rail during peak periods. This is because there is no capacity to increase services on the rail network in peak periods without significant additional investment and as ferries have had declining service frequency in

recent years. As part of determining an efficient price (based on social marginal cost, chapter 2), the benefits of increased service frequency are weighed up against the financial costs, the loss in efficiency associated with financial costs (the deadweight loss of taxation), and any road congestion costs.

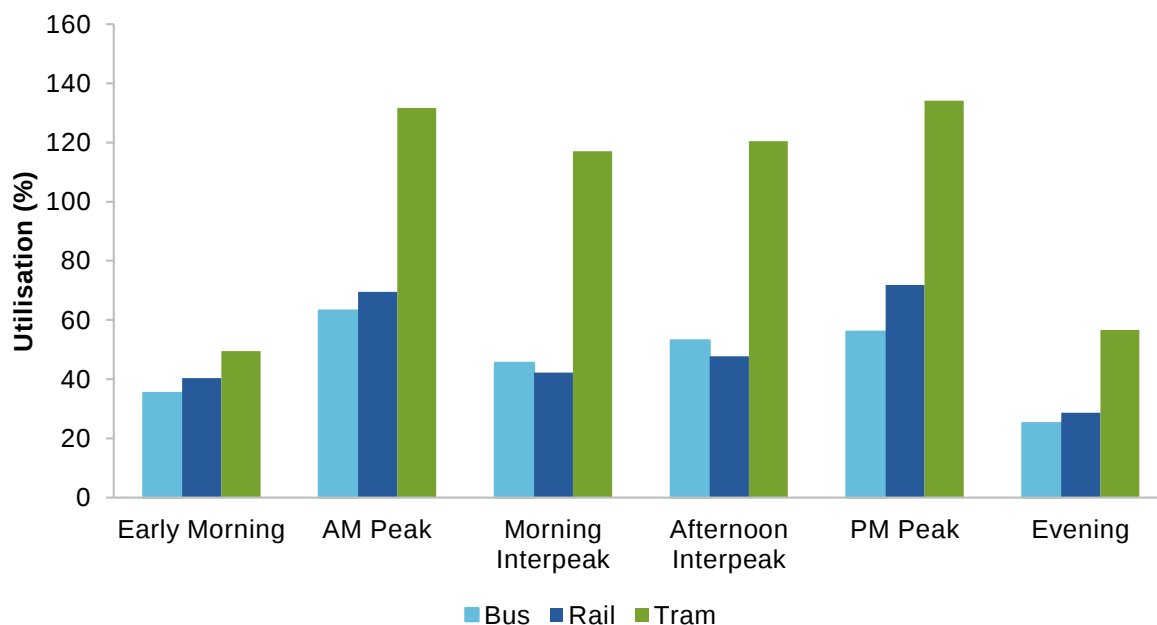
Modal pricing may also help to address crowding levels that systematically vary by mode and that are not easily addressed by capacity expansion. For example, train journeys to the Melbourne CBD are often crowded. With modal pricing, a crowded train journey would be priced higher than a less crowded bus trip. However these journeys incur the same price (Infrastructure Victoria 2020b, p. 17). IV argued that bus fares should be lowered to increase patronage and more closely align with the social marginal cost of bus trips (2020b, p. 16). (It noted that about 70 per cent of bus routes operate at less than a third of their capacity in the morning peak.) That said, the degree to which modal pricing can reduce crowding depends on consumer responses to changes in relative prices (discussed below). Regardless, modal pricing would be more equitable, as train users are more likely to be of high-income, and bus users, of low-income (chapter 6).

Other jurisdictions also have differences in transport utilisation by mode that depend on time of day. For example, in Adelaide, trams are overutilised through the morning peak to the afternoon peak, and although average rail utilisation exceeds that of buses in peak periods, this is not the case for the interpeak periods (figure 4.4).

Modal pricing could also act as a proxy for location-based pricing. This would be particularly beneficial where areas serviced by certain modes experience persistent under or overcrowding.

Figure 4.4 – Service capacity varies by mode and time of day in Adelaide

Average utilisation by mode, Adelaide, August 2019



Source: Unpublished data from the South Australian government.

Evidence points to differences in the efficient price (the expected social marginal cost) for different modes of public transport. There will also be differences by jurisdiction. Ultimately, jurisdiction-specific estimates of the different financial costs and external benefits for each mode are required to determine efficient prices. Governments may also wish to consider the equity consequences of modal pricing that again vary by

jurisdiction, depending on factors such as where people of different socio-demographic characteristics reside and the social objectives of a jurisdiction (chapter 2).

Demand responses to modal pricing

The benefits of more cost-reflective fares are contingent on how users' travel behaviour responds to fare changes.

- At one extreme, if users are entirely unresponsive to fare changes, the benefit of greater cost-reflective pricing would accrue to taxpayers and to users of lower-cost modes. Those travelling by more expensive modes would pay a greater share of the cost, reducing the reliance on general operating subsidies. All else equal, this would reduce the total deadweight loss incurred from using government revenue to fund delivery costs — which vary greatly depending on the relevant tax and can be high (box 8.3, chapter 8).
- At the other extreme, if users are highly sensitive to fare changes, benefits could include reduced road congestion and an improved passenger experience through reduced crowding or more frequent services. This effect is contingent on two key factors: that users have a viable alternative mode to substitute to — which requires network operators to offer competing modes for the same trip, and that users do indeed substitute between modes in response to a change in relative price.

Evidence on how users respond to fares suggests the most likely scenario is somewhere between these two extremes. This not only reflects individual preferences, but also network design and geography. For example, for many users, it may not be feasible to switch to another mode of transport, given network coverage, service availability, or timing.

Cross-price elasticities — which measure the sensitivity of demand for one mode in response to the change in price of another mode — provide some indication of the expected substitution between competing modes. Indeed, studies on transport elasticities suggest relatively low rates of modal substitution. For instance, aggregate cross-price elasticities indicate that, on average, a ten per cent increase in peak train fares in Sydney would result in a 0.7 per cent increase in bus use for single-mode trips between 3 and 8 kilometres (table 4.1).³² These results do not provide an indication of the extent to which substitution occurs within multimodal trips, nor of any induced travel or non-public transport substitution possibilities.³³ Elasticity studies undertaken internationally suggest a similar result. For example, a ten per cent increase in London rail fares or underground fares would increase bus demand by 0.6 or 1.1 per cent respectively (Paulley et al. 2006, p. 15).³⁴

³² Cross-price elasticities were estimated for trips of different distances, including 0-3km, 3-8km, 8-20km and over 20 km. For these distances, a ten per cent increase in peak train fares was expected to increase bus use by 0.61 per cent for 0 to 3km trips, 0.3 per cent for 8-to-20-kilometre trips and 0.46 per cent for trips over 20 kilometres.

³³ Though elasticities are estimated for multimodal trips, the aggregate elasticities do not distinguish the modal combination, and are therefore limited for understanding modal substitution. The Sydney study also holds public transport demand fixed, which provides limited evidence on how many additional users may be attracted to the public transport system with lower fares, or how many users decide not to travel at all with a higher fare. Cross-price elasticities do not consider non-public transport modes like driving, walking or cycling, which means they provide limited evidence on the additional generated public transport activity (unless these modes are included in the original cross-elasticities) (ATAPSC 2021, p. 11). Diversion rates can instead estimate the proportion of new passengers who did not previously use public transport, but no estimated diversion rates for different public transport modes were identified, either as a result of modal fares, or fare changes generally. Diversion rates are discussed in relation to avoided road congestion in box 5.2 in chapter 5.

³⁴ Like the Sydney study, London studies find that the effect of an increased train fare on bus demand is not equivalent to the effect of an increased bus fare on train demand, potentially because bus users are generally more price responsive than train users, and there are likely to be more bus trips for which substitution to rail is feasible, than the reverse (Litman 2021e, p. 52; Paulley et al. 2006, p. 15).

Substitution rates between private car and public transport also appear to be much larger than between public transport modes. In their social marginal cost analyses, both IPART and IV use simulation models to estimate changes in users' travel behaviour, including substitution between modes of public and private transport, as well as induced or avoided travel. Both use modal substitution rates that are much higher for private cars than those between modes of public transport. For example, in the Melbourne context, it is estimated that an additional train trip would on average result in 0.52 fewer car trips, 0.02 fewer tram trips, and 0.1 *additional* bus trips. These results suggest that bus and rail trips are complementary, likely due to bus feeder services to rail stations, whereas tram services appear to be substitutes for both bus and rail (CIE 2020a, p. 62). IPART uses substitution rates that are similar in magnitude, although it does not find a positive association between modes (IPART 2020e). The modelling approach taken in these studies is slightly different, but, notwithstanding this, rates of modal substitution are likely to vary across jurisdictions due to specifics of the network.

Table 4.1 – Users do not switch much between modes in response to fare changes
Cross-price elasticities for an adult weekday journey in Sydney, 3-8km^{a,b}

	Train pre-peak	Train peak	Train post-peak	Bus	MM pre-peak	MM peak	MM post-peak
Train pre-peak	-0.008	0.001	0.001	0.001	0.001	0.001	0.001
Train peak	0.036	-0.105	0.052	0.072	0.039	0.045	0.047
Train post-peak	0.02	0.024	-0.370	0.041	0.022	0.026	0.027
Bus	0.209	0.254	0.313	-0.413	0.226	0.265	0.279
MM pre-peak	0	0	0	0	-0.005	0	0
MM peak	0.005	0.006	0.007	0.01	0.006	-0.116	0.007
MM post-peak	0.001	0.001	0.001	0.002	0.001	0.001	-0.150

a. Rows of the table represent a fare change, and with the columns representing the change in quantity in percentage terms. MM is multimode. **b.** Only 3-8km estimates are presented here, as this is the distance band most likely to have the greatest extent of substitution between modes.

Source: Hensher and Ho (2020, p. 305).

Other factors may affect modal substitution more than fares. For example, a recent meta-analysis of modal cross-elasticities found that passengers were more sensitive to changes in overall travel time than fares (Fearnley et al. 2018). The wait time, journey time, access, egress and transfer time — factors that affect the generalised cost of travel for users — were more significant in determining travel choices.

Using modal pricing to better target user segments

As noted in chapter 3, modal variation for peak and off-peak periods could better target users' travel patterns and encourage behavioural changes. Indeed, if fare differentials between modes were set according to time of day, they could reflect the higher price elasticities usually observed in off-peak times, or be set to manage demand during more crowded periods. The latter would better align with the costs of capacity-augmenting investment, given these costs are primarily attributable to the peak period (when crowding mainly occurs).

Modal and peak pricing in tandem could sometimes also be justified as an efficient form of price discrimination or premium pricing. As Litman noted, modal choice is relevant to user preferences and experiences of quality:

Rail transit is considered more comfortable and prestigious than buses, and so tends to attract more discretionary riders (travellers who would otherwise drive) within a service area, but a bus network can reach more destinations, providing more comprehensive and direct coverage through

a region, and so may attract more riders with a given level of investment. Rail passengers appear willing to accept more crowded conditions than bus passengers. (Litman 2021a, p. 21)

Implications for investment

There may also be benefit in adopting modal pricing to better align fares to investment costs. Indeed, the Commission has observed little or no link between current fares and investment costs across Australian jurisdictions. In contrast to flat fares, modal fares can encourage governments to avoid demand-led overinvestment in the expansion of more costly networks (such as heavy or light rail). Even if consumers do not change their level of demand, the process of estimating cost-reflective modal prices reveals to governments the real costs of alternative transport modes. This information can help to inform government decisions, particularly in the absence of demand-driven signals for efficient investment. Where public transport fares do not reflect the costs of service provision — including the costs of capacity — resultant travel patterns can provide poor signals for investment. What could appear as overcrowding and therefore present as a rationale for further investment, may in fact reflect an inefficiently low fare (though there are legitimate equity rationales for ‘inefficiently’ low fares for some users, as discussed in chapter 6).

Moreover, where additional capacity is genuinely required, more cost-reflective fares might encourage governments to undertake more cost-effective capacity expansions, such as rapid bus transit in place of light rail for some distances. Evidence suggests that different modes are better suited to different journey lengths — for example, Infrastructure Partnerships Australia (2012, p. 10) found that heavy rail is particularly cost-effective from the user’s perspective for trips greater than ten kilometres.³⁵

Ultimately, fare policies should be considered in conjunction with governments’ non-fare levers to determine what modes are used. These might include encouraging use of cost-effective modes like express buses as a complement to crowded rail services, or providing lower-cost bus or other feeder services in place of expanding rail networks.

Are there any risks with modal pricing?

There are risks in adopting modal pricing that warrant careful consideration by governments. In its latest review, IPART, for example, highlighted several reasons for its recommendation to move away from modal pricing, including that:

- modal pricing penalises multimode trips, which would add a barrier to users taking the most efficient combination of modes, particularly given Sydney’s increasingly integrated public transport network
- passengers cannot choose the transport offered in their area, and therefore it would be unfair for some users to pay higher fares but not others
- charging the same fare irrespective of the mode would help transport planners to design the network efficiently and reduce duplication between modes (IPART 2020c, p. 17).

These arguments are explored in turn below.

Balancing modal pricing and fare integration

There is a trade-off between the benefits of cost-reflective pricing and pricing for efficient marginal network use. In situations where a multimode trip would be more efficient (in terms of travel time, asset utilisation, or reduced crowding), poor fare incentives could influence users to choose a less efficient single-mode journey.

³⁵ This is estimated on a generalised cost basis — factoring in various time costs to users.

This could involve, for example, users staying on a crowded train where part of their journey could be completed by an underutilised bus service. This not only affects passenger comfort and travel times, but also contributes to capacity bottlenecks that can lead to costly network augmentation.

This trade-off affects decisions about the degree of fare integration, which is the extent to which different modes, distances, and trip combinations are charged a single fare.³⁶ Network efficiency is a core rationale raised by IPART in advocating for fare integration, with concerns centred primarily on the efficiency effects for multimode trips.

The spectrum of fare integration ranges from, at one extreme, having consistent fares irrespective of mode (akin to a single public transport network access charge), to the other extreme of charging passengers separately for each leg of a journey. Other options include discounts for additional trip legs, or charges only for the most expensive mode for a multimode trip. The variation in approaches used in Australia and overseas indicates a lack of consensus on the ideal level of fare integration. In Melbourne, Canberra, and Brisbane the same fare applies across different modes for travel within given transport zones. In Sydney fares vary across modes, but with transfer discounts for multimodal use and daily and weekly fare caps. In all jurisdictions there are variations in the time that multiple legs of a trip must be taken to qualify for transfer discounts or fare-free travel. In their latest reviews, IV and IPART argued for moving away from their respective jurisdictions' existing arrangements, with IV recommending less fare integration; and IPART recommended removing modal pricing (except for ferries) to pursue fare integration (Infrastructure Victoria 2020a; IPART 2020c).

The key question is whether the benefits of modal fares outweigh the risks of inefficient network use. While this is difficult to assess directly with available evidence, the former are likely to outweigh the latter. Most public transport trips are single-mode trips, meaning that revenue losses under fare integration could be significant compared with more cost-reflective modal pricing. And although some existing single-mode users have the option to choose between competing modes for the same trip, many are unlikely to have this choice, reducing the likelihood of inefficient network utilisation, as people's modal choices are constrained by network availability.

Moreover, fares are only one factor influencing use, and the other factors that make up the bulk of the generalised cost to users — like travel and wait times — act as deterrents (or enablers) of inefficient network use. Even in the limited circumstances where users can choose between modes, network inefficiency arising from single mode trips would only be expected to occur where a user takes an already crowded, cheaper mode (bus) in place of the more expensive mode with excess capacity (train). In this instance, the speed and comfort of rail is likely to exceed that of the bus, which would go some way to reducing the likelihood of users picking a crowded bus over a comfortable train. Indeed, fares tend not to be the main barrier for uptake amongst those who do not use public transport. Survey evidence suggests other factors like travel time and service access are more significant barriers (chapter 6) and contribute more to mode choice.³⁷ Moreover, evidence on crowding levels by mode in Sydney and Melbourne generally suggests greater crowding on *trains*, not buses.

³⁶ Fare integration is distinct from ticketing integration, which is the term to describe a single ticketing platform for users irrespective of mode. There are clear user benefits derived from integrated ticketing systems through improved ease of navigating transport systems and customer experience generally. Ticketing integration is typically a first stage of — and prerequisite for — fare integration.

³⁷ Multimode users already face time and comfort penalties that are likely barriers to further uptake of multimode trips by single-mode users. For example, the ATAP guidelines estimate that users incur a transfer penalty estimated at 1.5 times the in-vehicle travel time to capture the transfer connection time, in addition to wait time estimated at six minutes (of in-vehicle travel time) for same mode or ten minutes for different mode transfers (ATAPSC 2021, p. 50).

Equity implications of modal fares

Proponents of fare integration also argue that it is fairer, as many individuals cannot choose what modes of public transport are available to them. Passengers may be captive to a particular mode, or may require multiple modes to complete a particular trip. Integrated fares might also be considered fairer as users are not penalised for decisions of government regarding network design or planning (for example if investment in a high-cost mode like light rail could have been serviced by a lower cost bus service).

These arguments are relatively weak.

- The financial cost of public transport investments not borne by users ultimately still falls to taxpayers, who are required to fund the difference between the fare and the total cost. And though there are good reasons for funding infrastructure through public subsidies, a fairness argument could also be made with respect to the share of costs between public transport users and taxpayers generally.
- Fares are but one small component of the costs relevant to consumers. There are many others that matter more: service frequency, travel time, wait times, distance to transport nodes and crowding. It is inconsistent to focus on fare equivalence only, but not these other, often more important, attributes.
- Fairness has two common dimensions: setting prices on the basis of capacity to pay and providing equal treatment to people who are otherwise identical. By creating a margin between train and bus fares, modal pricing would generally improve the first type of fairness given that train users have higher than average incomes. On the other hand, all other things being equal, it would worsen the second for the subset of consumers who only had access to rail services, but who would have preferred a somewhat lower cost bus. Since, there are few instances where only a train service is available, this is likely to be a small subset, undermining the significance of this form of unfairness.
- While it is true that people are sometimes the accidental victims of governments' poor transport choices, fare variations that reflect those choices would make the public better aware of the costs of those choices and improve accountability.
- Governments that implement modal pricing can take steps to avoid disadvantaging multimode users. For example, they can: offer a rebate on multimode trips that can be used for future trips (indeed its introduction in Sydney increased uptake of multimode trips (Hensher and Ho 2020)); provide free bus transfers for train journeys, as proposed by Infrastructure Victoria (2020b, p. 35); or charge only the highest cost leg of the trip. These options require careful design if implemented in conjunction with distance-based pricing, as they could increase complexity for users and lead to some perverse transport use, for example if users take an unnecessary additional leg to reduce total costs.

Transport planning and efficient network design

Modal pricing may not be suitable in some jurisdictions due to the characteristics — such as the geography and historical decisions on network planning — that affect its transport network. Notwithstanding this, the relatively low cross- and own-price elasticities observed with modal pricing suggest that any behavioural response will be relatively small. As a result, the introduction of modal pricing is unlikely to substantially shift current travel patterns.

IPART has pointed to the importance of an integrated transport network as a reason for moving away from modal pricing. While improved network integration has considerable benefits for users, it does not necessarily follow that servicing a route with multiple modes, nor modal pricing, would jeopardise these benefits. In particular, new bus routes might be the best network design option to service areas with high crowding, particularly where existing rail routes are highly congested and further expansion is very costly.

Ultimately, relative costs and benefits should determine fare differentials. Fare integration is best suited to modes that have similar marginal costs per kilometre travelled. However, as noted above, this is not the case

for buses and trains in multimodal networks like Sydney and Melbourne. Indeed, IPART's proposal for fare integration would increase train fares for journeys less than 20 kilometres, bringing them in line with bus and light rail fares (IPART 2020d, p. 19). Though this would be a sensible change, there is likely to be merit in further increasing rail fares above bus fares to better reflect the social marginal cost of these trips.



Finding 4.1

Modal pricing is more cost-reflective than flat fares

Cities without modal pricing — Melbourne, Brisbane, Adelaide, Perth and Canberra — would benefit from its adoption, particularly where network capacity constraints emerge. This would better align fares with the social marginal cost of trips, improve cost recovery, and — depending on the extent of passenger responsiveness — make incremental improvements to managing network crowding.

4.2 Distance-based pricing

Like modal and peak pricing, distance-based pricing would be more cost-reflective compared with flat fares, yet there is significant variation in the use of distance pricing in Australia and internationally. Several Australian jurisdictions have distance-based pricing, either via zones (as in Melbourne, Brisbane, Perth and Hobart), or using general price bands that depend on kilometres travelled, as is the case in Sydney.³⁸ Adelaide, Canberra and Darwin do not have distance-based fares.

Like modal pricing, recent perspectives do not provide a consensus view on the merits of distance-based pricing. In their 2020 reviews, IPART advocated for the retention of distance-based fares, whereas IV argued for modal fares, concluding that social marginal costs related more to mode than distance, and that having both modal and distance-based pricing would be unnecessarily complex for users (Infrastructure Victoria 2020b, p. 52; IPART 2020c).

Costs and distance

Generally, public transport costs increase with distance travelled, with the strength of the relationship changing due to factors such as network design and travel patterns. Efforts to model this relationship can produce different results, depending on the approach taken to cost allocation and the assumptions that have been made. This is a key point of difference in the IPART and IV modelling — while there is consensus that distance is a driver of cost, there are divergent opinions on the extent to which it is the *main* determinant of costs (box 4.1).

With regard to externalities, distance is most significantly related to road congestion. IPART estimates a per kilometre incremental cost of road congestion, which implies that benefit of reduced road congestion also increases with distance travelled, thereby lessening the case for distance-based pricing on cost reflective grounds. IV's results indicate that there is a larger increase in the social benefits of avoided road congestion compared with the financial costs incurred, such that the marginal social cost could be lower for longer trips (Infrastructure Victoria 2020b, p. 51).

³⁸ Cities that have zonal fares include Melbourne (3 zones including the free tram zone), Brisbane (8 zones for SE Queensland, extending out to Noosa and Coolangatta) and Perth (9 zones, though the maximum fare will be based on the cost of two zones only, following an election commitment).

There do not appear to be robust relationships between distance and other externalities.

- Scale benefits are derived from reductions in users' waiting times, such that increased service frequency leads to increased demand and lower costs per passenger. Where capacity expansion is feasible, IPART models scale benefits on a per trip and per kilometre basis, suggesting that capacity expansion has some relationship to distance. However, there is not an intuitive connection between distance and scale benefits, per se. In practice, governments likely make capacity investments independently of distance travelled, so the relationship between distance and scale benefits is uncertain.
- There is no intrinsic relationship between distance and crowding. What matters more are the varying levels of demand for trips by location (Infrastructure Victoria 2020b, p. 49). For instance, trips to the CBD at peak hour will tend to be crowded for short trips and for a sizable share of the length of longer-distance ones. Crowding tends to be low for trips out of the CBD at morning peak times, regardless of the distance.

Reflecting these issues, estimates of distance-related costs depends on the methods used and cost assumptions.

Box 4.1 – IPART and Infrastructure Victoria's modelling of costs and distance

IPART assumes that a portion of both incremental use and capacity costs vary by passenger kilometres travelled (IPART 2016a). In the IPART model, additional passenger kilometres travelled have the same marginal cost, whereas IV's analysis assumes fixed service timetabling, such that per kilometre financial costs are only incurred in the peak period and when capacity is expanded (CIE 2020a, p. 31). Though the bulk of costs fall to peak periods under both models, the per kilometre costs vary.

IV (2020a, pp. 50–51) argues that although marginal costs do increase with distance travelled, capacity bottlenecks and network location can have a significant bearing on costs where a smaller critical section of a route can determine the maximum capacity, particularly in a radial — rather than grid — network design. IV also notes that on average, a one unit increase in demand has required an additional one unit fleet size increase based on past capacity decisions for the Victorian network, suggesting that network capacity and location — not distance — may be a greater driver of costs.

Ultimately, both IV and IPART acknowledge that distance is a key determinant of network costs, especially for buses, for which operating costs (like fuel costs) are a greater proportion of total costs compared with trains that are more capital intensive (Infrastructure Victoria 2020a, p. 51).

Distance-based customer segmentation

Willingness to pay for public transport services also varies by distance travelled. This means that differentiated fares could be a form of efficient price discrimination (or price differentiation where service quality differs by mode). A potential benefit of price discrimination is that fares can recover costs more effectively (chapter 2), and in a more equitable manner if willingness to pay and incomes differ by distance travelled (chapter 6). However, this is contingent on whether short- or long-distance travellers are more price sensitive.

Generally, demand is more sensitive to fares for longer-distance trips (ATAPSC 2021, p. 9; table 4.2; Hensher and Ho 2020, p. 313). There are exceptions to this. Elasticities for very short-distance trips tend to be higher as these trips are substitutable with walking. Furthermore, the relationship between price sensitivity and distance travelled is much less clear cut for bus trips (though this partly reflects that bus trips are on average shorter than rail trips) (table 4.2). Accordingly, the effect of distance-based pricing on

demand depends on mode, and may vary non-linearly with distance. Network design and city geography could also affect how users respond to distance-pricing.

Table 4.2 – Fare elasticities vary by distance travelled

Own-price elasticities, adult weekday journeys, Sydney Opal network, 2019

Distance travelled	Pre-peak train	Peak train	Post-peak train	Bus
0-3 km	-0.005	-0.069	-0.215	-0.183
3-8 km	-0.008	-0.105	-0.370	-0.413
8-20 km	-0.020	-0.149	-0.644	-0.289
20+ km	-0.036	-0.200	-0.597	-0.339

Source: Hensher and Ho (2020, p. 13).

The implication of these results for fare setting is that distance travelled alters users' sensitivity to prices. Though increasing price sensitivity by distance might undermine attempts to increase cost recovery by charging more for longer trips, elasticities are relatively low overall, even for long distances. This suggests that the greater price sensitivity would not be sufficient to undermine the relationship between cost and distance, particularly as distance travelled is one clear driver of cost.

Overall, there remain differences in the social marginal cost of trips by distance travelled, which lend weight to the case for distance-based pricing. Yet, the variation in magnitude of the various costs and benefits point to a need for further work to estimate how this should be applied in different jurisdictions.

Implementing distance pricing

Zonal pricing is a simple, easily understandable form of distance pricing, albeit with some potential loss in efficiency benefits. Other potential benefits of zonal pricing are that it:

- can include some zones that are priced higher (such as a CBD zone) thereby providing the flexibility to adjust the location and size of zones to match variation in social marginal costs that occur across different areas of a city and transport network
- helps to manage equity issues, given variation in income by city geography (chapter 6)
- enables charging of higher fares for longer, higher cost trips that cross multiple zones
- is consistent with the idea that bottlenecks and other sections of peak capacity are a main driver of costs. With zonal pricing a surcharge could be applied for bottleneck or capacity-constrained zones. Zones can therefore act as a proxy for location-based charges and reflect that congestion of public transport and road networks tend to converge closer to the CBD.

The efficiency and equity of distance-based fare structures would depend on how well the zone structure aligns with social marginal cost and where passengers of different socio-demographic characteristics travel. These factors can have significant effects on fares paid, including for example: the number of zones, where zone cut-offs occur, and any time restrictions on transfers within a zone. Changes to zone structures can have significant effects on the fares paid by users. For example, Wang, Liu and Corcoran (2021, p. 117) found that the 2017 fare reforms in South East Queensland (which included simplification of 23 zones to 8 zones) had the effect of increasing patronage, total revenue, and improving horizontal and vertical equity as measured by comparing the fare paid per zone travelled across different user groups.

4.3 Combining peak, modal and distance-based pricing

Though peak, modal and distance-based pricing can each individually result in more efficient fares, combining them would go further to align fares to the variation in social marginal cost by time of day, mode and distance. However, New South Wales is the only Australian jurisdiction with peak, modal and distance-based pricing, and other larger jurisdictions would also likely benefit from taking a similar approach, depending on how social marginal costs vary across each specific network.

One potential deficiency of incorporating multiple elements into fare structures is the additional complexity for passengers. The variations by mode, distance and time of travel, accompanied by fare caps, limits on the duration of travel, and concessions mean that there are many possible combinations of fares depending on the context.

It is likely that the adverse effects of fare complexity on public transport patronage would be outweighed by the benefits of fare variations that are more closely aligned to costs. The main reason for this is that most people take the same trip on a regular basis, and therefore do not need to re-discover the fares that these trips entail. Notwithstanding this, efforts to manage the communication of fare structures — through public campaigns, marketing, and more informative smartphone applications for example — can help to ameliorate the problems of overly complex fare structures (chapter 7).

There may also be practical reasons for a jurisdiction to prefer singular use of either peak, distance or modal pricing. For example, the jurisdiction may have concerns about network planning and optimisation, or limitations to its ticketing systems. Indeed, modal and distance-based pricing are rough proxies for each other for some trips. For example, distance-based fares could proxy modal pricing for single mode trips, given that average distances travelled vary by mode. The benefits of more granular forms of differentiated pricing may not exceed the costs in smaller jurisdictions, particularly in the short term if costly technology upgrades are required to implement differentiated pricing.

Another way of combining modal and distance pricing is for fares to incorporate a network access fee (based on mode) and a per kilometre charge. This could provide a fare structure that would avoid disadvantaging multimode users, whilst also encouraging more cost-reflective pricing. It could also align with future subscription models (chapter 7). However, this fare structure would still involve trade-offs in balancing the two component parts. For example, a high access fee and low per kilometre charge might discourage bus trips, whereas a low access fee and high-per kilometre charge might discourage long-distance train trips, and increase substitution to cars (Infrastructure Victoria 2020b, p. 54).

Ultimately, there are different benefits to different pricing options (and their combination) to be weighed up in the specific jurisdictional context (table 4.3).

Table 4.3 – The benefits vary for different pricing options

Pricing option	Benefits	Limitations
Peak pricing only	• Captures crowding costs, and costs due to capacity constraints or bottlenecks.	• Trips that are longer distance or on high-cost modes likely underpriced.
Peak and modal pricing	• Captures where peak periods differ between modes. • Better reflects the capital costs associated with heavy and light rail infrastructure. • Can encourage efficient future investment.	• Long-distance trips likely underpriced. • Multimode journeys on uncrowded parts of the network likely overpriced.
Peak and distance-based pricing	• Best reflects social marginal costs for jurisdictions with bus networks only.	• For jurisdictions with multiple modes, trips taken on high-cost modes are likely underpriced.
Modal pricing only	• Better reflects the capital costs associated with heavy and light rail infrastructure. • Can encourage efficient future investment.	• Multimode journeys on uncrowded parts of the network likely overpriced. • Does not sufficiently reflect crowding costs, and costs associated with capacity constraints or bottlenecks.
Distance-based pricing only	• More consistent with the principle of fare integration than modal pricing only. • Well-aligned to the cost structure of buses, given high operating costs.	• Short train trips on crowded parts of the network likely underpriced.^a • Does not sufficiently reflect crowding costs, and costs associated with capacity constraints or bottlenecks.
Peak, modal and distance pricing	• Best captures differences in the social marginal cost of trips.	• Increased complexity of fare structures for users and ticketing systems.

a. This could be partly ameliorated through use of zones, or a network access fee and a per kilometre charge.



Finding 4.2

There are benefits to combining peak, modal and distance-based pricing

Governments should consider using peak, modal and distance-based pricing in combination. Fare structures could account for distance travelled through the use of zones or by combining a network access fee and per kilometre charge.

The benefits of combining peak, modal and distance-based pricing will depend on how social marginal costs vary across the transport network. Particularly in jurisdictions with crowding or congestion problems, the benefits of more cost-reflective pricing are likely to outweigh any adverse effects of fare complexity, though the latter can be further alleviated through advanced ticketing and more informative smartphone applications.

5. Road congestion

Key points

- * **Congestion is a major issue in many Australian cities, though is more pronounced in larger cities.**
 - The avoidable social costs of congestion in Australia are estimated to have been about \$24 billion in 2018-19 (before the pandemic) in 2018-19 prices, mainly due to the value of time lost on congested roads. Congestion costs are estimated to rise in real terms by about 45 per cent by 2029-30.
- * **Motorists travelling at peak times do not pay costs commensurate with the congestion they cause to each other. While the average Sydney driver in peak weekday times pays a number of road user charges (such as fuel excise, tolls and parking levies), their combined charge is dwarfed by congestion costs for peak weekday times (\$2.22 per trip and 40 cents per kilometre).**
- * **Road congestion justifies some subsidisation of public transport fares, particularly in the absence of more effective direct measures, such as road user charges.**
 - A rule of thumb is that for every 1 per cent increase in public transport fares, car use increases by 0.05 per cent, which at the margin can increase congestion for roads that are already busy. This effect means that fares should take into account their marginal effects on congestion and is one reason why full cost recovery is not efficient.
- * **However, at current highly subsidised levels, peak fare *reductions* would not significantly decrease road congestion, but would:**
 - aggravate crowding on public transport — another form of congestion
 - re-distribute to higher-income users
 - have large negative revenue effects, which must be funded through distorting taxes.
- * **The role of public transport fares in alleviating congestion diminishes once direct measures are introduced. While road user pricing is the best long-run solution to congestion, CBD parking levies that vary with arrival and departure times in congestion hot zones, and measures that reduce the free provision of car parking by employers provide alternatives (or complements) to road user charging, particularly in the short term.**

Public transport is an important alternative to car use. In addition to providing a means of transport for those unable to drive (promoting social inclusion and economic opportunity), public transport can ease congestion pressures on the road network by servicing travellers who would have otherwise driven.

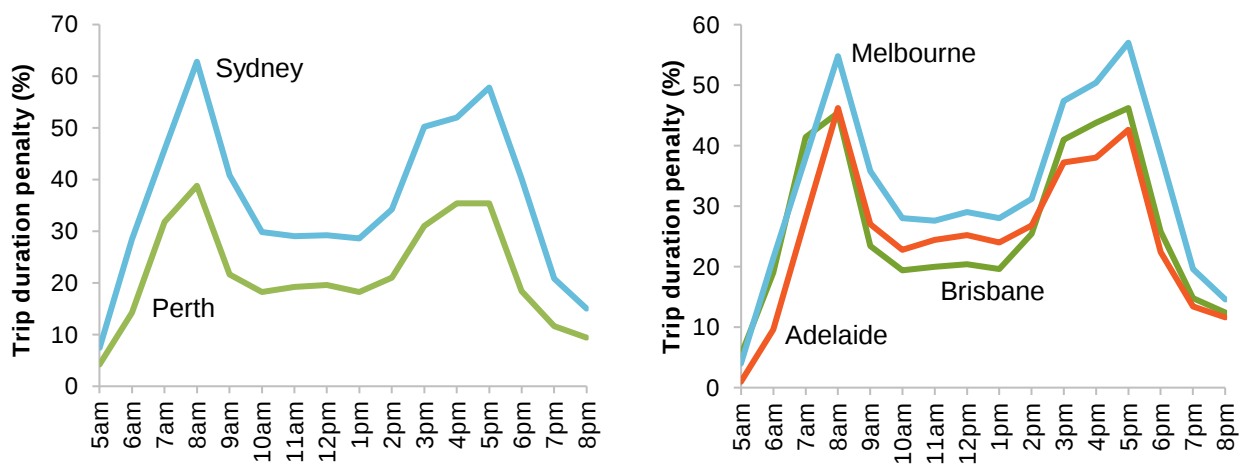
Notwithstanding the role of public transport *provision* in alleviating road congestion, the question is to what extent *fares* should support this objective — and how they might best do so.

5.1 The extent of road congestion and its costs

Road congestion affects many Australian capital cities, though is more pronounced in larger cities. In 2019, a road trip that would take 30 minutes in a typical uncongested period would take between 63 per cent (Sydney — the highest in Australia) and 37 per cent (Canberra — the lowest, excluding Darwin) more during the morning peak period (TomTom 2021).

Morning peaks (8 am–9 am) and evening peaks (5 pm–6 pm) tend to be similarly congested (figure 5.1). Congestion is greater in CBDs and surrounding suburbs (Infrastructure Australia 2019b). For example, in Melbourne, arterial roads in suburbs immediately surrounding the CBD experience the worst delays (Terrill 2017).

Figure 5.1 – Impacts of congestion on travel time
Weekdays, 2019^a



a. The percentage value represents how much longer the average 30-minute trip would take during this time, relative to when roads are uncongested (for example, a value of 50 per cent means that a trip would take 50 per cent longer than if roads were uncongested). The data relate to the pre-COVID-19 period. The expectation that similar congestion patterns will re-emerge as the pandemic subsides. The time refers to the beginning of the hour period (for instance, '8 am' refers to the period 8 am–9 am). Source: TomTom (2021).

Commuting times appear to be growing, with people reporting that on average they spent about 4.5 hours commuting per week in Australia in 2017 compared with 3.7 hours in 2002 (Wilkins et al. 2019, p. 79). There were only modest increases in average times for Sydney and Melbourne (17.4 and 11.5 per cent respectively), potentially a reflection of investments in new road infrastructure, but other capital cities like Brisbane (up by about 45 per cent) and Canberra (up by 65 per cent) have experienced significant increases over the relevant period. Commuting times appear to be converging across Australian capital cities, suggesting that congestion costs may also become similar.³⁹

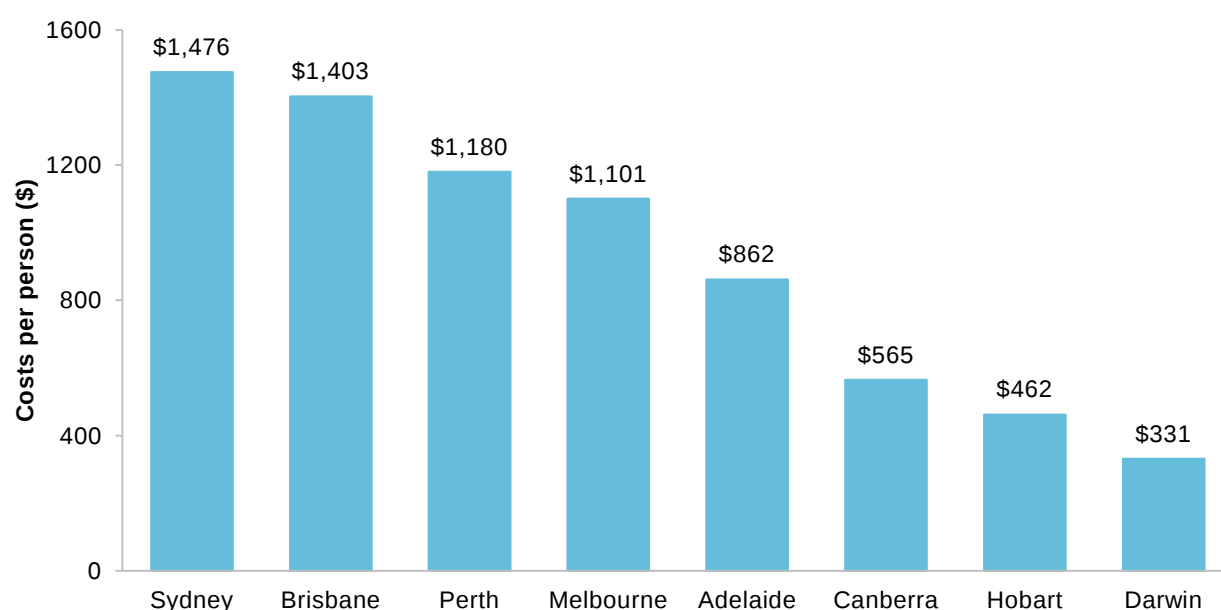
Congestion fell significantly in 2020 and 2021 due to COVID-related restrictions (chapter 1). There has also been a shift in attitudes, preferences and travel patterns. For instance, working from home has become much more common, which has reduced aggregate commuter numbers (PC 2021a). However, a much greater proportion of those who travel are deciding to do so by car because people feel less comfortable

³⁹ Convergence is measured by trends in the coefficient of variation (or 'sigma convergence') in travel times from 2002 to 2017 in Melbourne, Sydney, Brisbane, Adelaide, Perth and Canberra. There were no data for Hobart or Darwin (with only jurisdictional totals).

taking public transport (Nicholas 2021). Congestion levels during peak hours are still typically less than in the pre-pandemic period, though this will change as the pandemic recedes (chapter 1). While working from home may affect radial trips (primarily to the CBD), long-run population growth will ultimately continue to place pressure on scarce road infrastructure (which by its nature is costly to expand within the core of Australia's cities). As such, it is likely that as travel patterns normalise, congestion will continue to be a significant policy concern.

Congestion imposes substantial avoidable costs on motorists, businesses and the environment (figure 5.2). The fundamental issue is that an individual's decision to drive on a congested road aggravates the existing level of congestion, creating costs that are borne by other road users and the environment — the 'social costs' of congestion. These social costs apply whether a person is using an internal combustion engine or an electric vehicle. For conventional cars, other externalities arise from the health effects of toxic gas emissions and particulates, and from the contribution of vehicles to total carbon emissions. (Road use also leads to deaths and injury from accidents, though many of these are funded via insurance paid for by vehicle owners.)

Figure 5.2 – Road congestion is a problem in many Australian cities
Avoidable social costs of congestion (per capita), 2019-20 (2018-19 prices)



Source: Based on data from table 5.2, BITRE (2020) and ABS 2021 (*Regional population 2019-20 financial year*, Cat. no. 3218.0).

If road users do not pay a charge commensurate with these social costs, some will take trips for which the social costs exceed the benefits, making society worse off.⁴⁰ The net loss to society caused by such trips is referred to as the 'avoidable social costs' of congestion, as they could be reduced were road users to drive

⁴⁰ For example, consider a person who needs to take a trip at peak time and is deciding whether to drive (on a congested road) or take public transport (their next best alternative). If they value driving \$1.50 more than taking public transport (which costs the same), and driving generates \$2 worth of external costs (while public transport generates none), they will decide to drive — even though society would be worse off (compared with taking public transport). Note that not all congestion is bad as some argue — empty roads and zero congestion would be testimony to extraordinarily wasteful road investments (Meyrick 2011). Only the external costs matter.

on an alternate (uncongested road), drive outside of peak times, or travel by an alternate mode. In principle, this could be achieved by charging users according to their trip's external costs (discussed below).

There are relatively few estimates of the size of road congestion costs in Australia, notwithstanding their importance to decisions about public transport pricing or (alternatively) road pricing.

The Bureau of Transport, Infrastructure and Regional Economics (BITRE) (2015) estimated that the avoidable social costs of congestion in Australia's capital cities were about \$20 billion in 2018-19 prices in 2014-15 (based on CPI adjustment of estimates from BITRE 2015). Time costs were the largest contributor (accounting for 49 per cent and 36 per cent of the total for business and private road users respectively), in addition to extra vehicle operating costs (9 per cent of the total) and extra air pollution levels (6 per cent). These costs rose by a trend rate of about 5 per cent per annum between 1989-90 and 2014-15, with similar growth rates across jurisdictions (though *levels* of costs vary significantly, as shown below). BITRE projected that the costs would rise to about \$27 billion in 2019-20 and \$40 billion by 2029-30 (adjusted to 2018-19 prices).

BITRE's estimate for 2019-20 is likely to overstate congestion costs because of the effect of COVID-19 on vehicle kilometres travelled. The Commission calculated congestion costs up to 2019-20 based on more up-to-date estimates of kilometres travelled, estimates of the physical degree of congestion, and increases in wage rates (tables 5.1 and 5.2). These indicative calculations suggest congestion costs of about \$24 billion in 2018-19 and \$21 billion in 2019-20 (in 2018-19 prices). Forward projections of congestion costs after 2019-20 are also likely to be less than BITRE's estimates. This reflects lower projected population growth, the prospect that kilometres travelled per capita will not grow much, wage growth rates that are likely to be lower than the long-run historical average (with wages reflecting the 'opportunity cost' of the time wasted from more time in traffic), and the greater prevalence of working from home (PC 2021a). Nevertheless, back-of-the-envelope calculations suggest that congestion costs could credibly still hit about \$35 billion in 2029-30 in 2018-19 prices.

Table 5.1 – Estimated physical index of road congestion by capital
2015-16 to 2019-20, 2014-15 = 100.0^a

	Sydney	Melbourne	Brisbane	Adelaide	Perth	Hobart	Darwin	Canberra	Total
2015-16	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2016-17	105.4	104.6	105.9	104.6	103.0	102.2	107.9	105.6	104.8
2017-18	108.2	107.7	109.2	107.3	103.7	109.2	116.1	108.8	107.5
2018-19	108.4	109.8	112.2	104.1	104.3	111.5	116.1	109.4	108.6
2019-20	94.6	95.9	97.8	85.5	92.9	95.6	109.9	95.8	94.9

a. The results are illustrative and rely on the stability of previous relationships between kilometres travelled and congestion. The values are derived from regression analysis of the relationship between the logged value of a measure of physical congestion and the logged value of kilometres travelled for the period from 1989-90 to 2014-15. The parameters of the regression are then applied to actual kilometres travelled for the period from 2015-16 to 2019-20 to provide congestion values. The measure of physical congestion for the period from 1989-90 to 2014-15 is equal to BITRE's measure of congestion costs divided by average weekly wage rates for full-time workers.

Source: PC estimates; ABS 2021 (*Consumer Price Index, Australia, June*, tables 3 and 4, Cat. no. 6401.0); ABS 2008 and 2020 (*Average Weekly Earnings, Australia*, table 3 of Cat. no. 6302.0); BITRE (2015).

Table 5.2 – Estimated road congestion costs, by capital
Avoidable social costs of congestion (per capita), 2019-20 (2018-19 prices)

	Sydney	Melbourne	Brisbane	Adelaide	Perth	Hobart	Darwin	Canberra	Total
	\$b	\$b	\$b	\$b	\$b	\$b	\$b	\$b	\$b
2015-16	8.00	5.66	3.51	1.33	2.58	0.11	0.04	0.24	21.34
2016-17	8.45	5.93	3.73	1.39	2.66	0.11	0.05	0.26	22.43
2017-18	8.73	6.14	3.86	1.44	2.70	0.12	0.05	0.27	23.15
2018-19	8.83	6.33	4.01	1.41	2.74	0.13	0.05	0.27	23.63
2019-20	7.92	5.68	3.59	1.19	2.51	0.11	0.05	0.24	21.21

a. The results are based on dividing the congestion cost estimates by the index of average weekly wage rate for full-time workers and then indexing to 2015-16. Two decimal places give an excessively precise indicator for costs, but rounding would conceal changes for the smaller jurisdictions. The total is not the sum of the jurisdictions because the aggregate value is estimated independently.

Source: PC estimates; ABS 2021 (*Consumer Price Index, Australia, June*, tables 3 and 4, Cat. no. 6401.0); ABS 2008 and 2020 (*Average Weekly Earnings, Australia*, table 3 of Cat. no. 6302.0); BITRE (2015).

These estimates are *projections* under a business-as-usual scenario. A key goal of changes to policy settings for public transport and road pricing is to ensure the projections are wrong.

In Australia, road-users bear a wide range of charges, though they are not designed to reduce congestion.

- Car owners pay registration and compulsory third-party insurance fees, which mean that they bear many of the direct costs of accidents. As these are fixed costs associated with car ownership, they will partly reduce congestion (and other externalities) by discouraging some people from owning a car altogether. However, they create no incentives for car owners to travel during less busy times or to choose less congested routes.
- Governments charge fuel excise to all non-electric car users and a per km charge for electric vehicles in some jurisdictions.⁴¹ Both charges are an incremental cost associated with driving, so may serve to partially address the general environmental costs of driving. However, they do not effectively target congestion as discussed in section 5.3.
- Parking levies apply in some CBDs (Melbourne, Sydney and Perth). These levies provide an incentive to reduce CBD travel and partly reduce congestion. However, as they do not discriminate based on the time of arrival or departure, drivers do not benefit from shifting their travel to less congested times (section 5.3). Parking levies also do not discourage vehicles that drive through the CBD but do not park there.
- Some tolled roads also implement differential peak pricing (for example, the Sydney Harbour Bridge). These provide clear incentives to drivers to choose less congested routes or times of travel. However, the use of such charges is rare, and restricted to existing toll roads.

The consequence of the existing mix of road user charges is they have little relationship to congestion externalities. For example, IPART (2020d) estimated that the 'effective' road user charge in Sydney during peak weekday times is dwarfed by average external congestion costs during peak weekday times.

Road user charges in areas and times prone to congestion is a solution to this problem (as discussed in section 5.3), but in their absence, public transport pricing can play a role.

⁴¹ Road user charging for electric vehicles has been in place in Victoria from July 2021, and is slated for introduction in South Australia from July 2022.



Finding 5.1 Road congestion costs billions

Road congestion imposed an estimated avoidable cost on motorists, businesses and the environment of \$23.6 billion in 2018-19 and could credibly rise to about \$35 billion by 2029-30 in 2018-19 prices. Congestion costs are especially high in Australia's biggest cities — being as high as an estimated \$1500 per person in Sydney in 2019-20.

Existing charges on road users do not sufficiently internalise the external costs created by driving on congested roads.

5.2 What role could public transport fares play?

Public transport prices affect whether, when and the degree to which people travel by car — and accordingly, also influence the degree of road congestion. Given the high costs of congestion discussed above, even modest reductions (or avoided increases) in congestion can have sizeable public benefits. Public transport pricing decisions should consider these impacts.

The impact on road congestion is dependent on the (1) responsiveness of public transport use to fares, (2) the associated shift away/to cars, and (3) the degree to which changes in road use results in congestion costs via changes in the average and variance of traffic speeds. (The chain of relationships that lead to the final impact of transport fares on congestion in peak hours is set out in box 5.1).

While public transport demand is more responsive to prices at off-peak times, roads are less busy during this period so the removal of a car at this time does not produce significant benefits from reduced congestion. In addition, off-peak road use is rarely for commuting, but often for business and shopping activities, where public transport is a weaker substitute. Accordingly, the analysis of the role of public transport pricing in this chapter relates to peak periods.

Fares tend to play a modest role in people's modal choice decisions when compared with factors related to the quality of public transport, such as reliability, comfort and safety (ATAPSC 2018; Luk and Hepburn 1993), but they still matter and are complementary. The Independent Pricing and Regulatory Tribunal (IPART) calculated that were all public transport fares raised by 20 per cent at the morning peak, then car use would increase by one per cent (based on the analysis described in box 5.1). This is an average effect — such impacts would vary by mode, location and whether it is the AM or PM peak. Given the large number of trips and kilometres travelled by cars during peak hours, even a one per cent increase in car use would increase congestion costs materially.

IPART's calculations are for public transport price *increases*. The effect of a decrease in fares of a similar magnitude does not generate an equivalent reduction in congestion. The effect of an additional car in exacerbating congestion is greater, the higher the existing level of congestion (box 5.2). IPART have modelled the *marginal* congestion costs for Sydney (box 5.3), with results that provide guidance to other jurisdictions. Overall, IPART estimates that in 2019, the benefits of reduced congestion in Sydney to other road users of avoiding a car trip during peak hours was \$2.22 per passenger trip plus 40 cents per kilometre per passenger (IPART 2020d, p. 4). That means that shifting one person from driving at peak hour to rail transport for a 10 km journey would provide a public benefit of about \$6.20. The benefits of bus travel are slightly less because buses also contribute to congestion (by about 14 cents per trip and 2 cents per kilometre in peak hour traffic).

Box 5.1 – The effects of public transport prices

The impact of changes in public transport prices on car journeys (C) and the arising potential for congestion impacts depends on the interaction of the:

- own price elasticities of demand for each mode of public transport at the relevant time of day (given peak demand elasticities are much lower than off-peak). The estimated own price elasticities of demand at peak times vary between rail (R), which is -0.21 (ϵ_R) and bus (B), which is -0.33 (ϵ_B). This means that a 10 per cent increase (decrease) in rail or bus prices would decrease (increase) rail and bus use by 2.1 or 3.3 per cent respectively. These are low elasticities compared with many other goods, and reveal that making large differences to public transport patronage at the most congested periods is difficult (around current fare levels)
- degree to which if someone ceases to go on any given public transport mode, they divert to alternatives such as other public transport modes, walking and cycling, and cars. This is the parameter ϕ_R (or dC/dR) for rail and ϕ_B (or dC/dB) for bus. IPART estimates that ϕ_R is -0.9 and ϕ_B is -0.6, which means that if someone ceases taking a rail journey, 90 per cent of the time they substitute to cars, while if someone ceases taking a bus journey, 60 per cent of the time they substitute to cars.
- volume of car, rail and bus use at the time of the price change (denoted C, R and B respectively)
- congestion costs per additional car journey and travel distance.

The proportionate change in car journeys due to a uniform increase in public transport prices is $CE = (dC/C)/(dP/P)$ where dP/P is the proportionate change in public transport prices, which in this scenario is identical between rail and bus prices. dC can be broken down into $dC/dR \cdot dR + dC/dB \cdot dB = \phi_R dR + \phi_B dB$ so that $CE = [(\phi_R dR + \phi_B dB)/C]/(P/dP)$. By definition, $\epsilon_R = (dR/R)/(dP/P)$ and $\epsilon_B = (dB/B)/(dP/P)$. Accordingly, $dR = \epsilon_R \cdot R \cdot dP/P$ and $dB = \epsilon_B \cdot B \cdot dP/P$, which when substituted above, gives $CE = (\phi_R \epsilon_R \cdot R/C + \phi_B \epsilon_B \cdot B/C)$. This indicates how the combined effects of own price elasticities, modal substitution and baseline journey volumes determine the responsiveness of car use to public transport prices.

In Sydney, the ratio of rail to car journeys is 0.14 and bus to car journeys is 0.105 (using IPART modelling provided to the Commission), which, given the other parameters above, means that the cross-price elasticity is 0.047. The implication is that a 20 per cent increase in public transport prices increases car use by $100 \times 0.2 \times 0.047 = 0.94$ per cent or about 1 per cent. Other recent Australia econometric analysis of the cross elasticity of car use to public transport prices are even lower than this and suggest even smaller effects (Hensher and Ho 2020).

The overall decrease in public transport in this case is 5.2 per cent, which is much more than the percentage increase in car use. This reflects two factors. First, the number of journeys made by car are far more than by public transport, so any given change in absolute trips represents a smaller share of car trips than public transport. Second, some of the reduced public transport trips reflect lower demand from people not travelling by car. For the parameters above, 26 per cent of the forgone journeys on public transport reflect this effect and make no difference to road congestion (though they may reduce public transport crowding if it is at capacity).

The overall congestion costs then depend on outcomes for traffic flows, most particularly the value people place on longer trip times.

Source: Information provided by IPART and IPART (2020e, p. 7).

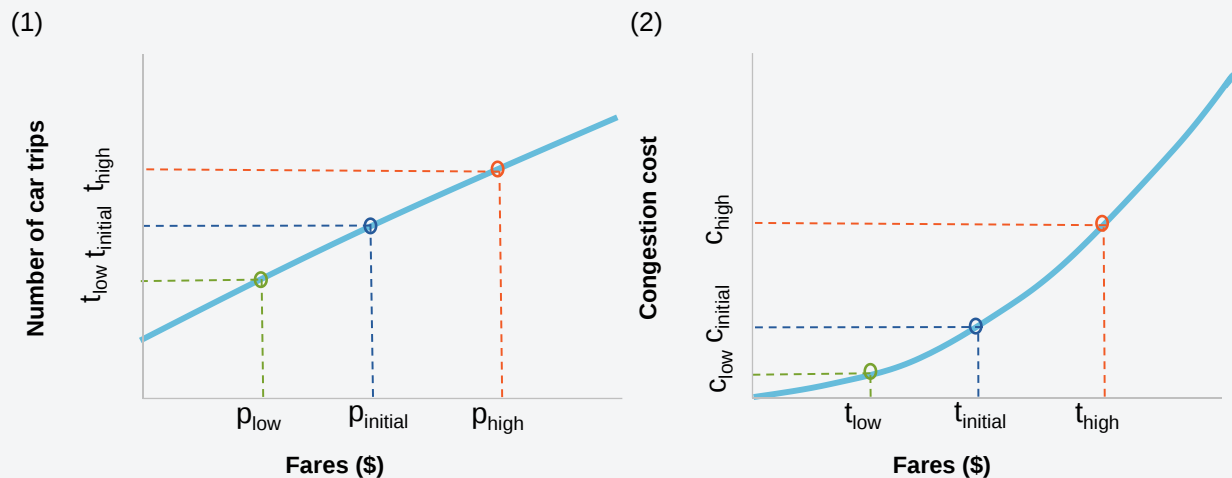
Box 5.2 – Asymmetry in the effects of fare changes on congestion

A change in public transport fares will affect the number of car trips taken (chart 1 below), which in turn will induce a new level of congestion (chart 2).

At the observed low elasticities between fares and car trips, the effect of fare changes on the number of car trips is very close to symmetric for small fare changes — reducing fares lowers the number of car trips to much the same extent that increasing fares raises them (shown in chart 1 — the distance between t_{low} and $t_{initial}$ is the nearly identical as that between t_{high} and $t_{initial}$).

The extent to which changes in the number of car trips affects the level of congestion is, however, asymmetric. This is because there is a strongly convex relationship between car trips and congestion — the effect of an additional car is greater if the existing level of congestion is higher (shown in chart 2). An additional car on an uncongested road will generate less congestion than an additional car on an already congested road. This means that a reduction in the number of car trips will have a smaller effect on congestion than an increase of the same magnitude — the distance between C_{low} and $C_{initial}$ is smaller than that between C_{high} and $C_{initial}$.

The effect of fare changes on congestion is therefore asymmetric in the same way — fare reductions have smaller effects on congestion than do fare increases.



The benefits of shifting people away from cars in off-peak periods remain material, but are less because congestion levels are lower during these periods (62 cents per journey and 15 cents per kilometre, so that the congestion savings of a 10-kilometre train trip are about \$2.10 or about one third of that during peak periods.

All things being equal, substantial proportionate increases in fares would be likely to exacerbate congestion in all of Australia's biggest cities, while large reductions would be unlikely to have similar positive outcomes at already highly subsidised fare levels. For instance, a 20 per cent increase in public transport fares in Sydney could add about 15 000 additional motor vehicles to the weekday morning peak. While that is only a paltry 1 per cent of total traffic, it can have large impacts on traffic congestion in parts of the city. For instance, on the already congested Parramatta road between Haberfield to Central, travel times would increase by 5 minutes, which is about 15 per cent more time than for the busiest period of use of this road (based on travel time data for peak morning traffic based on Google Maps and calculations from

IPART 2020d, p. 8). This may seem small, but adds up to the extent that such outcomes are repeated across other congested routes.

The effect of fares on car use and congestion varies by mode. In general, travel patterns suggest that in transport systems where there are trains and buses, trains are the mode most substituted for cars, and so train fares will have a greater impact. In Sydney, estimates of the modal substitution rates suggest that among people switching away from their normal mode of public transport, 90 per cent of train passengers would shift to car use (compared with 60 per cent of bus and light rail passengers and 30 per cent of ferry passengers) (IPART 2020e).

Box 5.3 – How IPART estimates road congestion costs

IPART measures congestion costs as the impact of additional motorists on existing motorists — the change in travel times (the most significant congestion cost), vehicle operating costs and reliability of travel. The link between fare changes and congestion is estimated in two steps.

First, the Transport Performance and Analytics (TPA)'s Strategic Travel Model (STM) — a model that projects travel patterns in the Sydney Greater Metropolitan Region Area under different scenarios — is used to estimate the people who are most likely to switch between public transport and driving, from their origin to destination, in response to changes in relative prices.

Second, the Roads and Maritime Services' (RMS) Strategic Traffic Forecasting Model (STFM) — which projects traffic levels and travel times under different scenarios — is used to calculate the vehicle kilometres travelled and travel times for the scenarios in which:

- there is no change in public transport fares (the baseline scenario) — where vehicle kilometres and travel times are calculated only for people who originally travel by car from origin to destination
- where there is a change in public transport fares — vehicle kilometres and travel times are recalculated for all motorists, factoring in both those who maintain driving from their origin to destination and those who switch from public transport to driving.

IPART then calculate the change in travel times for existing (baseline) motorists by applying the new recalculated average speed (for all motorists, both existing and new) to the original distance (kilometres) travelled by the existing motorists. The extra time taken is converted into a cost estimate by applying people's value of time to it. IPART also considers additional operating costs and unreliability of travel times as costs imposed by congestion, though these comprise only about 10 per cent of total congestion costs.

Source: IPART (2020d); TfNSW (2019b).

Similarly, public transport routes that are close substitutes for driving on congested roads (typically, those that travel through the CBD or inner suburbs) will be more relevant in alleviating congestion than other routes.

And larger fare increases would have much greater impacts. One indicator of the overall significance of public transport on congestion is the consequence of service disruptions — which act like very high price increases. In Melbourne, a withdrawal of train services would be expected to increase the number of severely congested road links by 175 per cent and reduce the average travel speed from 48 km/h to 37 km/h (Nguyen-Phuoc et al. 2018). Similarly, the natural experiment provided by a 35 day public transport strike in Los Angeles, found increased highway delays of up to 47 per cent (Anderson 2014). So just because modest

increases in the dollar cost of public transport have modest impacts on congestion should not be taken to read that public transport makes little difference to congestion.

In contrast, there are limits to the benefits of very low fares as a form of relief for congestion, as suggested by the experiences of going from the extreme of very high to zero fares. Some advocate free fares as a 'solution' to road congestion (as well as for other reasons). Going to zero fares often raises public transport patronage significantly. However, the evidence suggests that the effects on car use and associated congestion is much less.

Using a behavioural model of Sydney transport, IPART estimated that public transport could increase by about 40 per cent if it was free, but with an expectation that the reduction in private car use might fall by between 2 and 5 per cent, drawing on overseas experience (IPART 2020b). (This is consistent with the wide difference between the own price elasticities for public transport, the low cross price elasticities between public transport and car use, and the high ratio of car to public transport trips — as shown in box 5.1) In Australia, the experience with free tram services in Melbourne suggested little change in congestion levels (Legislative Council Economy and Infrastructure Committee 2020).

More generally, the Commission's examination of the experiences of those jurisdictions globally where free public transport has been relatively comprehensive and enduring (compared with access limited to selected groups, like students) accords with IPART's assessment (table 5.3). The key reasons for this are that free fares also attract non-car users (Hensher and Ho 2020) and that car use is far greater than public transport, so even sizeable percentage increases in public transport will not have similar percentage impacts on car use. Moreover, the proportionate effect on congestion is not equivalent to that on car use because some roads are not congested in the first place, the substituted travel is not all at peak, and car journey length and car trip numbers are different. Overall, the evidence suggests that at the highly subsidised and generally low prices that are typical for public transport, free transit would usually not make significant inroads to congestion.

An incidental concern about very low or free fares is that, unless accompanied by improvements in the service capacity, they induce greater crowding on public transport, which represents a hidden price increase for users, and undermines the impact of low monetary prices. The Melbourne tram experience bore this out — the Victorian Parliamentary inquiry into a potential expansion of Melbourne's Free Tram Zone noted that its introduction had led to 'severe overcrowding' on some routes (Legislative Council Economy and Infrastructure Committee 2020). Free prices at all times of the day also remove any price incentive to delay or bring forward travel to avoid peak time crowding on public transport.

Is IPART modelling a good proxy for price effects in other Australian cities?

IPART's empirical *framework* is sound for any jurisdiction. And Sydney's experience provides some indications of the aggregate impact of public transport on car use and associated congestion. Notably, the comparisons of traffic densities by time in key hotspots in Melbourne and Sydney appear to be similar (Terrill 2017).

Nonetheless, the layout, use of different transport modes, traffic choke points and fare levels vary across Australian cities, so there will still be variations that would inevitably affect the quantified costs of marginal congestion externalities. As noted earlier, congestion is negligible in some Australian cities (like Darwin) or specific to a few routes (as in Hobart). Even in Sydney, the effect of changes in public transport prices on congestion is low for much of the time in many places, given largely unconstrained traffic flows.

Table 5.3 – Impacts of free fares on public transport and car use

Place implementing full free public transport	Impacts	Source
Tallinn, Estonia	Public transport use increased by 14% one year after fare change. There was a 5 percentage point decrease in car use. Average distance travelled by cars increased.	Cats et al (2017, p. 1101) and Grzelec and Jagiello (2020, pp. 5–6)
Hasselt, Belgium	Public transport use increased 10-fold (from a very low base). Most new users had previously travelled by foot or bike or public transport. 16% of new users were from car users (which was probably affected by complementary improvements in services). Free fares were removed in 2013 due to budget pressures. Car ownership was unaffected.	Cats et al (2017, p. 1089); (van Goeverden et al. 2006, pp. 10–11); Grzelec and Jagiello (2020, p. 6); and Fearnley (2013, p. 80)
Dunkirk, France	Bus trips increased by 85% in 2 years (65% during the week and 120% on weekends). Half of new users had moved from cars to bus, and the modal shift from car to bus was 24% (a large effect), but no data on peak hour congestion effects. Impacts were probably increased due to complementary improvements in services.	Figg (2021)
Taichung, Taiwan	The comprehensive shift to free fares from July 2011 led to a about a 20-fold increase in ridership on the 8 km free bus, but service provision was also enhanced so the effects will be conflated. The modal share of cars for transport fell by 0.6 percentage points — though the causal link was not established.	Yeh and Lee (2019, pp. 10, 12)
Templin, Germany	Public transport use increased by more than 10-fold in 3 years. 80% to 90% of new use was from non-car use, mainly walking/cycling. Of the induced demand, 10-20% was from car users. (This is not a 10-20% reduction in total car use.). Templin is also a small town of 14 000 at the time of the scheme's inception — so the results may not generalise well	Cats et al (2017, p. 1090); Storchmann (2003)
Stavanger, Norway	Large increase in public transport use, but substitution was mainly from foot/bike not from cars. 11% took buses only for fun. There was no evidence of reduced car usage (and therefore congestion reductions).	Cats et al. (2017, p. 1087); Fearnley (2013)
Leiden, Netherlands	Bus use on the free routes increased threefold. Of additional users, 45% were from car users. No measurable impact on congestion.	(van Goeverden et al. 2006, pp. 8–9)
Frýdek-Místek (Czechia)	Public transport increased by 81% from 2010 to 2017, but some of this growth would have occurred anyway. 8% of car drivers (in a survey) said they shifted to at least partly to public transport use. But the study found no decrease in traffic flows or congestion. Only some residents were eligible for the free transport passes	Straub (2020, pp. 7–8)

This is why it is important to consider granular data about traffic flows and capacity constraints in cities using models like the NSW Government's Sydney Strategic Travel Model (STM) and Strategic Traffic Forecasting Model (STFM). There are already elaborate transport models used for measuring congestion, and in assisting in planning and infrastructure development for all of Australia's major cities. Governments could use these to undertake analysis similar to that of IPART (or adapt the models to do so). These models include the Queensland Government's Brisbane Strategic Transport Model, the South Australian Government's Metropolitan Adelaide

Strategic Transport Evaluation Model (MASTEM), the Tasmanian Government's Greater Hobart Urban Travel Demand Model, and transport models for Sydney, Melbourne, Brisbane, Adelaide, Perth and Canberra produced by Veitch Lister Consulting (VLC 2019c, 2019a, 2019b, 2019d, 2019e, 2019f). These models do not always give precise results — for example, there were significant changes in VLC's 2015 and 2019 projections of congestion costs for 2031 for some cities — a reflection of new data and modelling features. But it is better to use a systematic approach to the estimation of congestion costs and associated pricing, and learn and adapt models based on their predictive value, rather than make guesses. The reality is that such models will be needed for transport planning (and when it comes, road pricing) anyway.

Public transport pricing is an indirect tool for addressing congestion

While the congestion costs imposed by motorists on other motorists are relevant to public transport pricing, such pricing has several disadvantages that go beyond their relatively weak impacts.

Lowering peak fares has the perverse effect of discouraging walking and cycling — which other government policies seek to encourage. In contrast, road user charges reduce congestion *and* encourage all alternative modes of transport including walking and cycling.



Finding 5.2

Public transport pricing has limited effects on road congestion

The capacity for public transport pricing to make a large difference to road congestion is limited:

- The responsiveness of car use to public transport pricing is relatively low. A 20 per cent increase in public transport prices at peak increases car use by about 1 per cent.
- Fare increases tend to have larger effects on congestion costs than fare decreases. In the case of moves to free fares — the most extreme fare reduction available — there is strong evidence of increases in patronage, but not much evidence that it makes a substantive difference to road congestion.

Moving people from roads to public transport worsens crowding on public transport — the counterpart to road congestion — so that reductions in fares would need to be accompanied by service improvements on already stretched public transport routes.

Public transport pricing does not discriminate between parts of a city where roads are most congested and those not, whereas road charging could vary with congestion levels across locations and times.

Further, public transport fares are also likely to be less salient to road users than direct road-user charges, which further limits their effectiveness in changing behaviour (CIE 2001, p. 39). Intuitively, people will be more aware of the costs of transport they already take than transport they do not. To this end, regular road users outnumber regular public transport users. On Census day in 2016, 79 per cent of commuters drove to work compared with 14 per cent by public transport (ABS 2018a). This suggests that road-user charges will be salient to a larger population of commuters than would public transport fares.

A further complexity is that reducing congestion is only one (and a relatively lower priority) objective of public transport. Indeed, there are grounds for *higher* peak fares:

- Trains are the most expensive mode to run, and therefore have the strongest justification for higher fares under a modal pricing scheme.

- Setting peak fares higher can smooth public transport demand across the day by encouraging off-peak travel (reducing crowding and/or the need for costly infrastructure investment).
- Similarly, the public transport routes and modes (mainly rail services) that are the closest substitute for congested roads tend to be the most susceptible to crowding. There is less scope to accommodate crowding on rail than buses given physical constraints on frequency and the high cost of augmenting networks in those parts of Australian cities where road congestion is highest. (New surface corridors are rarely available in these zones and tunnelling is inordinately costly.)
- Lower-income people tend to travel less often at peak periods and are therefore less exposed to their higher fare levels.
- Peak pricing is one of the best ways of limiting the budgetary impacts of public transport while not significantly undermining patronage (as discussed in more detail below).

Therefore, when setting (peak) fares, the benefits of alleviated road congestion need to be weighed against the other objectives of public transport.

Public transport peak fare reductions would erode revenue

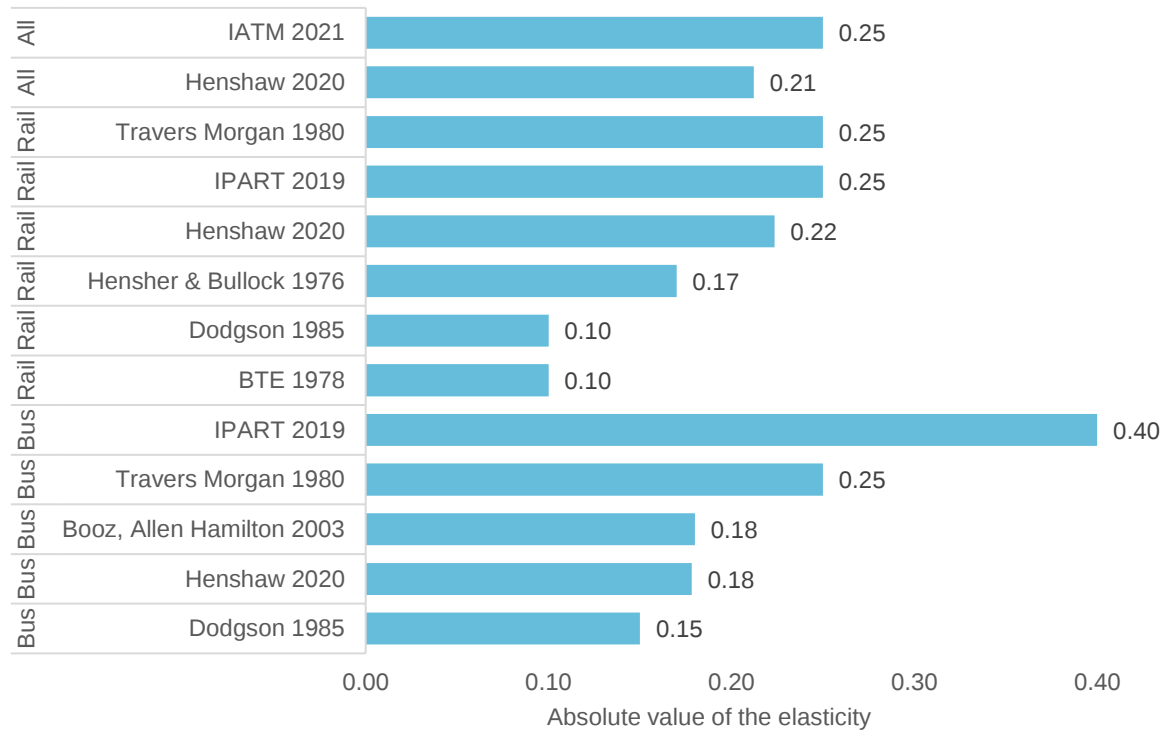
The effect of reduced peak public transport fares on cost recovery depends on the demand response, the fare level in relation to marginal cost, and the extent of asset utilisation. Services with low patronage experience low levels of asset utilisation, high average costs per passenger, and low marginal costs per additional passenger (until loads approach capacity). If a small reduction in fares were to stimulate additional patronage, and no additional services were required, this may improve cost recovery.

The key determinant of revenue outcomes is the 'own price elasticity of demand', which measures the extent to which a proportional increase in a fare for a given mode affects demand for that mode of public transport. If that elasticity is less than one, the additional patronage would not make up for lost fare revenue. Point estimates suggest that around current fares, short-run peak demand is less responsive to fare changes than off-peak demand, with this applying to both train and bus services (chapter 3 and figure 5.3).⁴²

Sydney is the only city for which exhaustive analysis has been undertaken across all modes, time of week and distances, with significant variations in elasticities across these dimensions. For example, in 2016, the weekday train peak elasticities vary between -0.069 for journeys less than 3 km and -0.2 for journeys over 20 km (CEPA & HGroup 2018). Combined peak and non-peak bus elasticities are higher and in the range from -0.183 (less than 3 km) to -0.413 (3-8 km). While there is little work on long-run elasticities in Australia, the evidence suggests that longer-run transit elasticities are about double that of short-run estimates (Litman 2021e), though the resulting long-run elasticities would still fall short of one.

While the own-price elasticity is the prime determinant of the demand effects of changes to peak prices, lowering peak prices will also encourage some public transport customers to shift from non-peak to peak periods. This 'cannibalises' other public transport revenue.

⁴² Most models of demand use a log-log econometric specification that forces elasticities to be constant regardless of the current price. In contrast, the elasticities of linear demand functions become higher as the price rises. There is some empirical evidence of point elasticities that rise (fall) with higher (lower) prices (Litman 2020). Variable elasticities are unlikely to make a difference within the relatively narrow band of price changes usually envisaged by governments, but would be relevant to any substantial re-calibration of fares (including free fares).

Figure 5.3 – Peak public transport own price elasticities

a. The values are drawn from any known Australian study as published in the BITRE database of elasticities, Litman (2021e) and calculations from the STM model from IPART (2020e), in addition to recommended values of elasticities for Australian transport analysis by Hensher (2020a) and IATM (2021). The chart excludes the detailed estimates of the peak period price elasticities by mode, day of week and distance as produced by Hensher and Ho (2020) and described briefly in the text.

Source: BITRE transport elasticities (www.bitre.gov.au/databases/tedb), Litman (2021e), IPART (2020e), Hensher (2020a) and IATM (2021)

The Commission modelled a 10 per cent decrease in all weekday peak fares using Sydney as the case study (bus, train and mixed mode) based on the own and cross price elasticities and journey numbers specified in CEPA and HGroup (2018), with no changes in fares for non-peak services.⁴³ Peak weekly public transport journeys increased by about 2 per cent, reflecting the low responsiveness of peak trips to fares. In addition, non-peak services fell by about 3.2 per cent because some non-peak users switched to peak. The overall change in weekly trips was negligible (at about 0.3 per cent) once these combined effects were considered. The revenue effects were larger because all existing peak customers received a 10 per cent discount, with peak revenue falling by about 8.1 per cent (largely a windfall gain effect for existing customers) and non-peak revenue by 3.5 per cent (the cannibalisation effect). Of the overall revenue loss, about 14 per cent originated from the diversion from non-peak services, an effect that can only be estimated

⁴³ Given the CEPA and HGroup report did not differentiate between peak and off-peak bus services, the calculations here adopt the approach taken by IPART (2020e) to provide own-price elasticities for services these times, while judgment was used for most bus cross-price elasticities (taking into account the patterns apparent for train cross price elasticities). Light rail and ferry services were ignored in the analysis as they amount to a trivial share of services. The revenue effects require fares by distance, mode, time of week and off-peak/peak periods. Opal fare prices for 2016 (the base year) were used for each of these (with some simplifying assumptions, such as using only adult fares). It was assumed that travel on weekends was not affected by peak fare changes during weekdays.

by using the cross-price elasticities. Beyond that additional revenue effect, cannibalisation of non-peak services may also affect service frequency, making out-of-peak travel less attractive to customers.

Accordingly, the short-term outcome would be a minor reduction in road congestion during peak periods, but large revenue effects that must be funded. Lower cost recovery would further the reliance on taxes to raise revenue, which have adverse effects on efficiency — the ‘marginal excess burden of tax’ — due to their perverse incentives on investment, consumption, and labour supply and mobility. In its consideration of the welfare losses of transport subsidies, IPART uses the marginal excess burden of the Goods and Services Tax (GST), which is about half of that above. However, while the GST is often characterised as a state tax, it is collected and set by the Australian Government, and is not a viable source of any additional revenue needed by states and territories. In that context, the inefficiency burdens of taxes that state and territory governments can control is more appropriate. Though the taxation mix differs by jurisdiction, a commonly used estimate is that for every dollar of revenue raised there is a cost in economic inefficiency of about 25 cents (CIE 2020a; Dobes, Argyrous and Leung 2016). For some state and territory taxes, like conveyancing, insurance taxes, and motor vehicle stamp duty, the inefficiencies are close to, or sometimes exceed \$1 (Murphy 2016; Nassios et al. 2019). This worsens the prospects that reductions in peak public transport fares would have net economic efficiency benefits, though it depends crucially on where state and territory governments obtain any additional revenue for their spending.

The longer-term effects on revenue would be less given that demand responses tend to increase in time. But that would be a protracted period, and the trade-off between the gains from road congestion gains and tax inefficiency looks unlikely to be re-balanced.

In contrast, well-designed road user charges do not create these distortions as they are essentially taxes on socially undesirable activities (so-called Pigouvian taxes).

It may seem that the above analysis implies that IPART’s consideration of the externalities from road use in its current fare setting approach is wrong. However, that need not be so. Starting points matter. The analysis above relates to fare reductions from current levels. IPART’s analysis relates to fare reductions from an unobserved higher price that would hold absent any consideration of road congestion. The key point is that were there to be little demand for public transport at full cost pricing, then roads would be severely congested. In that case, fare reductions would have larger effects on congestion and should therefore be factored into fare determination. But once congestion is at a more manageable level, the incremental gains from further fare reductions become smaller (as IPART has found in its modelling of transport network pressures).



Finding 5.3

Road pricing is the most effective way of tackling road congestion

Road user charging is the most direct means of addressing congestion because it can target congested routes at the right times. It promotes rather than inhibits walking and cycling, consistent with governments’ policies. It would encourage more use of public transport and allow peak public transport prices to rise, with greater cost recovery, better targeting of those able to pay, and better incentives for people to shift to off-peak public transport and alternative travel modes.

The Australian Government’s Future Fuels and Vehicles Strategy, aimed at promoting the uptake of electric vehicles, gives added importance to the adoption of road pricing.

5.3 Policy options

Governments have several tools available to address road congestion. The extent to which public transport fares should play a role depends on other measures governments undertake.

New forms of road user charging

Ideally, road users would have to pay a price consistent with the social costs of their trips, ensuring more efficient road use. Road users are subject to considerable taxes and charges, but they only partially address the costs of road use.

Excise tax on fuels are de facto road user charges, but of a relatively crude and untargeted kind. Excise revenue per vehicle is correlated with kilometres travelled, but cars with high fuel efficiency pay much less for road use than those with lower efficiency. And while fuel use per kilometre rises for slow-moving vehicles on congested roads, the revenue collected is primarily unrelated to the degree of congestion on any given road. Fuel taxes also discourage the external costs of emissions, though existing charges do not internalise those costs because the tax collected does not even meet road congestion burdens.

Tolls on major urban freeways are also an increasing source of road funding, rising from about \$1.6 billion in 2010-11 in 2018-19 prices to \$2.5 billion in 2018-19 (BITRE 2020, p. 53), though a temporary COVID-related reduction in revenue is expected for 2019-20 and 2020-21 (IBISWorld 2020). To the extent that the infrastructure funded by tolls would not have otherwise been built (a questionable assumption), then tollways partly reduce average congestion. But tollways are a road funding measure, not a congestion tax. The price is the same regardless of traffic flow or time of day, so tollways are not immune from congestion in peak periods. In addition, charges are regulated so that they cannot respond to changes in congestion over time (for example, often limited to rising by the change in CPI or average weekly wages). As most roads are not priced, the effect of tollways is to add pressure to non-tolled roads, exacerbating local congestion, as suggested by the recent impact of a toll increase on a major Sydney motorway (figure 5.4). Road pricing — including its role in abating congestion costs — should apply to the whole urban road network, not just the segments of it where governments and private parties see an opportunity for a public-private partnership.

Compulsory risk-rated third party personal insurance (effectively a tax) to meet the injury costs of accidents is the only well-targeted road user charge, though even then there are small uninsured costs that are met through taxpayer funding, such as police services (IPART 2020d, p. 19).

Accordingly, the mish mash of existing road charges and tolls are not well-targeted at congestion, nor a good basis for coherent sustainable funding source for infrastructure and its maintenance. (To the extent that excise revenue erodes with the electrification of the car fleet, then revenue will have to come from some other tax.)

Optimally governments would apply road user charges to all vehicles, including electric vehicles, with the rate varying by the degree of congestion and the mass of the vehicle and its axle loading. Well-designed road user pricing could better target congestion and act as a funding source. Road congestion charging is in its infancy in Australia and globally, notwithstanding advocacy of its use that has persisted from 60 years ago (Vickrey 1963) to the present (box 5.4). It was recommended by the Industry Commission — the predecessor body to the Productivity Commission — nearly 30 years ago (IC 1994, p. 13).

Box 5.4 – Recent proposals for road user charging

The Productivity Commission's Public Infrastructure report (2014) and the 5-Year Productivity Review (2017c) recommended implementation of road user charging and pooling of these funds into a hypothecated 'road fund', eliminating the need for fuel excise and registration fees. In addition to the goal of reducing congestion, one motivation for the recommendation of these reforms was that the increase in uptake of electric vehicles would reduce fuel excise revenue, necessitating other means of obtaining revenue to fund roads.

Similarly, the Harper Competition Review (2015) recommended that road user charging should be introduced with a progressive and concurrent reduction in indirect charges and taxes on road users so that charging is revenue neutral. It also recommended that revenues be hypothecated to road transport investment.

The Grattan Institute (2019) recommended that state governments:

- introduce 'cordon charging' within the next five years, where drivers would pay to cross a boundary into the capital city CBDs in the morning peak and out in the afternoon peak
- charge people to drive along the busiest urban freeways and arterial roads at peak periods, within the following five years
- eventually charge people on a per-kilometre basis for driving across the city's entire road network at the busiest times
- double the parking levy in the Melbourne CBD (to match Sydney's).

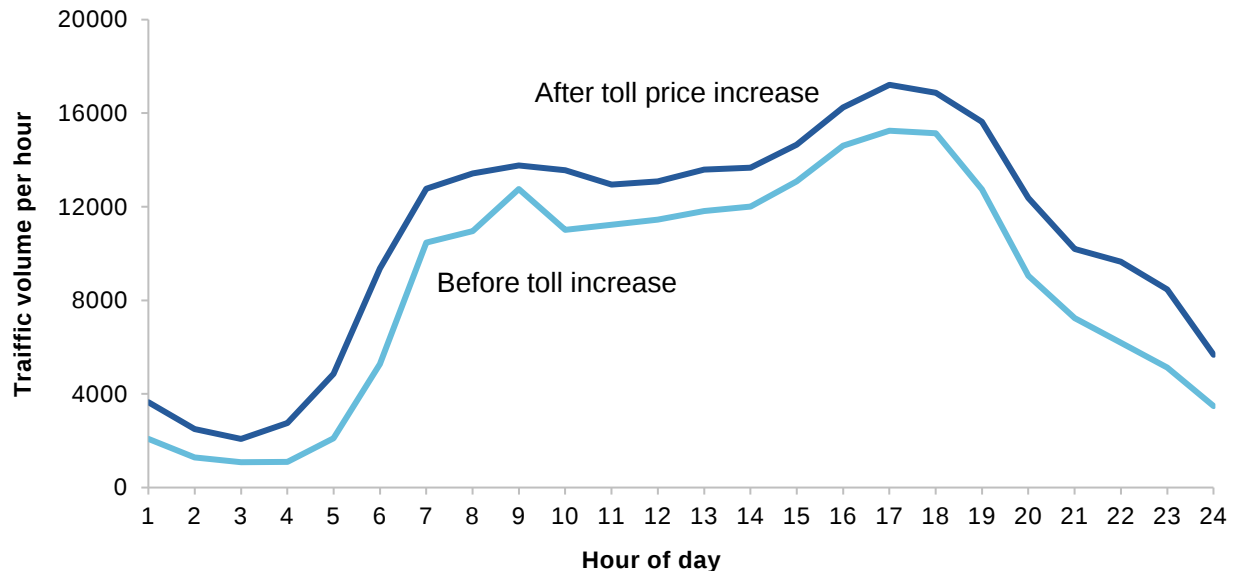
Infrastructure Victoria recommended large-scale trials of various road pricing options across Melbourne using a randomised control trial design to identify impacts for different income and demographic groups (Infrastructure Victoria 2020c). It also recommended the expansion of car parking congestion levies and trials of dynamic pricing of parking near public transport nodes. (Dynamic pricing entails setting prices based on real-time variations in demand, as used for example by Uber in its surge pricing in peak demand. It varies from peak pricing in that it is not set for a particular time.)

The New South Wales, Victorian and South Australian Governments have announced distance-based road user charges for electric vehicles, reflecting that EVs are not subject to fuel excise. Arrangements for EVs are a move towards road user pricing and may, over time, increase in sophistication and vehicle type coverage.

That said, examples exist that have proven the workability of such charges. Cordon charges have been levied on road users in Singapore since 1975. Today, similar cordon charges are levied in London and Durham in the United Kingdom, Stockholm and Gothenburg in Sweden, Milan in Italy, and some cities in Norway (such as Oslo and Bergen). The first congestion charge in the United States is planned for New York City in 2022. In Melbourne, Transurban undertook a trial of road user charging, which included a congestion-based charge, suggesting that cordon charging could be an effective congestion management tool in Australian cities (Transurban 2016).

Congestion charges can be controversial. Some congestion charge proposals and pilot schemes have foundered after public opposition, including in Edinburgh, Birmingham, Coventry and Manchester in the United Kingdom, Hong Kong, and an earlier proposal for Manhattan.

Figure 5.4 – Impact of new toll on use of substitute roads
Forest /Stoney Creek Road intersection following change in toll price on M5 East



Source: Rabe and Gladstone (2021).

For road user charges to alleviate congestion, they should be targeted at areas and routes most prone to congestion. This could be achieved by implementing, for example:

- CBD ‘cordon’ charges — in which drivers are charged for entering a city’s CBD
- corridor charges, where drivers are charged based on how far they travel along congested arterial roads and freeways (in the peak direction).

Such charges could include a higher charge for peak times (or be made applicable only during peak times). Cordon charges are likely to be more feasible to implement in the short term (Terrill, Moran and Ha 2019).

Regardless, while an oft-repeated (and largely ignored) policy recommendation, the recent shift to road pricing of electric vehicles in some jurisdictions, heavy vehicle charges and some successful trials, suggest that there is realistic scope for shifting away from current road charging approaches, especially given the wide availability of the technologies that allow its easy adoption. Public acceptance of road user charging would also be enhanced if there was a link between localised pricing and the allocation of funds for the road infrastructure and maintenance most valued by motorists (PC 2017c).

Parking levies

Well-designed parking levies can also play a role in mitigating congestion, particularly until road user charges are fully implemented.

Implementation involves little new technology, does not raise the privacy concerns of road pricing, can be rolled out incrementally and in ‘hot zones’ and, if not too highly priced, is acceptable (Litman 2021d, p. 6). Area wide parking schemes have been implemented in several major Australian cities since the 1990s (Hamer, Currie and Young 2011).

Parking levies have shown some success in reducing congestion. For example, a review of the impact of the Melbourne parking levy found a reduction in traffic into the levy area of 6 per cent, though it is hard to be sure that all of this can be attributed to the levy (DTF (Vic) 2010, p. 13). In survey analysis, parking fees and

availability emerge as a major motivator to shift away from car use. One survey found that of Sydney residents who used public transport, about half did so to avoid 'parking problems', though that will include fees and availability of spots (Corpuz 2007, p. 7). A parking levy in Nottingham (United Kingdom) — drawing on the design of Australian levies — found significant positive effects on mode switching (Dale et al. 2017, 2019). Transport simulations also suggest large impacts (Kolomatskiy et al. 2020).

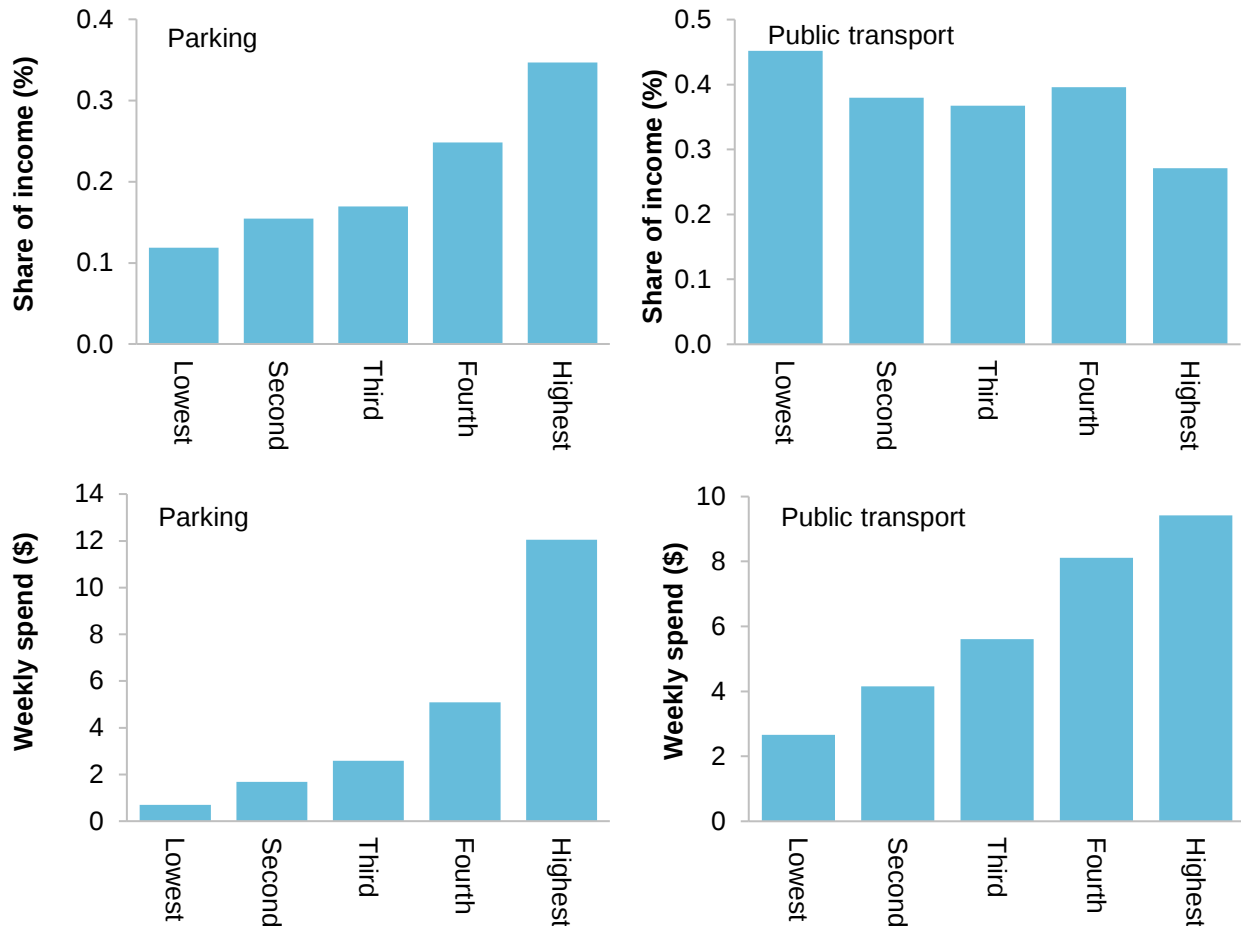
These findings are reinforced by substantial evidence that car parking prices have significant impacts on parking demand (Lehner and Peer 2019). The impacts of parking prices flow to road use, with a literature survey concluding that the elasticity of vehicle trips with respect to parking costs is between -0.1 to -0.3, meaning that a 10 per cent increase in parking prices elicits a 1 to 3 per cent reduction in car trips (Litman 2021e, pp. 44–47). Another review found ranges between -0.1 and -0.68 (Hamer, Currie and Young 2009). The relevant elasticity of car demand to public transport is a fraction of this (at about 0.05). Part of these demand responses reflects a greater likelihood of carrying passengers when parking prices are high. These effects suggest that parking levies may be more potent in addressing road congestion than public transport fares, while being simpler than the full-scale introduction of road pricing. This effect is reinforced to the degree that parking fees make it easier for people to find an available spot (akin to reducing 'crowding' of parking) given that significant road congestion arises from people 'cruising' to find a car parking spot (Litman 2021d; Millard-Ball, Weinberger and Hampshire 2014; van Ommeren, Wentink and Rietveld 2012; Zhu et al. 2020).

For parking levies to be most effective in reducing congestion, they should ideally target drivers in congested routes for whom public transport is a viable alternative (in regard to timing, location, cost and other factors). An advantage of car parking levies is that they can be varied by location, targeting congested areas at a more granular level than transport fare subsidies. This is to some extent already the case in Melbourne and Sydney, which use two different zones (where the more central zone is charged more).

Parking levies are also progressive when compared with public transport subsidies. Commuters who park in the CBD typically also have higher ability to pay and a greater number of other transport options (figure 5.5).

Moreover, unlike road user charges, parking levies would avoid added costs for those drivers who have less ability to change travel behaviour (for example, for occupations that require car use). Notably, fuel costs rise moderately across income quintiles (an indicator that kilometres travelled also do not vary greatly), while they fall as a share of income. Lower-income people therefore use cars, but do not often park them in costly and busy CBD locations, which makes parking an attractive source of congestion charging.

Figure 5.5 – Car parking costs are much higher as a share of income for higher-income households



Source: ABS 2017 (*Household Expenditure Survey, Australia: Summary of Results, 2015-16*, Cat. No. 6530.0).

There are a number of weaknesses in existing parking levies and practical challenges in designing them to achieve their intended goals:

- Users do not bear the direct costs of levies as they are imposed on suppliers of parking. Many employers offer free parking, which provides no incentive to substitute between travel modes and times. There is also evidence of incomplete pass through of costs to motorists by commercial parking operators, which weakens the price signal and associated impact on motorists' behaviour. Following the introduction of the Melbourne levy, one major operator indicated close to full recovery from customers, but the other major operator said that it faced difficulties in passing on the full costs (DTF (Vic) 2010, p. 10). It has been estimated that the incomplete incidence of the Melbourne parking levy on motorists meant that only 11 per cent of the theoretical impact of the levy on car travel demand was achieved (Hamer, Currie and Young 2011, p. 14).
- Levies are not uniformly applied across all forms of parking, leading to some substitution between different types of parking, blunting the demand response and increasing 'cruising' to find any spare cheap parking spots (Lee, Agdas and Baker 2017). The impact of non-uniform pricing may be partly addressed by apps (such as the NSW Government's PARK'nPAY, Canberra's ParkCBR and various commercial apps) that provide real time information about parking availability, though uptake by motorists is not clear, nor its coverage of on-street parking.

- Without significant red-tape costs, it may be difficult to achieve full compliance with levies on private household off-street parking that involve private deals between parties (which are now supported by apps).
- The existing forms of levies do not encourage parking outside of peak. Parking levies in Sydney, Melbourne and Perth impose flat prices on car park operators each year.⁴⁴ Non-time varying levies leave it to operators to determine the timing and level of charges that maximise recovery of the levy, in which case they will recover more from customers that are least responsive to prices, who appear to be short-stay customers. The Melbourne CBD levy increased short-stay parking prices by a greater percentage than long-stay 'early bird'⁴⁵ parking prices (DTF (Vic) 2010, p. 11), contrary to the desired impact of the levy. Nevertheless, CBD commercial operators still increased charges for all day parking, which would tend to reduce total road movements into the CBD. However, the purpose of congestion taxes is not to uniformly discourage car use for commuting, but to reduce the costs of travel during the most congested periods. That suggests that levy rates should be lower for out of peak time parking, even if the parking duration is 8 hours or more.
- The impact of parking costs (and availability) on congestion depends on the pattern of traffic movements in a city. For instance, while its current significance is uncertain, in Sydney, through-traffic entering the CBD appears to comprise the lion's share of traffic and cannot be influenced by parking prices (Enoch and Ison 2006). How much this affects inner-city congestion depends on the types of through roads and their capacity (such as motorways compared with typical streets). Either way, this factor points to the only partial role that parking can play in relieving congestion.
- The elasticity of demand for parking — the critical determinant of the behavioural response to levies — in CBDs or other zones where congestion on feeder roads are high is dependent on the adequacy of alternative modes of transport. Levies must go hand in hand with public transport measures to raise service quality in peak periods (such as crowding, frequency, accessibility).
- The public acceptability of increasing the value of levies beyond annual CPI increases in may be limited in some cities given existing rates,⁴⁶ suggesting that the form, not the level of the levy may be a key target in some jurisdictions.

In light of these, the initial direction of policy could be the introduction of levies that are lower for off-peak arrival and departure times, targeting levies at zones that are most likely to reduce congestion, and implementing measures that increase the pass-through of parking costs to motorists (such as encouraging cashing out of free parking offered by employers and removing some of the fringe benefit tax exemptions that apply to parking).



Finding 5.4

Well-designed car parking levies can partly relieve road congestion

Car parking levies in congested city hubs can reduce traffic flows but should be lower for off-peak arrival and departure times.

Levies provide only a partial solution, particularly where congestion reflects through traffic in city centres.

⁴⁴ Governments have sometimes modified parking schemes to remove differentials between short- and long-term parking. For example, in Melbourne the levy concession of 25 per cent on short-term parking was removed.

⁴⁵ Notwithstanding that the label might suggest a discount for parking outside peak traffic hours, early bird parking is designed for all day parking and include arrival and departure times during peak traffic periods (for example, arriving between 6 am and 9.30 am and leaving between 3.00 pm and 11.45 pm).

⁴⁶ For example, in July 2021 the annual levy for a single category 1 parking space in the Sydney CBD was \$2 540.

Fare setting on the reform path

Once road user charging (and/or effectively targeted parking levies) are implemented, the justification for addressing road congestion through public transport fare reductions will become weaker. Indeed, as the periods for road congestion and public transport crowding tend to coincide, it is likely to be optimal to implement a zonal road user charge for the city centre, combined with higher public transport fares in the peak; such an approach was modelled for Paris by Kilani et al. (2013). This would ensure that public transport users are appropriately encouraged to travel off-peak and support greater levels of cost recovery and higher service quality.

Without the need to offset road congestion, the socially optimal level of public transport fares would increase. Until such reforms are undertaken, however, there would be risks in any *significant* increases in peak public transport prices given the potential for aggravating road congestion. Any such increases should be gradual and could be suspended if road congestion rose unacceptably. Equally, there are poor prospects that reducing peak fares below their existing low level would do much to address congestion, though jurisdictions outside Sydney should test this using the transport models already available for their major cities.

6. Better supporting social policy goals through pricing

Key points

- * A significant barrier to governments adopting efficient public transport pricing is their concern that higher fares would disproportionately fall on people with lower incomes.
- * Overall, public transport is most heavily used by people commuting to work. The evidence also suggests that people with higher incomes travel relatively more on trains and less on buses, and travel relatively more during peak time. On average, the people with the lowest incomes travel the shortest distances to work.
- * Equity should not be a cause to avoid more efficient pricing. Indeed, some changes would improve efficiency and equity (meaning overall, people with lower incomes pay lower fares).
 - Due to the positive externalities of public transport (chapter 2) there are sound reasons for the subsidy of fares for average users, however this does not extend to free fares.
- * Public transport is important to achieve social policy objectives, including social and economic inclusion and participation. It also has a role as a social safety net for people who do not have access to other modes of transport. In particular, public transport can help reduce the risk of social exclusion for some people. But as well as being affordable, services also need to be available, accessible and of reasonable quality.
- * While Governments may wish to subsidise public transport fares to promote social inclusion through affordability, the main way they should do this is through well targeted concessions, not broad based fare subsidies that do not otherwise have an efficiency or externality rationale.
- * What should governments do? They:
 - would do better to spend scarce resources on improving services for those at risk of social exclusion than on broad based fare subsidies. Low fares are of no use to people with no convenient public transport nearby.
 - should review their concession eligibility criteria to better target people most in need and look at ways to offer further discounts to concession card holders.

Public transport connects people to employment, education and essential services like medical care. For people who cannot afford a car, or who find it difficult to drive, walk or cycle due to disability or age, public transport can support participation in activities with other people (social participation), which is important for their wellbeing (through social inclusion, or their feeling of belonging to and being valued and respected by a social network).

Australian governments (like governments internationally) treat public transport as an essential public service available to all, rather than as a commercially-oriented business enterprise that should fully meet its costs (IC 1991, p. 38). However, as with other essential (human) services, the achievement of its policy objectives has multiple dimensions and is constrained, not least by exhaustible taxpayer contributions:

A key challenge when considering equity issues is balancing community expectations about service quality and how (and by whom) those services should be funded. Equity of access to services might be achieved by providing the same service to all members of the community on the same terms ... Equity of access might not lead to equity of outcomes from human services. Some people have greater need than others, and achieving similar outcomes might require allocating more resources to serve people who face the biggest challenges. (PC 2017b, p. 73)

The social policy goals for public transport are like those for other essential services covered by community service obligations at the federal and state levels. For example, public transport fares, especially concessions (and by implication, government subsidies) are set with affordability as a major consideration, akin to electricity concession grants and rebates provided under community service obligations with State and Territory Governments. Other social policy goals relate to the ubiquity of access to services, such as universal service obligations for telecommunications.

This chapter examines the social function of public transport and the role that fares can play in making public transport an effective way to promote the goals of equity, affordability and social inclusion.

At the heart of most issues relating to equity is the degree to which patterns of demand vary with income (section 6.1) and linked to that, the extent to which people find transport affordable (section 6.2). Social inclusion is closely related to affordability and equity, but also includes non-price aspects of public transport such as useability of services by people with disabilities and the availability of services for people who cannot afford cars or who are distant from services and economic activity. All governments view social inclusion as an important goal for public transport (section 6.3). While it is important to understand the stylised facts presented in sections 6.1 to 6.3, the policy dilemma is how to craft fares so they are effective at achieving equity goals without forfeiting some of their efficiency functions (section 6.4).

6.1 Public transport equity in Australia

Equity in public transport refers to the distribution of benefits and costs among different users (and non-users) (Litman 2021b, p. 6). The benefits reflect the value of the services when used (and to some extent, the insurance value they have for non-users — such as being available if a person cannot drive or walk to work), the benefits they provide to drivers in reducing congestion externalities, and their broader social inclusion benefits, which arguably accrue to all citizens. The costs relate to the fares that people pay and the costs to taxpayers of funding the gap between fare revenue and full costs. An adjunct to these taxpayer contributions (which are transfers) are the efficiency losses associated with raising taxes, whose incidence is complex, but could include factors like reduced labour mobility due to housing stamp duties.

There is no simple uncontested framework for assessing the *desirable* equitable distribution of costs and benefits — especially because any framework would need to take account of other policies (including those outside public transport) that have an effect on such a distribution. As noted by the Commission in its examination of Australia's tax and transfer system (PC 2015, pp. 10–14), the normative concepts of vertical equity (charges for services and taxes should take into account the 'ability to pay') and horizontal equity (people in the same circumstances should be treated the same) also have analytical value because they identify two dimensions for analysing the *consequences* of policy choices. While horizontal equity is often given as much weight as vertical equity in tax

policy, the most prominent concern in public transport policy concerns its effects on people with lower income or experiencing disadvantage. Accordingly, this chapter focuses on this dimension of equity.

This report largely avoids making normative judgements about whether public transport should be more or less equitable. It does, however, evaluate whether policies are inconsistent with governments' stated equity objectives. For example, if a government intended fare discounts to target lower-income consumers, but also included higher-income ones, this could be inconsistent with the government's policy goals unless there were other reasons for the inclusion of the latter (such as simplicity).

Equity analysis is also relevant to the consideration of cost recovery. As public transport attracts significant government subsidies, equity analysis tests the potential for public transport users to fund a larger share of the services they use (subject to arguments in favour of subsidisation relating to externalities, chapter 2). If significant subsidies are being provided to people with higher incomes, then governments could charge higher fares to this group. Governments could then use that revenue elsewhere or to lower taxes.⁴⁷ Even if price increases were to fall on all users regardless of income, governments could use the additional revenue to better target lower-income or disadvantaged groups such as through greater concessions or improvements in the quality of public transport services in areas where disadvantaged groups predominate (which acts as a targeted *de facto* fare decrease). This highlights the non-pricing aspects of public transport which are particularly important for social inclusion (section 6.3).

In addition, there is a potential trade-off between more efficient fares (for example, higher peak fares) and equity, which distributional analysis can shed light on. On the one hand, the efficient pricing discussed in chapter 2 does not address the distributional impacts of prices as these are not quantified as social benefits or costs. On the other hand, more efficient fares may still promote equity. For example, the social costs of peak train trips justify a higher fare and high-income users are more likely to catch a train during peak times. Furthermore, more efficient fares would promote horizontal equity by ensuring all trips are priced properly.

There are other equity and efficiency trade-offs in public transport. For example, a public transport system may face a trade-off between favouring services that attract more users or services that have a wider geographical reach, but with low usage rates and therefore high costs per service (Stanley and Stanley 2021, p. 374).

The key implication is that transport pricing and service provision have equity effects that should be tested as rigorously as their efficiency impacts, and without the assumption that they necessarily work in opposing ways.

Measuring public transport equity

The relationship between income, transport use and fares is the centrepiece of analysis of equity.

Attempts to isolate the effect of income on public transport demand (the income elasticity of demand for public transport) are complicated by the interaction of income with other factors influencing travel behaviour, including car ownership. Moreover, public transport is not a homogenous good. A weekday commuter train trip is a different product to a local bus trip in an outer suburb to a nearby shopping centre. Ferry services on weekends cater to different customer types than those on weekdays.

Nevertheless, it is useful to gauge the average effect of income on public transport demand, because if demand fell as incomes rose there would be a long-run decline in public transport patronage as incomes rise over time. This would threaten its economic viability and its long-run capacity to meet the needs of an ever-dwindling pool of lower-income customers. In assessing that risk, the evidence on income elasticities

⁴⁷ A complexity here is that full or greater cost recovery from higher-income beneficiaries may not be consistent with a *broader* concept of equity if they have already paid a large contribution to the services through their taxes.

suggests an unhelpful imprecision in estimates, with a meta-analysis finding a range from -0.82 to 1.18 with an average of 0.17 (Holmgren 2007, p. 1025). However, this wide variation partly reflects differences in model specifications, which lead to biases in estimates. In models that derive estimates from a complete demand system — a generally more rigorous approach than single equation estimation for public transport — the estimated elasticity is 0.47 (Holmgren 2007, p. 1031). The standard method for identifying expenditure elasticities using the ABS Household Expenditure Survey found an income elasticity of 0.71, also consistent with transport demand rising with total income, though not as a share of total income (Jaaskela and Windsor 2011, p. 11).

A more nuanced story about the links between income, disadvantage and patronage emerges from more granular data, and provides insights into the role of fares in meeting social objectives. This covers the level of fares, concession eligibility and whether to differentially price by travel features (mode, distance and time of travel) — and balancing equity objectives against efficiency.

Spending on public transport by income group

Spending on public transport rises with household income. The 40 per cent highest income households account for about 60 per cent of spending, while the bottom 40 per cent account for about 20 per cent, which will partly reflect the impact of concessional fares.⁴⁸ Aggregate spending on public transport is small for all household income groups, amounting for less than one half of one per cent of total consumption and disposable income, and for all income groups comprise about 3 per cent of all personal road-related spending (primarily cars and taxis).

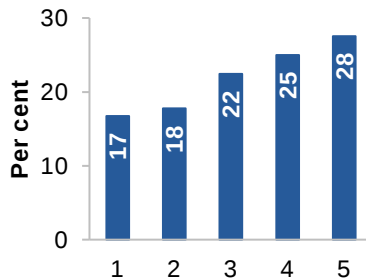
However, many households — rich or poor — hardly use public transport at all, so while public transport prices do not have significant effects on low-income households collectively, those effects are larger for those who do use them. This is particularly true for people with lower incomes because the likelihood of spending anything for public transport is lower for this group than others (figure 6.1). The consequence is that while there is still a strong positive relationship between spending and income, the public transport spending share of income is about three times higher for people with low incomes once those who spend zero are omitted, though at less than 5 per cent, it is still relatively low. Close to 50 per cent of the lowest income group (quintile 1) spend less than \$10 per week on public transport and more than 70 per cent less than \$20 (figure 6.2). Higher income groups are roughly equally distributed among spending amounts, though the most common weekly spending amount is \$40 or more. The distributional impacts are somewhat less than implied by the results described above because some people receive free services (such as some veterans, box 6.5), which will be recorded as zero spending, but still constitutes use of services.

Overall, the results suggest that small changes in fares cannot have major effects on the capacity to purchase other goods and services.

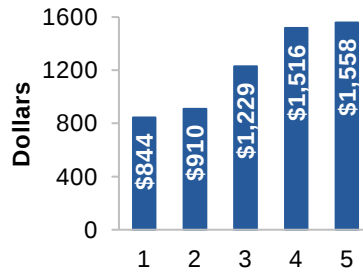
⁴⁸ Productivity Commission analysis of ABS 2017, Household Expenditure Survey, Australia: Summary of Results, 2015-16, Cat. no. 6530.0.

Figure 6.1 – Spending patterns by income quintile
2015-16

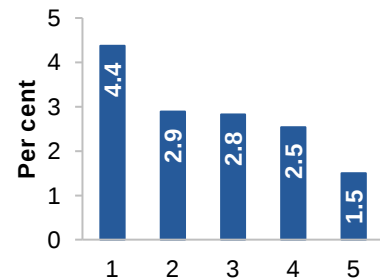
Share of households with some public transport spending



Annual public transport spending^a



Public transport spending as a share of disposable income^a

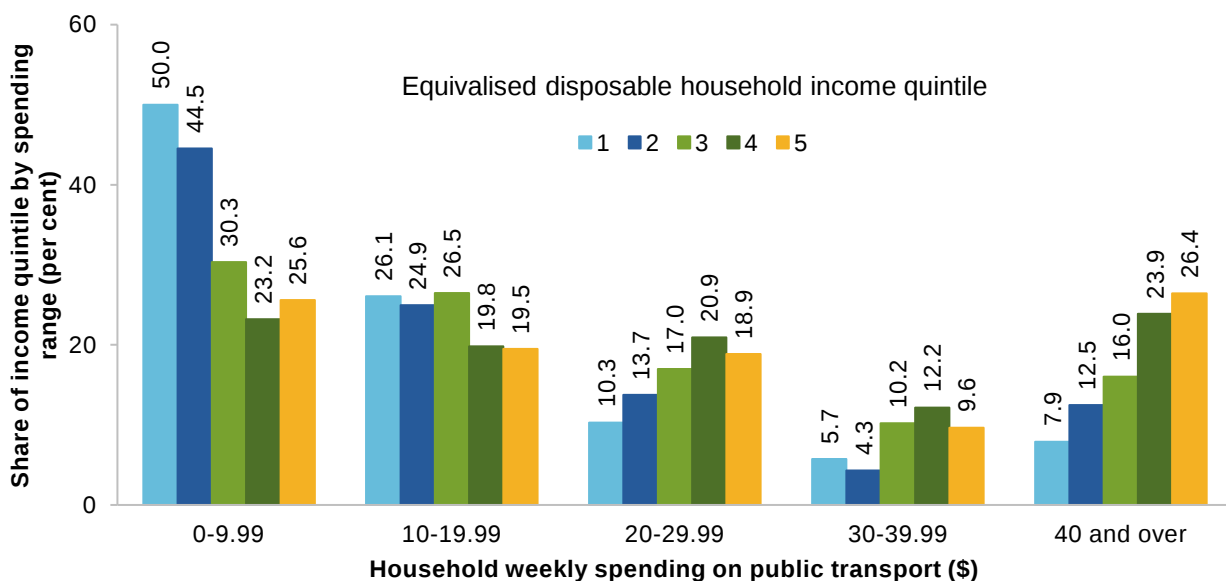


Equivalised disposable household income quintiles 1 to 5

a. For households that spend money on public transport.

Source: Analysis of the confidentialised unit record file of the ABS 2017, *Household Expenditure Survey, Australia: Summary of Results, 2015-16*, table 3, Cat. no. 6530. Results are weighted.

Figure 6.2 – The distribution of public transport spending by income quintile^a
2015-16



a. For households that spend money on public transport.

Source: Analysis of the confidentialised unit record file of the ABS 2017, *Household Expenditure Survey, Australia: Summary of Results, 2015-16*, table 3, Cat. no. 6530. Results are weighted.

Public transport use in Australian cities by income

In Australian capital cities, the share of people who took public transport to work increased with personal weekly income (table 6.1). In 2016, 18.4 per cent of people in the lowest income range took public transport to work, compared with 24 per cent of people in the highest income range. This pattern partly reflects that other factors — travel during standard business hours, accessibility of public transport, the radial nature of transport networks that favour travel to CBDs — are important drivers of the choice to take public transport, and also

correlated with income (BITRE 2019a). These same factors act against the usefulness of public transport for some lower-income workers. Changes to fares for such people would be an ineffectual mechanism for attracting them to services whose purposes and timing are not in tune with their job demands.

In the larger capital cities (Sydney, Melbourne, Brisbane and Perth), public transport use tends to increase with income, while in the other cities (Adelaide, Hobart and Canberra — putting aside Darwin where some peculiarities drive the results⁴⁹) it tends to decrease or remain relatively stable. The underlying factor is that in cities without significant road congestion and with ample parking, cars are the most attractive mode for those who can afford them.

Table 6.1 – The share of people taking public transport to work increases with personal income for the bigger cities^a

Share using public transport by personal weekly income, 2016

Location	\$0 to \$499	\$500 to \$999	\$1000 to \$1499	\$1500 to \$1999	\$2000 to \$3000	\$3000 and over	Total (all income)
	%	%	%	%	%	%	%
All capital cities (excluding Darwin)	18.4	15.1	17.3	19.5	24.4	24.0	18.2
Greater Sydney	25.7	22.4	24.9	27.6	34.3	34.1	26.4
Greater Melbourne	18.2	14.8	17.5	20.3	25.9	23.0	18.2
Greater Brisbane	14.6	10.9	13.2	15.5	19.0	14.6	13.5
Greater Adelaide	12.1	9.2	10.7	11.0	10.9	5.5	10.3
Greater Perth	12.5	9.4	10.5	11.6	15.2	16.9	11.6
Greater Hobart	10.6	5.9	5.3	4.7	4.0	2.3	6.1
ACT	12.5	7.6	8.1	8.3	7.8	4.1	8.2

a. Excluding Greater Darwin.

Source: ABS, *2016 Census of Population and Housing*, TableBuilder, Method of Journey to Work, based on counts of person by place of enumeration.

Another way to analyse public transport equity is to look at the income distribution of only those people who used public transport to get to work. Nearly half (48.3 per cent) were low-to-middle income earners (earning \$500 to \$1499 per week, or \$26 000 to \$78 000 per year) (table 6.2).

Looking beyond the commute to work, analysis has been conducted using the Victorian Integrated Survey of Travel and Activity as it publicly reports household income (necessary for equity analysis) and has travel data spanning several years, providing a sufficient sample size.⁵⁰

⁴⁹ Statistics detailing the use of public transport for the journey to work in Darwin in the 2016 Census should be taken with caution as private buses are included in the public transport category alongside public buses. This is because the selection option 'bus' does not distinguish between private and public buses. In Darwin, private buses were used to transport (high-income) workers to an LNG plant built in 2014 (Loader 2017). To illustrate the effect this had, the share of people earning over \$2000 per week taking public transport to work increased from 2.1 per cent in 2011 to 27.5 per cent in 2016.

⁵⁰ The availability of travel survey data varies across jurisdictions — in some jurisdictions, data on income are not available publicly and some travel surveys are conducted as one-off surveys, rather than as a regular survey.

Table 6.2 – But most public transport trips to work are from middle-income earners^a
Share of total public transport trips for the journey to work by personal weekly income

Location	\$0 to \$499	\$500 to \$999	\$1000 to \$1499	\$1500 to \$1999	\$2000 to \$3000	\$3000 and over	Total (all income)
	%	%	%	%	%	%	
All capital cities (excluding Darwin)	14.8	25.0	23.3	16.2	12.9	7.9	100
Greater Sydney	13.4	24.6	22.6	16.0	13.7	9.6	100
Greater Melbourne	15.4	25.2	23.6	16.1	12.5	7.1	100
Greater Brisbane	15.4	25.9	24.5	17.1	11.9	5.2	100
Greater Adelaide	19.0	30.8	26.0	14.9	7.4	1.8	100
Greater Perth	16.1	22.1	22.2	16.0	14.2	9.4	100
Greater Hobart	27.0	33.9	22.2	11.2	4.5	1.1	100
ACT	16.8	19.4	23.9	20.1	16.1	3.7	100

a. Excluding Greater Darwin.

Source: ABS, *2016 Census of Population and Housing*, TableBuilder, Method of Journey to Work, based on counts of person by place of enumeration.

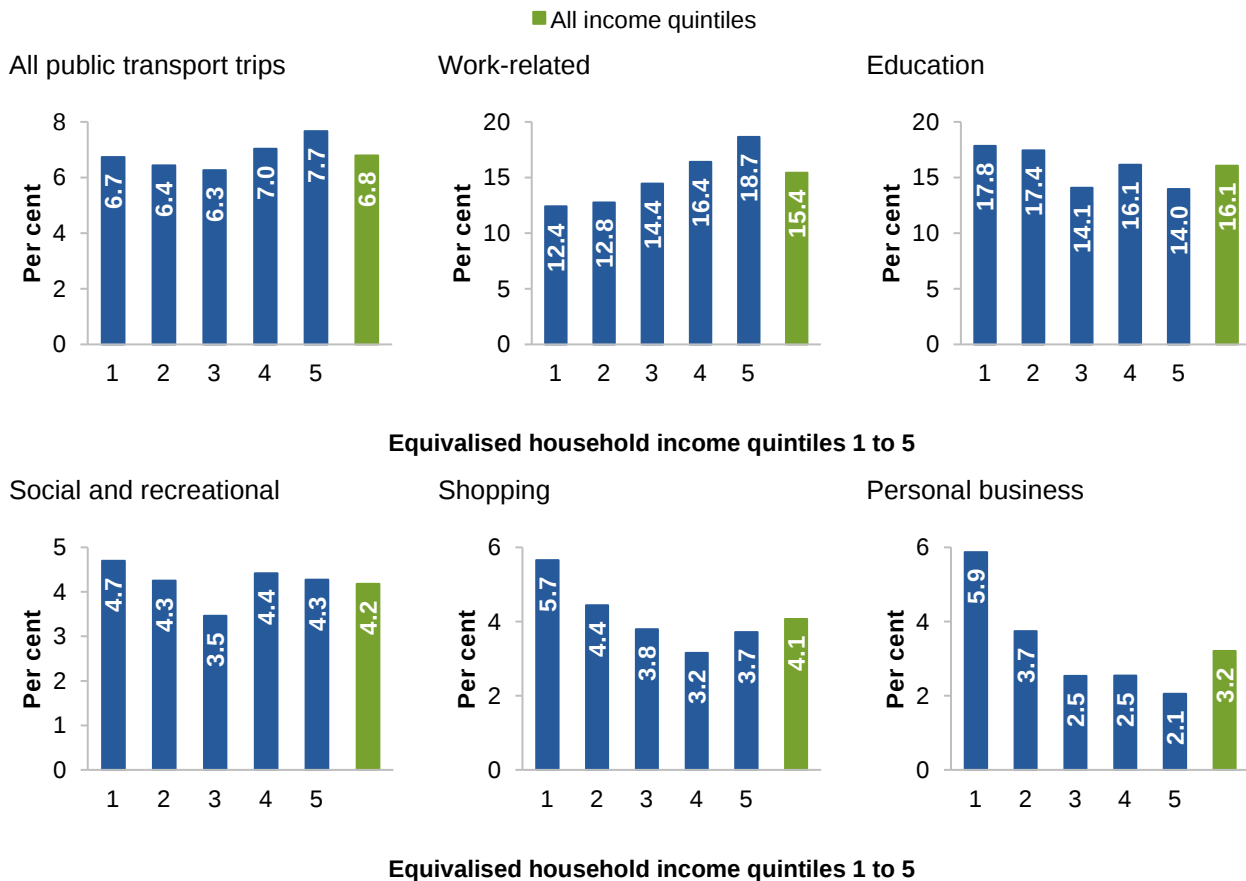
Examining public transport use for any reason (not just journey to work) for Greater Melbourne (figure 6.3) using equivalised household income quintiles — which accounts for cases where a person may have a low *personal* income, but belong to a household with a high *household* income — shows the relationship between public transport use and income is U-shaped. About 6.7 per cent of trips made by people in the lowest income quintile involved public transport, compared with 7.7 per cent of trips by made by people in the highest income quintile (figure 6.3, top left).

The purpose of travel influenced people's public transport use — the percentage of trips that involve public transport was highest for travel to education (16.1 per cent) and work (15.4 per cent), with public transport use markedly lower for travel for social and recreational (4.2 per cent), shopping (4.1 per cent) and personal business (3.2 per cent) (figure 6.3).

There were also income-based travel patterns by trip purpose — public transport use increased with income for work-related travel, while it decreased for shopping and personal business. For example, for work-related travel, 12.4 per cent of trips taken by people in the lowest household income quintile involved public transport, compared with 18.7 per cent in the highest household income quintile. In comparison, for travel to conduct personal business, 5.9 per cent of trips made by people in the lowest income quintile involved public transport, compared with 2.1 per cent for people in the highest income quintile.

Figure 6.3 – Public transport mode share is highest for work and education travel in Melbourne

Public transport mode share by trip purpose and equivalised household income quintile on an average weekday

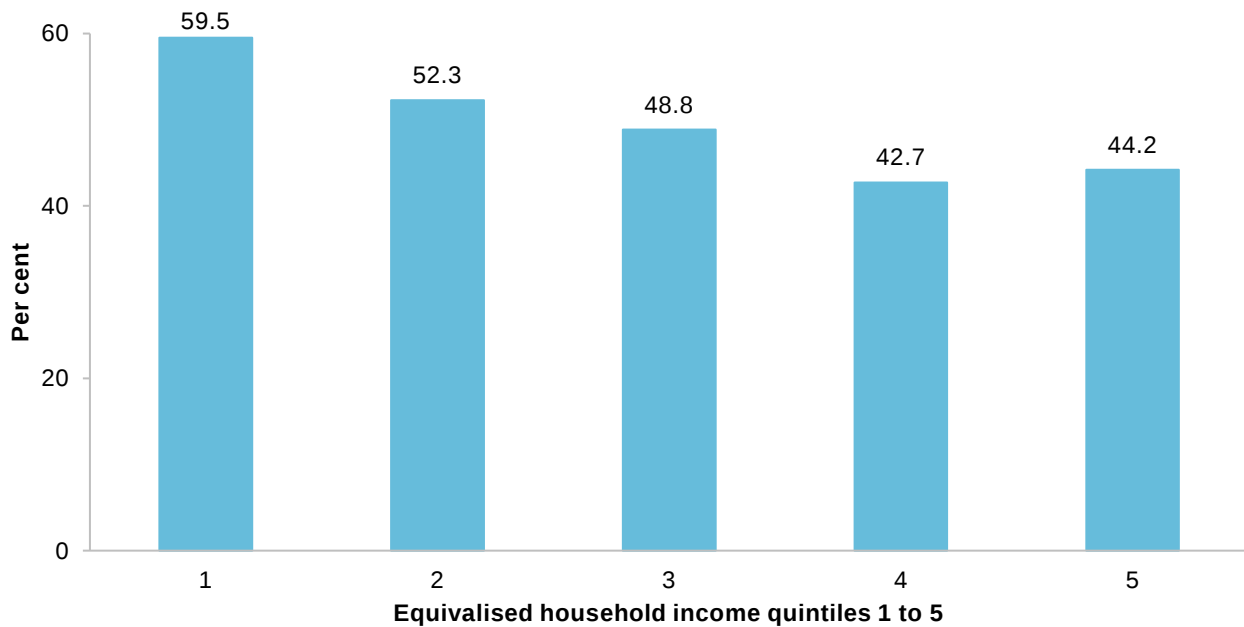


Source: Productivity Commission analysis of Victorian Integrated Survey of Travel and Activity combined 2012–2018 dataset. Excluding trips made by school bus. Household income was inflated using the Melbourne CPI series. Results are weighted.

Tertiary students are highly likely to travel by public transport (figure 6.4). The results for education highlight the need for care in interpreting equity at a given time. Adult students tend to have higher lifetime income than less educated peers so that conceptually, the equity grounds for concessions are weaker than cross-sectional evidence suggests. Concessional fares for this group are based (legitimately) on affordability criteria.

Figure 6.4 – Public transport is often used to get to tertiary education

Public transport mode share for university and TAFE students by equivalised household income quintile on an average weekday



Source: Productivity Commission analysis of Victorian Integrated Survey of Travel and Activity combined 2012–2018 dataset. Excluding trips made by school bus. Household income was inflated using the Melbourne CPI series. Results are weighted.

Public transport mode

The efficiency case for modal pricing of public transport (chapter 4) arises from the different costs of operating public transport modes. Estimates of public transport operating costs in Australia suggest that trains and ferries have the highest operating costs, followed by light rail and then buses (ATAPSC 2021, p. 76). Modal pricing also contributes to horizontal equity because otherwise equivalent people receive different subsidies based only on their modal choice.

The effect of modal pricing on vertical equity depends on the travel behaviour of low-income public transport users, including whether they have alternative transport choices and whether they can adapt their travel behaviour to reduce fares paid.

For the journey to work, the percentage of trips where a train is the main mode tends to increase with personal income for all cities with rail networks except Adelaide, while the relationship between bus use and income is mixed (table 6.3).

- As previously noted, Darwin has been excluded because of the high share of people with higher incomes travelling by private bus to work.
- Bus use declines with income in Adelaide, Hobart and Canberra. In Melbourne, bus use declines slightly with income, while it increases with income in Sydney. In Brisbane, bus use is highest for the lowest income range but lowest for the second-lowest income range.

Table 6.3 – Train mode share tends to increase with income, while bus mode share is mixed
Share using train and bus as main mode of transport by personal weekly income, 2016

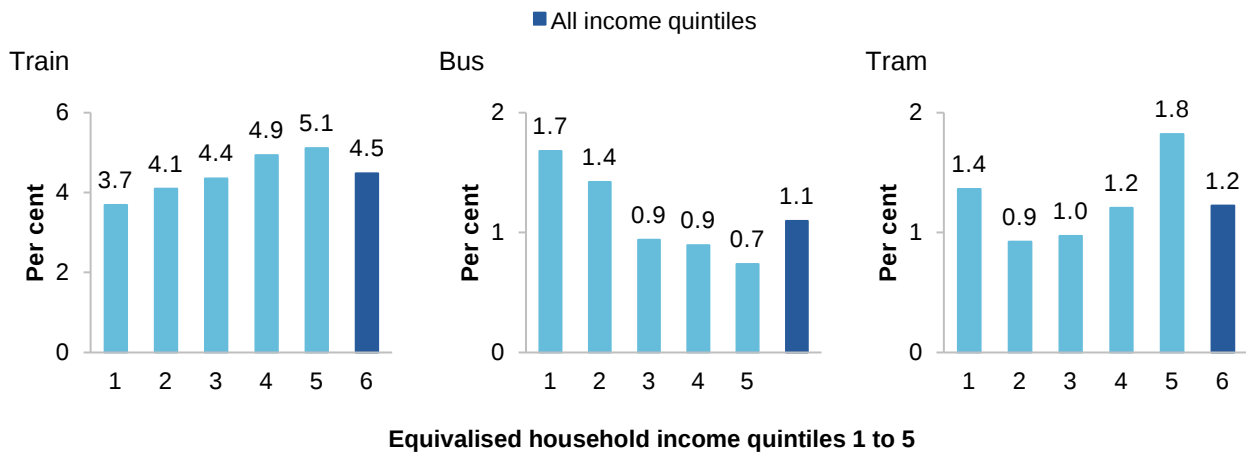
	Train	Bus	Train	Bus	Train	Bus	Train	Bus
Personal weekly income	Greater Sydney		Greater Melbourne		Greater Brisbane		Greater Adelaide	
\$0-\$499	17.3	8.2	11.2	3.9	5.5	8.8	2.6	8.9
\$500-\$999	16.5	5.7	10.5	1.8	5.5	5.1	2.4	6.0
\$1000-\$1 499	18.6	5.8	13.3	1.1	7.1	5.6	3.1	6.6
\$1500-\$1 999	20.2	6.7	15.8	1.0	8.3	6.7	3.1	6.8
\$2000-\$2 999	24.0	9.0	20.7	1.2	10.3	8.0	3.2	6.7
\$3000 or more	20.2	11.2	17.9	1.1	7.3	6.2	1.5	3.4
	Train	Bus	Train	Bus	Train	Bus	Train	Bus
	Greater Perth		Greater Hobart		Australian Capital Territory			
\$0-\$499	6.3	6.1	—	10.5	—	12.4		
\$500-\$999	6.0	3.3	—	5.8	—	7.4		
\$1000-\$1 499	7.4	3.1	—	5.2	—	7.9		
\$1500-\$1 999	7.9	3.7	—	4.5	—	8.0		
\$2000-\$2 999	9.6	5.5	—	4.0	—	7.6		
\$3000 or more	10.0	6.8	—	1.9	—	3.7		

Source: Analysis of ABS, *2016 Census of Population and Housing*, TableBuilder, Method of Travel to Work based on counts of person by place of enumeration.

In Melbourne, as the equivalised household income quintile increases, the share of trips (for all purposes) involving trains as the main mode increases, while the share of trips involving buses as the main mode decreases (figure 6.5). The share of trips involving trams as the main mode was greatest for the highest income group.

Figure 6.5 – The share of trips involving trains (buses) as the main mode increases (decreases) by income quintile

Share using train, bus and tram as the main mode of transport by equivalised household income quintile on an average weekday



Source: Productivity Commission analysis of Victorian Integrated Survey of Travel and Activity combined 2012–2018 dataset. Excluding trips made by school bus. Household income was inflated using the Melbourne CPI series. Results were weighted.

The implication of these results is that a premium for train fares to reflect their higher operating costs than buses would relatively favour lower-income groups.

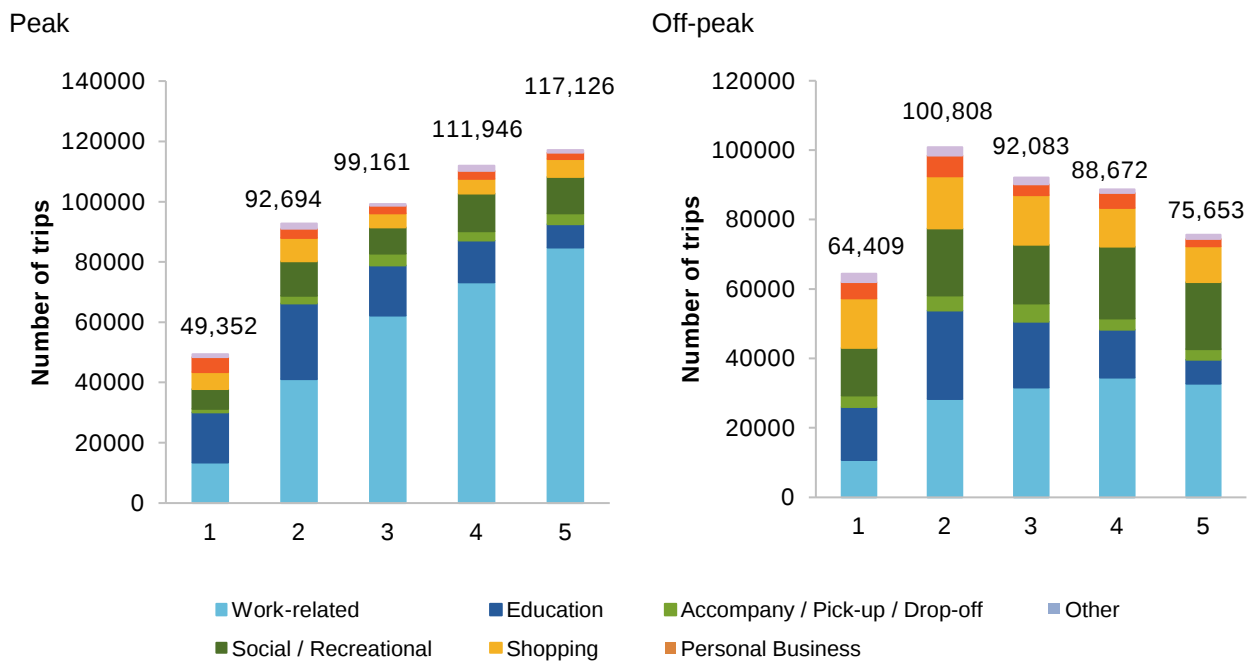
Low-income users comprise a larger proportion of off-peak trips

The equity effects of peak pricing will depend on when people on different incomes travel.

In Melbourne, public transport use during peak times is highly correlated with income, reflecting the employment and occupational status of those who need to travel at these times (figure 6.6) — a result likely to apply across all jurisdictions. Off-peak use is initially responsive to income but with no additional effects on use for higher-income groups.

Figure 6.6 – More peak trips are taken for work purposes and by people with higher household incomes^a

Number of trips by equivalised household income quintile on an average weekday



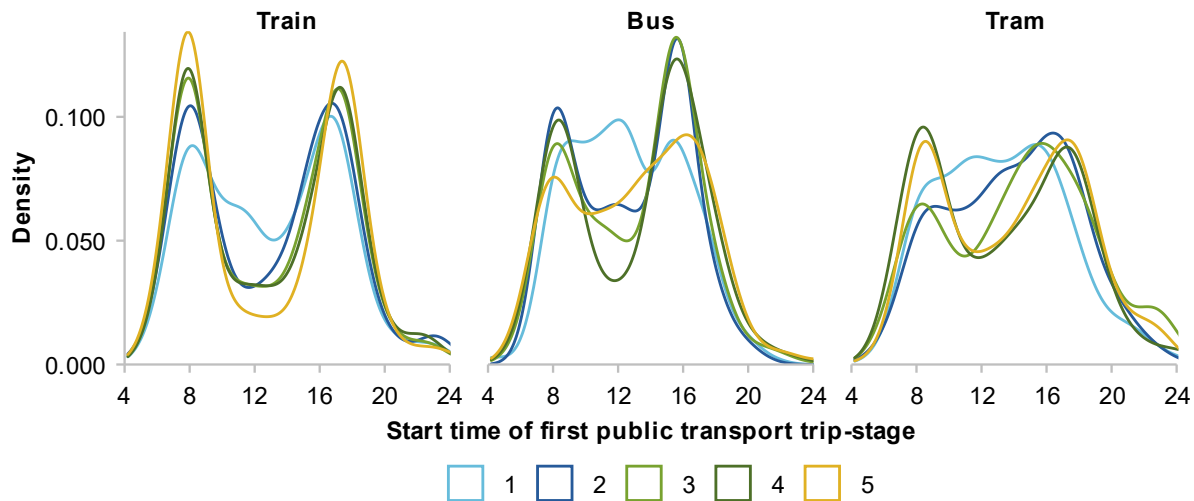
Equivalised household income quintiles 1 to 5

a. Trips are classified as peak if the start time of the first public transport trip-stage is between 7:30 am and 9:30 am (morning peak) or between 4 pm and 7 pm (afternoon peak). All other trips are classified as off-peak.

Source: Productivity Commission analysis of Victorian Integrated Survey of Travel and Activity combined 2012–2018 dataset. Excluding trips made by school bus. Household income was inflated using the Melbourne CPI series. Results are weighted.

There are also striking modal differences in off-peak use with people in the lowest income quintiles concentrating their usage of buses and trams (but not trains) in off-peak periods (figure 6.7). At the time of the survey there was no peak/off-peak pricing so travel patterns were not influenced by fares (temporary off-peak discounts were introduced in 2021).

Figure 6.7 – People with lower incomes tend to use buses during the off-peak^a
Density of the starting time of trips where a train, bus or tram was the main mode of transport on an average weekday by equivalised household income quintile



a. Trips were selected where the main mode of transport used was a train, bus or tram. The starting time of a trip was assigned by obtaining the starting time of the first trip stage that used a public transport mode. The Victorian Integrated Survey of Travel and Activity measures time using a twenty-seven hour day, although only trips beginning from 4am to midnight are displayed in the figure.

Source: Productivity Commission analysis of Victorian Integrated Survey of Travel and Activity combined 2012–2018 dataset. Excluding trips made by school bus. Household income was inflated using the Melbourne CPI series. Results were weighted.

The implication of the greater use by lower-income groups of off-peak services is to reinforce arguments for lower off-peak pricing (higher peak pricing). This would not only reduce crowding and the need for investments in public transport during peak periods (chapter 3), but also support equity and affordability.

Distance of travel

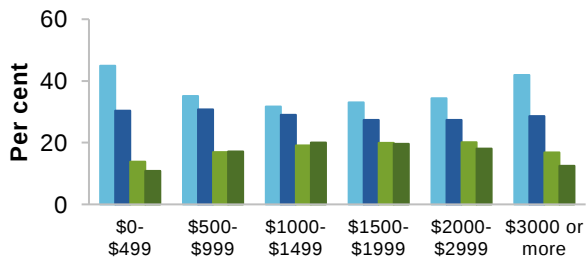
The equity implications of distance-based pricing depend on the distances travelled by people on lower or higher incomes. Across most Australian capital cities, there does not appear to be a strong correlation between one's personal income and distance between one's residence and place of work for public transport users, except for those in the lowest income range earning less than \$499 per week in 2016 (figure 6.8). Rather, distance travelled for work appears more closely related to mode choice (figure 6.9). The average distance travelled for the journey to work in Australia was highest for train users (22.5 km), followed by ferry users (15.6 km), bus users (13.1 km) and then tram users (7 km) (BITRE 2019a, p. 8).

Figure 6.8 Public transport users with very low incomes tend to live closer to their workplace than other public transport users

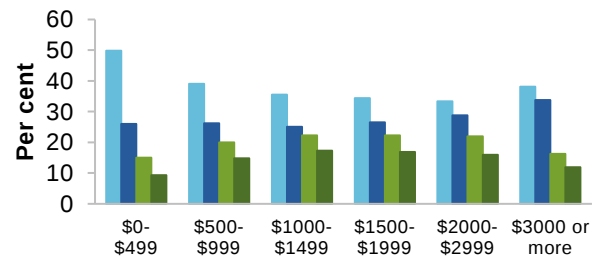
Share of users in a personal weekly income range that live within a specified distance range from work

■ 0 km to less than 10 km ■ 10 km to less than 20 km ■ 20 km to less than 30 km ■ 30 km and over

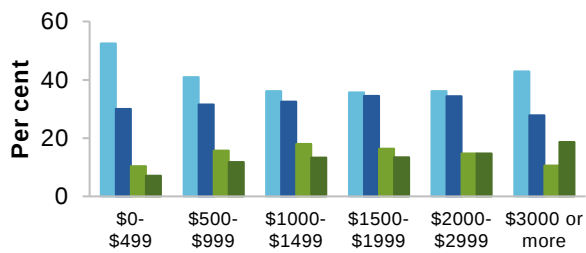
Greater Sydney



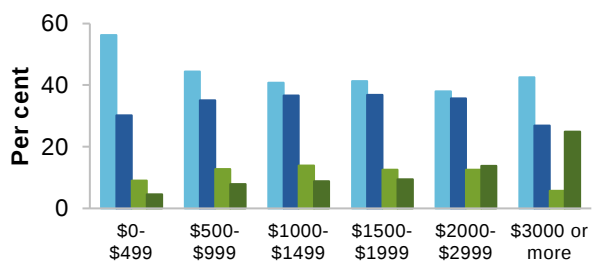
Greater Melbourne



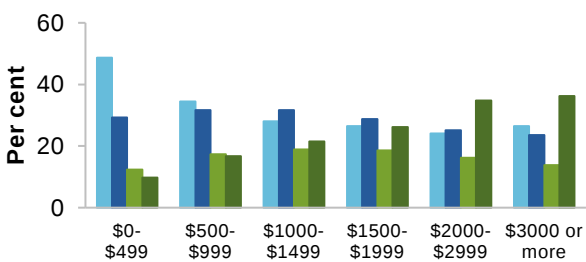
Greater Brisbane



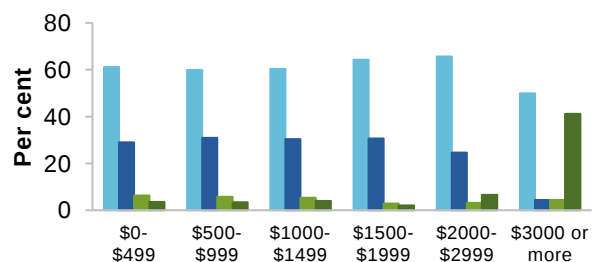
Greater Adelaide



Greater Perth



Greater Hobart



Australian Capital Territory

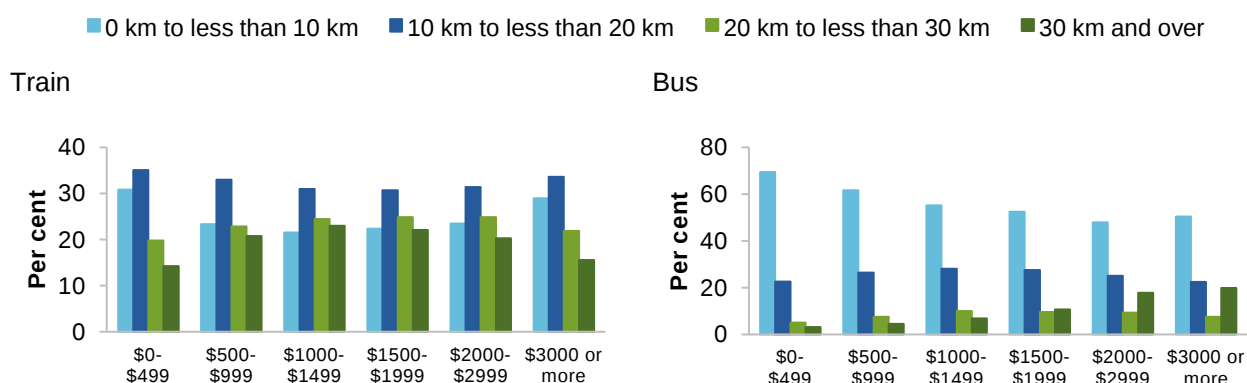


a. Excluding Greater Darwin.

Source: ABS, 2016 *Census of Population and Housing*, TableBuilder, on method of travel to work, based on counts of person by place of work.

Figure 6.9 – Across all income ranges, train users tend to live further away from their workplace^a

Percentage of public transport users in a personal weekly income range that live within a specified distance range from work and use a given mode in capital cities



a. Excluding Greater Darwin.

Source: ABS, 2016 *Census of Population and Housing*, TableBuilder, on method of travel to work, based on counts of person by place of work.

In Melbourne, the distribution of the distance travelled via public transport on an average weekday is similar across all income ranges (table 6.4). Overall, the median distance travelled by people in the lowest income quintile was about 15 per cent shorter than those in the highest quintile. The distance people travel is likely to be closely linked to the mode of travel they use; trips by train tended to be longer than trips by bus or tram.

That said, comparing distances between people who use the same mode shows some differences. The median distance travelled by train by someone in the lowest income quintile was about 30 per cent longer than that travelled by someone in the highest quintile. However, for bus trips, the median trip distance was about 40 per cent shorter for those in the lowest income quintile, compared with those in the highest quintile.

In Sydney, train trips tend to be longer than bus trips, with an average distance of 28 km compared with 9.9 km (BITRE 2019a, p. 9). For train trips, people earning less than \$800 per week travelled shorter than average distances (that is, less than 28 km), while for buses, the average distance travelled was highest for people earning more than \$2000 per week (13.8 km). People in the lowest income range, earning less than \$150 per week, also travelled longer than average distances (10.6 km on average).

Overall, on average, these results suggest that distance-based pricing would not be vertically inequitable.

Table 6.4 – Distance of public transport trips are linked to the main public transport mode used

Cumulative distance of all public transport stops (kilometres) comprising a trip by main public transport mode on an average weekday

Equivalised household income quintile	Public transport mode	25 th percentile	Median	75 th percentile	Average
Lowest	All modes	3.4	7.4	17.7	13.8
	Train	10.7	17.2	27.4	20.7
	Bus	2.6	3.8	6.5	5.7
	Tram	2.1	3.8	5.7	5.2
Second	All modes	4.0	10.6	21.8	16.2
	Train	11.2	18.6	27.3	22.1
	Bus	2.3	4.1	8.3	6.4
	Tram	2.0	3.0	6.3	5.1
Third	All modes	5.2	11.2	21.0	15.2
	Train	9.5	15.9	26.4	19.2
	Bus	2.7	5.1	9.2	6.7
	Tram	1.8	3.4	6.1	6.0
Fourth	All modes	5.0	10.5	21.0	15.6
	Train	9.3	15.7	25.0	19.5
	Bus	2.3	4.4	10.4	7.7
	Tram	2.0	4.0	6.3	5.1
Highest	All modes	4.0	8.7	17.0	13.3
	Train	8.0	13.2	22.4	17.2
	Bus	3.3	6.3	11.0	7.8
	Tram	2.1	3.3	5.2	4.5

a. Trips were selected where the main mode of transport used was a train, bus or tram. For a given trip, the distance travelled using modes other than public transport (for example, the distance covered by travelling by car to a train station) was excluded.

Source: Productivity Commission analysis of Victorian Integrated Survey of Travel and Activity combined 2012–2018 dataset. Household income was inflated using the Melbourne CPI series. Results were weighted.

Availability of public transport

Some State and Territory Governments aim to make public transport available to most of their city residents. The ACT Government, for example, has a ‘coverage target’ of 90 per cent of the population (MRCagney 2015a, p. 100) while one planning objective in Victoria is for every home within an urban area to have direct access by public transport to a ‘principal’ or ‘major activity centre’ (i.e. areas of focused activity with a wide range of services and employment) with a maximum travel time of 30 minutes without changing vehicles (Department of Transport 2013, p. 7).

For all Australian capital cities, access to public transport is correlated with proximity to CBDs, although public transport accessibility can actually be worse in areas close to the CBD — for example, if there is no nearby major rail or bus route. Almost all inner suburb residents in Australia's major capital cities (96 per cent) live within walking distance of medium-to-high frequency public transport,⁵¹ while only 71 per cent and 44 per cent of those residing in middle and outer suburbs are within walking distance (Infrastructure Australia 2018, p. 26). Poor access to public transport can contribute to geographical inequity and requires car ownership (alongside associated purchase and maintenance costs), where some households could otherwise have lower transport costs. Notably, low-income households with less access to public transport tend to have higher car ownership rates than their low-income counterparts who are well-served by public transport. For example, in Melbourne, 32 per cent of households in the lowest quartile of the income distribution living in Outer Melbourne owned two or more cars, compared with 23 per cent living in Middle Melbourne and 7 per cent in Inner Melbourne (Currie, Delbosc and Pavkova 2018, p. 13). While such households often have favourable views of car ownership, it comes at a significant cost (Currie, Delbosc and Pavkova 2018, p. 3). For example, in Queensland, the average annual cost of operating a light car is about \$8600 (RACQ 2021).

The distribution of public transport supply can be quantified in similar ways to income and wealth by measuring the share of transport supply available to varying shares of the population. For example, the Gini coefficient for public transport supply in Melbourne is 0.68 (Delbosc and Currie 2011, p. 1255), compared with 0.62 in Sydney and 0.53 in Perth — implying that public transport is more evenly distributed in the latter two cities (Xia et al. 2016, p. 216).

In many Australian cities, being close to public transport is also linked to socio-economic advantage. One measure of relative disadvantage is the Index of Relative Socio-Economic Advantage and Disadvantage (IRSAD) which ranks areas based on a weighted sum of various indicators of advantage and disadvantage, such as unemployment, income, educational attainment, and crowding in housing (ABS 2018b). In Melbourne and Brisbane, the share of the population living within walking distance of public transport increases with IRSAD quintiles, while in Sydney, Adelaide and Perth the lowest and highest IRSAD quintiles tended to have the lowest share of the quintile population living within walking distance of public transport, forming an inverted U-shaped pattern (figure 6.10). Across all five cities, the share of residents and jobs accessible through a 30-minute public transport trip tends to be lowest for the lowest IRSAD quintile but shows no strong income pattern otherwise.

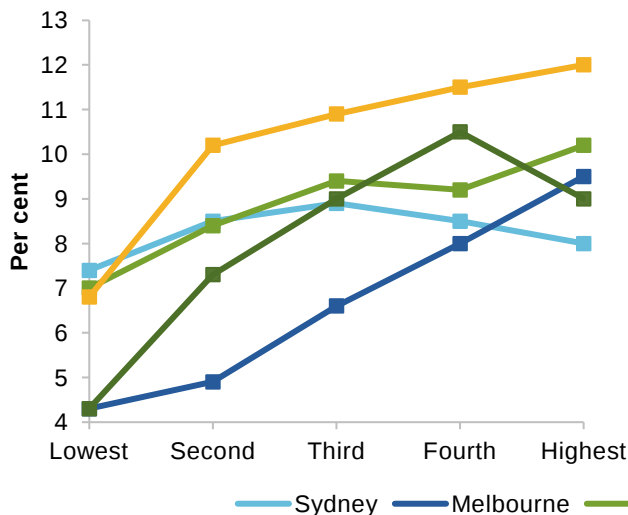
Renters of low-cost housing are less likely to live in areas with good public transport access. An examination of private rental stock in Melbourne and Sydney found that in comparison to all flats and houses available for rent, low-cost flats and houses (defined as having rents at least 20 per cent below the median price for a property of comparable type and bedroom size) are more likely to be located in areas of low public transport accessibility (Burke et al. 2014, p. 26), with public transport conferring greater property prices.

Accordingly, while governments can seek to make public transport fares more affordable, behind the scenes, barriers to accessibility undermine their purpose.

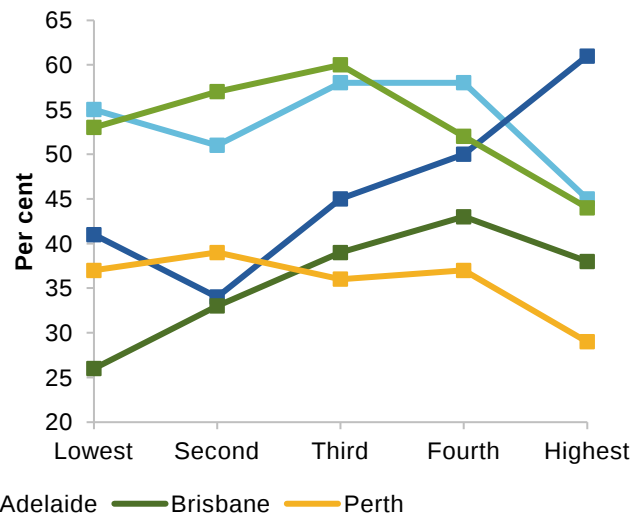
⁵¹ Infrastructure Australia defines major capital cities as Sydney, Melbourne, Brisbane, Adelaide and Perth, as they have a population of more than a million people. Access to medium to high frequency public transport is satisfied where a resident lives within 800 metres of a train station or within 400 metres of any other public transport service, where there are at least four services during the morning peak.

Figure 6.10 – Households in disadvantaged areas generally have relatively low access to public transport

Share of population and jobs accessible by a 30-minute public transport trip



Share of households in IRSAD quintile with access to medium-to-high frequency public transport



Source: Scheurer et al (2017), table 2: Overview of residential network coverage and average 30-minute contour catchment.

6.2 Public transport affordability

In addition to being accessible, to fulfill its social function public transport must be priced so that people on low incomes can still afford to use it for the purposes most valuable to them. This is closely linked with broader expectations around accessibility, namely that there should be a set of ‘social safety net public transport service levels’ so that most people (not just those with some disability) can access most of the things they might wish to do, most of the time (Stanley and Stanley 2015, p. 427).

In recent years, State and Territory Governments have tended to avoid large public transport fare increases in the name of affordability. Indeed, some have reformed fare structures to effectively cut fares for many people for this reason (box 6.1). The impact of the COVID-19 lockdowns on household finances and declining public transport patronage also led to a decline in real fares in 2020, with some states introducing off-peak discounts to reduce crowding and lower fares to encourage users to come back to public transport.

Affordability is considered by state-specific regulatory and advisory public transport bodies (where such bodies exist) alongside transport ministers, who have final decision-making powers over fares. In Queensland, the independent Public Transport Fares Advisory Panel, which provides confidential advice to the Minister for Main Roads and Transport on fare-setting decisions, must consider ‘community views on the affordability and fairness of public transport fares’ and ‘the economic, social and environmental benefits of greater public transport use’, alongside costs to public transport users and taxpayers (TMR 2019). In New South Wales, under the *Passenger Transport Act (2014)*, IPART must consider ‘the protection of consumers from abuses of monopoly power in terms of prices, pricing policies and standards of service’ and ‘the social impact of the determination or recommendation’. In its latest fare review, IPART said:

Access to transport at an affordable price is a necessary part of a well-functioning society. As a result, one of our objectives for the review is to ensure that public transport fares are affordable. (IPART 2020a, p. 1)

Box 6.1 – Affordability is highlighted in changes to fare policies

Media statements by state governments announcing changes to fares often emphasise that decisions have been made with a view to maintaining affordability and low fares:

The \$50 Opal weekly travel cap will take effect on Monday, saving tens of thousands of regular public transport users up to \$686 a year. Premier Gladys Berejiklian said the decision to slash the current cap by around 20 per cent will help to ease cost of living pressures for around 55,000 train, bus, ferry, metro and light rail customers. (NSW Government 2019)

The Department of Transport has today announced the lowest increase to public transport fares since 2010. From 1 January 2020, public transport fares will increase by 1.7 per cent on average in line with the Consumer Price Index (CPI). (PTV 2019)

There will be no increase in Transperth or Transwa fares in 2021-22, benefiting those in metropolitan Perth and regional areas. The McGowan Government will also deliver its election commitment for a two zone fare cap on Transperth fares, beginning on January 1, 2022, saving some households up to \$8.20 per one-way fare for every trip. (Government of Western Australia 2021)

Achieving affordability need not entail low prices for all, and indeed one of the challenges for transport pricing is how to target price discounts at those who most need them (section 6.4). But a starting point for consideration of that issue is the general affordability of public transport.

People's views on the relative barriers posed by prices suggest they play a small role. For example, a survey of university students and staff in Queensland using public transport found about 14 per cent of respondents regarded cost as a barrier to use (Wang and Liu 2015, p. 10). Very few people do not take public transport because the fares are too high. A 2009 ABS survey found that 1.9 per cent of respondents did not take public transport to work or study due to 'cost considerations', with no significant difference across jurisdictions (ABS 2009). This had risen to 2.7 per cent by 2012 (ABS 2012), and was fractionally higher for Queensland (4.5 per cent) and NSW (3.2 per cent). While these are dated results, real prices have scarcely moved in the subsequent years, so it seems unlikely that a new survey would tell a different story.

Quantitative measures of the financial burden of fares provides another perspective. One intuitively-appealing benchmark is the travel costs of one person paying the full adult fare traveling to and from the CBD five times a week where their home is in a middle-ring or outer suburb (AAA 2021). According to this measure, the average weekly public transport cost in Australian capital cities is about \$41 per week, being highest in Perth and Brisbane after accounting for daily and weekly caps on fares (table 6.5). For full-time workers, public transport fares comprise a small share of pre-tax labour earnings. The relative costs are significantly higher for people working full time on the minimum wage, reaching a high of more than 8 per cent of the minimum wage in Perth. In other scenarios, including for part-time workers working over several days of the week, transport fares as a share of wages were still well below 10 per cent.

The affordability measures are more meaningful if they could be compared against a threshold for affordability. While any threshold is arbitrary, one that is commonly used considers a ratio exceeding

15 per cent as unaffordable (City Futures Research Centre and Astrolabe Group 2019, p. 36). In no plausible scenario in Australian cities is the 15 per cent threshold exceeded for people taking public transport.⁵²

People's varying incomes and circumstances mean that the metrics in table 6.5 are relatively crude indicators of affordability. Many people who are on social welfare payments are eligible for concessional fares, travel at times when fares are lower, and travel less frequently than assumed for the benchmark service, so while their incomes may be lower than most wage earners, the ratio of fares to income will often still be relatively low. On the other hand, such people may not be able to afford discounted travel passes by purchasing monthly and yearly tickets upfront. Moreover, personal income is not always the best measure of available resources. At the household level, there may be several people supported by just one wage, though all need to travel.

Table 6.5 – Affordability of weekly public transport commuting

	Weekly adult fares	Ratio to weekly National Minimum Wage	Ratio to average weekly earnings
	\$	%	%
Sydney	50.00	6.5	2.8
Melbourne	45.00	5.8	2.6
Brisbane	56.52	7.3	3.4
Adelaide	38.40	5.0	2.4
Perth	62.10	8.0	3.3
Hobart	28.00	3.6	1.8
Darwin	20.00	2.6	1.2
Canberra	29.72	3.8	1.6

a. The minimum wage is the national minimum wage. Average weekly earnings are ordinary full time earnings per person for the corresponding state/territory. The suburb of reference chosen for each city by SGS Economics are Penrith (50 km from Sydney), Glenroy (13 km from Melbourne), Beenleigh (32 km from Brisbane), Armadale (38 km from Perth), Woodville (8 km from Adelaide), Glenorchy (7 km from Hobart), Wagaman (10 km from Darwin) and Franklin (4 km from Canberra) where distances are straight-line distances.

Source: Australian Automobile Association 2021, *Transport Affordability Index Q2 2021*; ABS 2021, *Average Weekly Earnings, Australia*, Cat. no. 6302.0.

A more subtle concern about the pressures of affordability is that fares for commuters comprise a fixed cost of having a job, acting like a flat tax on labour returns. This is most problematic for people on low wages, particularly those who spread part-time or casual hours over multiple days. For these people, the affordability rate is towards the higher end shown in table 6.5. The implication of this is that for any working day, the implicit tax per hour declines with hours worked on that day (which should encourage more hours), but that the fixed costs may discourage some from supplying labour at all (especially short shifts). The evidence suggests that higher commuting duration (which also acts as a fixed cost) increases hours worked by those who stay in the labour market, but modestly decreases labour participation for females (Carta and Philippis 2018; Farre, Jofre-Monseny and Torrecillas 2020; Gimenez-Nadal and Molina 2014).

The overall labour market effects of public transport affordability do not appear to be large, reflecting a wide range of factors, not least that the costs of private transport are a much bigger barrier and that most people

⁵² Moreover, at the global level, Australian public transport networks rank in the top half of affordability of included international cities when examining the time for a minimum wage earner to earn the cheapest adult fare (NineSquared 2021).

do not take public transport to work. Moreover, only a minority fall into the most at-risk group — minimum wage employees working limited hours over three or four days.⁵³ More so than the fare, lengthy travel times or long distances to public transport stops/stations could impose barriers to labour market participation that fall disproportionately on people in this group. Finally, more recently, the increased long-term potential for more flexible work (including working from home) arising from the COVID-19 disruption to working patterns will also insulate some workers from any labour supply effects of transport fares. As fares rise, they could adjust their travel and working patterns where employers permit this (PC 2021b, pp. 81–82).⁵⁴

Public transport is also more affordable than private transport. The average weekly costs of car ownership — including purchase, insurance, fuel and maintenance — was about \$190 a week in 2015-16 (ABS 2017), far higher than public transport fares in any Australian capital city. Expenditure on private motor vehicle transport and essential services have much bigger budgetary effects for low-income households than public transport. For example, total motor vehicle expenditure (purchase, fuel, maintenance, parking) are more than 30 times greater than public transport spending for the lowest-income households (figure 6.11).⁵⁵

Equally, public transport expenditure is a fraction of discretionary expenditure, comprising about 1.3 per cent for the lowest income quintile and 1.1 per cent for the highest.⁵⁶ Total weekly discretionary spending for the lowest income quintile group was about \$207 in 2015-16, which means that at fare levels applying at that time, even regular users of public transport in this group would have some scope to compensate for an increase in the price of public transport through lower discretionary spending — something that would be far more difficult for utility services.

However, fares may be unaffordable for a sub-group of users of public transport or deter some from making trips, particularly those experiencing disadvantage. Such users may not be eligible for concession fares, or if eligible, still find that fares pose a financial burden where these users are under severe financial hardship. As such, addressing affordability for these users is important in improving social inclusion through travel.

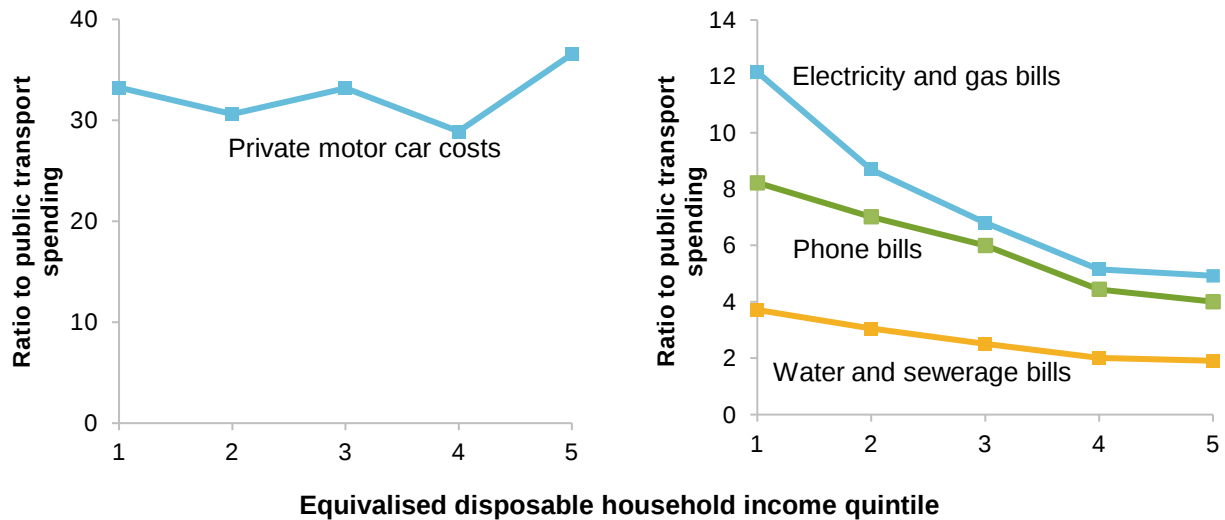
⁵³ As a proxy, where mode of travel is known, income earners with \$1 to 21 799 annual personal income using public transport and working more than 24 hours a week account for 0.18 per cent of persons working (based on the ABS, *Census of Population and Housing 2016*, TableBuilder).

⁵⁴ This capacity is currently greatest for higher-income more-educated people and so often not an option for the groups of people at whom distributional policies are most targeted, however, that may change for some groups for whom the costs of commuting are primarily non-pecuniary and so high as to preclude labour supply at all, such as the difficulties faced by someone with a disability. The issues arising from such costs is assessed in section 6.3.

⁵⁵ When only examining households who spend money on public transport, the ratio of spending on private motor costs to public transport is between 4.8 to 10.6, generally increasing with income quintile. The ratio of spending on utilities compared with public transport ranges from 1.5 to 2 for electricity and gas bills, 0.6 to 0.8 for phone bills and from 1.4 to 1.8 on water and sewerage bills. The ratio of spending for these three utilities was highest for households belonging to the second quintile.

⁵⁶ Based on classifying the detailed expenditure items into discretionary and non-discretionary items at the nine-digit level in the *ABS Household Expenditure Survey, 2015-16*, drawing on, but refining the approach used by Croxon et al. (2020).

Figure 6.11 – Other essential expenditures are multiples of public transport spending, particularly for low-income households



Source: ABS 2017, *Household Expenditure Survey, Australia: Summary of Results, 2015-16*, Cat. no. 6530.0. Public transport and social inclusion

Social exclusion is a multi-dimensional concept that relates to the inability of individuals to participate or engage in key economic, social and political activities (McLachlan, Gilfillan and Gordon 2013, pp. 72–73). It is a broader measure than income poverty, reflecting the varying factors that make a difference to people's wellbeing — for example, having a job and steady income may be more important for people of working age, while retired people's wellbeing may be more dependent on their level of community involvement and the social support available to them (McLachlan, Gilfillan and Gordon 2013, p. 90). Social exclusion is strongly associated with mental-ill health (PC 2020a, p. 357).

Most people have the capabilities and resources to participate in mainstream society. However, a lack of mobility can combine with urban design and the location of essential services to exclude some people.

Social exclusion tends to become self-reinforcing when the only affordable living locations are those with the poorest infrastructure, services and job opportunities. Thus, social exclusion is in large part an issue of public policy and planning for the availability of the means for people to be included through the provision of infrastructure and services. It is an issue of social justice and improving society as a whole for all people. (Stanley and Stanley 2021, p. 368)

Some people rely on public transport for most of their travel. These 'captive riders' have few or no other viable options that meet important travel needs, in contrast to 'choice users' of public transport who have access to other transport options if they were not to use public transport (Krizek and El-Geneidy 2007). In general, lower-income and disadvantaged groups — the very old (box 6.2), younger Australian adults, the unemployed and people not in the labour force — are less likely to hold a driver's license or own a car (Loader 2019b, 2021; Wilkins and Lass 2018, pp. 133–136). In 2018, about 15 per cent of the total population aged over 16 years did not hold a car driver's license (ABS 2020a; BITRE 2019b).

Box 6.2 – Public transport for seniors

Mobility improves seniors' wellbeing by maintaining their sense of independence and feeling of connection to society — for seniors, having favourable perceptions of one's local transport systems has been found to be correlated with social inclusion (He et al. 2020).

The public transport mode share for seniors varies by city, although private transport is still the overwhelmingly dominant form of getting around in Australia's cities. Whereas about 20 per cent of Australians aged 18-34 years old used public transport on all or most days before COVID-19 struck, this was 3.4 per cent for those aged 65 or more years. Nearly 40 per cent of older aged Australians never or almost never used public transport and a further 15 per cent once a year or less.⁵⁷ The numbers vary across the country and by mode. Using Victorian travel survey data, the total public transport mode share by seniors is about 12.5 per cent — with buses comprising 1.5 per cent, trams 2.5 per cent and trains 8.5 per cent (Fatima and Moridpour 2019, p. 3). In Greater Hobart, only 1.4 per cent of trips by people over 70 involved buses (Department of State Growth 2019). There is some evidence for Queensland that people older than 75 years tend to increase their use of public transport and reduce their use of private vehicles compared with those aged 65 to 74 (TMR 2012, p. 84), which is likely to reflect the lower license rates for the oldest Australians (Loader 2019b, 2021).

The typical travel patterns of seniors differ to those of working-age adults and of children. Public transport travel by seniors tends to be more dispersed throughout the day, rather than being clustered around a morning and afternoon peak (Du et al. 2019), which will reflect reduced work and education commitments. For example, in Perth, senior and pensioner ticket-holders comprised only 2.5 per cent of trips that alighted in the CBD during the morning peak (in comparison, 82 per cent of trips alighting in the CBD were made by standard ticket-holders).⁵⁸ The most common purposes for public transport travel are for shopping, social and recreation purposes and for personal business (Fatima and Moridpour 2019, p. 2; Mackett 2017).

As ticketing systems become more advanced, digital literacy and the accessibility of technology will be increasingly important for senior users. For example, when designing webpages to be more accessible to users, age-related conditions, including vision, physical ability, and hearing and cognitive ability will need to be considered (W3C Web Accessibility Initiative (WAI) 2021)

The accessibility needs of seniors also influence the design of physical public transport infrastructure. A survey of seniors who travelled by bus in Adelaide found infrastructure improvements would improve their experience. Seniors valued infrastructure improvements such as greater availability of buses that can tilt towards the passenger for easier boarding ('kneeling buses'), more priority seats and more accessible stop buzzers (Somenahalli and Taylor 2010). In the same survey, service frequency during the off-peak in weekdays and weekends was also perceived to be inadequate.

How public transport promotes social inclusion

Public transport can help people get to work, participate in community activities and keep in contact with their friends and family — the key features of social inclusion — especially for people who cannot drive or who

⁵⁷ ABS 2021, *Household Impacts of COVID-19 Survey, March 2021, Australia*, Cat. no. 4940.

⁵⁸ From unreleased Transperth data.

would experience financial stress if driving was their only form of transport. This is recognised by State and Territory Governments, who include it as one of their public transport objectives (DIPL 2016, p. 4; TfNSW 2019a, p. 3; TMR 2020a, p. 60; Victorian Government 2010). Travel to work, education or essential services like medical care may be considered highest priority for the general population, but for those at risk of social exclusion, even travel for social or recreational purposes is highly valuable.

The NSW Council of Social Services summarised the importance of public transport for social inclusion:

For people on low incomes and/or impacted by other forms of disadvantage such as unemployment, under-employment, disability, mental ill-health, lack of secure housing etc, public transport is an essential service that allows them to keep food on the table and improve their circumstances ... Residents should reasonably expect to have functional and affordable access to public transport regardless of their socioeconomic position. (NCOSS 2017, p. 2)

Through its ubiquity and affordability, public transport can reduce geographic isolation, and hence improve social engagement for all people. The mere act of taking public transport and being with other people can reduce social isolation (Currie and Stanley 2008, p. 541). Beyond its general social benefits, it can also promote better mental health (PC 2020a, pp. 390–391). For example, in England, issuing free bus passes to seniors increased their public transport use, which was associated with reduced symptoms of depression, perceptions of loneliness and increased participation in social activities (Reinhard et al. 2018).

Work is a major contributor to social inclusion, and better public transport can help more people get to work. For example, there is a positive association between public transport accessibility and employment probability for people with lower levels of education (Bastiaanssen, Johnson and Lucas 2020, p. 616, 2021, pp. 17–18). One English study found that reducing bus travel times by 10 per cent was associated with (all else equal) a 0.13-0.3 per cent increase in employment for an area, with the greatest impacts in denser urban areas (Johnson, Ercolani and Mackie 2017, p. 6). Such an effect will ultimately be limited by the nature of the pool of non-employed labour and the other structural determinants of labour supply. It is unlikely, therefore, that doubling the speed of public transport in an area would increase employment by 1.3 to 3 per cent.

Public transport can promote social inclusion by increasing its availability, accessibility, affordability and acceptability (Passenger Transport Executive Group 2010). Without addressing all four aspects, some people may find services difficult to use.

- Availability means services are within proximity of users and service coverage and frequency are conducive to travel needs.
- Accessibility means infrastructure design (for vehicles, stops, stations and nearby walking routes and information provision) does not impede public transport use.
- Affordability means fares are not priced excessively high.
- Acceptability means users perceive public transport to be a quality transport option (including safety and reliability).

Fares are key to affordability, while availability, accessibility and acceptability are different aspects of service quality and service coverage.

The role of fares

Low income is a common contributor towards social exclusion, so if public transport is to be effective in reducing the risk of social exclusion then fares need to be affordable (Stanley and Stanley 2021, p. 376). All States and Territories consider fare affordability generally (section 6.2) and use concession fares to make public transport more affordable for certain groups (section 6.4).

Even with significant fare discounts, the overall ‘cost’ of a public transport trip can be high for a person with disability when the difficulties of accessing and using services are taken into account. For example, one study estimated that the whole of journey cost for a wheelchair user was about 60 per cent higher than for other passengers (Wang and Crovato 2017, p. 15).

Availability, accessibility and acceptability of public transport

Concessionary travel and fare discounts are only useful if services are available (Gates et al. 2019, p. 35; box 6.3). Public transport availability and accessibility can be poor in many parts of Australian capital cities (section 6.1). Public transport may not go where people want it to, or when, or it may be difficult to use or get to (Social Exclusion Unit 2003, p. 24).

Box 6.3 – How availability promotes social inclusion

Governments determine the location, capacity and frequency of public transport services based on their competing goals of maximising the use of services (*patronage*) and wide access (*coverage*).⁵⁹ The first goal maximises the economic value of public transport and increases fare recovery. The second is principally aimed at social inclusion even if it entails low frequency services with little actual use. Social inclusion objectives mainly centre on adequate coverage, but may also be relevant to patronage objectives — such as providing commuting services to people in urban fringe growth areas.

Low service frequency increases the time costs associated with public transport travel because of additional waiting times. Where patronage levels are sufficiently high, low service frequencies can also increase the discomfort associated with overcrowding and make it hard to find a seat, which can significantly affect people with mobility restrictions. In some cities, users with low incomes comprise a larger percentage of off-peak public transport users, such as in Melbourne (figure 2.7 and Infrastructure Victoria (2020a)). Improvements to off-peak service frequencies reduce waiting times for existing public transport users with low incomes. Low service frequencies may also lead to a ‘death spiral’ that discourages public transport use (Infrastructure Australia 2018, p. 18), especially for services operated for social inclusion and coverage purposes. Where low service frequencies result from low patronage levels (comparable to the scale effect where strong patronage induces additional service provision), there are lower cost recovery ratios, as costs are dispersed over fewer passengers, which can reduce the willingness to fund service improvements that may otherwise improve patronage, as such, patronage remains low.

The optimal service frequency would depend on the net social benefit of travel on those routes, taking into account that the budgets that fund them either entail higher taxes or foregone spending elsewhere. The value of public transport for any given people at risk of social exclusion is likely to be higher than an average value for other passengers.

⁵⁹ For example, Canberra sets a ‘coverage target’ of 90% of the population (MRCagney 2015a, p. 100). In Victoria, one planning objective is for every home within urban area to have direct access to a Principal or Major Activity Centre by public transport, ideally with a maximum travel time of 30 minutes without changing vehicles (Department of Transport 2013, p. 11).

Availability and accessibility may be more difficult for people with disability or mobility restrictions, including the elderly. About a quarter of people with disability avoided public transport due to their disability, while almost a third had difficulty or an inability to use public transport (ABS 2019b). Major factors contributing to difficulty using public transport included getting to stops or stations (9.2 per cent), ingress and egress of vehicles due to steps (12.7 per cent) and doors (4.6 per cent) and lack of seating or difficulty standing (6.4 per cent).

Accessible public transport is necessary to avoid discrimination against people with disability. Equal access to the physical environment, transportation and other facilities and services is viewed as a pre-requisite for people with disability to live independently, participate fully in all aspects of life and have unrestricted enjoyment of their human rights. Governments and public transport operators are bound by law to provide accessible public transport for people with disability. The *Disability Standards for Accessible Public Transport 2002* (Cth) and the *Disability Discrimination Act 1992* (Cth) require equivalent access to transport for people with disability. Operators and providers can vary the equipment or facilities that give access to public transport for people with disability, so long as they maintain an equivalent standard of amenity, availability, comfort, convenience, dignity, price and safety.

Some governments are at risk of not meeting their obligations for accessible public transport. For example, for Melbourne's trams to be considered fully accessible, the trams need to have a low floor (i.e. have no steps) and the tram stop needs to be raised to provide level access. The Victorian Auditor General's Office found that in 2018-19 only 15 per cent of Melbourne's trams services had both low floors and level access stops (VAGO 2020, p. 30). 12 tram routes had no services with a low-floor tram at a level-access stop. Even on the 11 routes with low-floor trams and level access stops, a person with mobility restrictions may need to wait longer than other passengers for a low-floor tram. On the worst routes, on a typical day, a person may be waiting an additional 16 minutes for a low-floor tram, while on a bad day they could be waiting an additional 61 minutes (VAGO 2020, p. 34). The Victorian Auditor General's Office warned that 'noncompliance poses a financial risk for the state due to possible legal rulings against it for not meeting legislative requirements' (VAGO 2020, p. 1).

In addition to conventional measures of quality and convenience, the *perceived* accessibility of public transport (its 'acceptability', box 6.4) can also play a part in social inclusion (Lattman, Friman and Olsson 2016). This includes impressions of service quality (such as frequency) and safety. Safety itself can be objectively high, but impressions of it, low (Currie, Delbosc and Mahmoud 2010).

Box 6.4 – Acceptable public transport

For public transport to be effective in promoting social inclusion, potential users need to see it is an acceptable option for their transport needs. That is, there are basic expectations of public transport, that go beyond service availability and service frequency to safety, cleanliness (including in supporting facilities, like toilets in stations) and disability access.

Certain users — such as women and seniors — are more likely to report that they feel less safe around public transport. For instance, a 2019 survey of 500 university students in Melbourne found that concerns about safety were a significant driver of public transport use (or avoidance):

A large proportion of female students report a climate of fear on public transport. A little less than half (45.1 per cent) of female students report feeling 'rarely' or 'never' safe on public transport after dark, as compared to 11.3 per cent of men. A similar proportion of women (58.9 per cent) say they use a plethora of behaviours (from avoiding certain lines and stops, to ensuring they are met at a stop, to

Box 6.4 – Acceptable public transport

constant alertness) to mitigate their risk of victimisation. A little less than half (45.4 per cent) of female students report fear of victimisation as a reason keeping them from using public transport.
(Whitzman, Marathe and Thompson 2019, p. 2)

Fare reductions would have a negligible impact as an inducement for travel when safety and other high-priority needs are most salient for people (and indeed, the fare levels that might make a difference would be negative). The measures that improve acceptability are direct, and include better lighting and visibility, cleaner stations and the presence of more customers and staff to allay concerns (Cozens et al. 2004, p. 29).

6.3 Addressing equity and affordability through fares**Balancing equity and efficiency**

Social marginal cost pricing is a good efficiency benchmark for public transport pricing (chapter 2), but does not intrinsically generate vertically equitable or inequitable outcomes for users. Both equity and efficiency objectives are present in legislation governing public transport in states and territories. For example, in South Australia, the *Passenger Transport Act 1994* (SA) established the creation of a public transport network which among other objectives, ‘promotes social justice’ and ‘efficiently uses physical and financial resources’. As such, policymakers need to make judgements on the weight of equity and efficiency objectives during the fare setting process. An example of this balancing act is during IPART’s reviews of Opal fares, where IPART is obliged to consider factors specified in the *Passenger Transport Act 2014* (NSW), which included social impact and the cost of services. The final determination is then made holistically by IPART after considering economic modelling and analysis (including outputs from the social marginal cost pricing model) and views from stakeholder consultation.

Whether much balancing is needed depends on the consequences of social marginal cost pricing. Fares based on social marginal costs will involve differential pricing by a combination of mode, distance and time (peak and off-peak). Whether, on average, social marginal cost pricing benefits low-income users and other social groups depends on travel patterns — that is, average propensities to travel on different public transport modes, by times of day and across different distances — as well as the level of fares specified by social marginal cost pricing.

Infrastructure Victoria, in their *Fair Move* report, considered that the equity and efficiency objectives of its reform directions were well-aligned. Under Infrastructure Victoria’s recommendation of modal and peak pricing (but not kilometre-based pricing on user comprehension grounds) households on the lowest incomes would pay 26 per cent less for fares on average (IV 2020, p. 3). This is because in Melbourne, low-income users comprise a larger share of bus users and off-peak users (section 6.1), who would stand to have their fares reduced, and a smaller share of peak train users, where fares would stand to be raised.

Results from section 6.1 suggest that on average:

- modal pricing would be consistent with vertical equity in capital cities with train networks, except for Adelaide
- peak pricing would not be vertically inequitable
- distance-based pricing would not be vertically inequitable.

This suggests that to the equity considerations are not themselves arguments against pricing reforms.

Nevertheless, even if, on average, higher income users may pay a greater share of mode, distance and peak fares overall, some low-income users would also pay higher fares and would be unable to change their travel times, modes or distances to avoid higher fares. This is sometimes seen as unfair:

Thanks to decades of hands-off planning, Melbourne has a train system (plus a few express buses that act like trains) heavily oriented toward central-city commuting in peak hour, a well-used but geographically limited tram system, and a residualised bus system that caters to small populations in the suburbs who don't travel long distances and are prepared to work around infrequent services ... Train users have higher incomes on average, but this masks the fact a lot of lower-income people use trains too, including in peak hour. And it's those lower-income people who are less likely to be able to adjust their work hours and take advantage of discounted off-peak train fares. (PTUA 2020)

However, setting standard prices even below their currently highly subsidised levels to address the affordability concerns of particular groups of people is costly to state budgets, inefficient and inequitable as it equally benefits the overwhelming bulk of people not facing financial constraints. This suggests policies that better target those groups needing the most assistance, such as through concession policy or transfer payments.⁶⁰

Public transport users, including lower-income users, who face higher fares (for example, because they travel on peak train services) may also receive higher non-monetary benefits in the form of reduced crowding (Infrastructure Victoria 2020a, p. 66).



Finding 6.1

Reforms to make prices more efficient would generally also be consistent with equity goals

Reforms to pricing structures and levels of public transport are broadly consistent with both equity and efficiency.

- Governments have largely achieved their primary goal of making public transport affordable, and existing fares are a very low share of low-income households' budgets.
- Modal pricing that made buses less expensive than trains would tend to favour lower income users, who more frequently use buses.
- Peak use of transport largely serves employed people with higher incomes, justifying a significant margin between peak and off-peak pricing.

The availability, accessibility and frequency of public transport services can be more effective than lower fares in meeting the needs of public transport users, including those experiencing financial disadvantage. Service quality improvements will be at risk if governments do not stabilise mounting financial losses on public transport.

⁶⁰ For instance, a study of the potential effects of introducing social-marginal-cost-based pricing for public transport and roads in Belgium found that marginal cost pricing and higher social security benefits produced the highest benefits (Mayeres and Proost 2003).

Fare setting for concession fares

Concessions are the primary way that State and Territory Governments promote affordability for groups at risk of social exclusion. All States and Territories offer concession fares to children, students, seniors (age thresholds vary but generally apply for those over age 60 years and working less than full time) (table 6.6), pensioners (including disability pensioners), and veterans and their dependents. South Australia, Queensland and New South Wales do not offer concessions to people with a Commonwealth Health Care Card, although they do offer concessions to recipients of the major Centrelink Benefits (table 6.6).

Table 6.6 – Concession eligibility

	Age	Work hours	Health		Other Centrelink Payments
			Seniors	Care Card	
New South Wales	60+	<20 hours	No		Maximum rate of JobSeeker Payment, Youth Allowance (for job seekers), Parenting Payment (partnered), Partner Allowance, Widow Allowance, Exceptional Circumstances Relief Payment, Farm Household Allowance. Receiving any rate of Jobseeker (incapacitated), Youth Allowance (incapacitated), Special Benefit, Sickness Allowance
Victoria	60+	< 35 hours	Yes		na
Queensland	65+	<35 hours	Yes, if over 60 ^b		JobSeeker Payment, Youth Allowance (for job seekers)
Western Australia	63+ ^a	<25 hours	Yes		na
South Australia	60+	<20 hours	No		JobSeeker Payment, Youth Allowance, Community Development Project, New Enterprise Incentive Scheme, Partner Allowance, Special Benefit, Parenting Allowance, Widow Allowance, Farm Household Allowances
Tasmania	60+	<25 hours	Yes		na
Australian Capital Territory	60+	<20 hours	Yes		na
Northern Territory	60+	na	Yes		na

a. The qualifying age for the Seniors Card depends on one's birthdate, but is scheduled to be increased to 65 years by 1 July 2023. **b.** The default qualifying age for the Seniors Card in Queensland is 65 years, although people who are 60-64 years of age can be eligible for a Seniors Card if they hold a Health Care Card.

Concession fares vary across states and territories but are most commonly 50 per cent of the full fare (box 6.5). Non-full-fare ticketholders account for a significant share of patronage and in many jurisdictions, exceed that of full fare patronage (table 6.7).

Box 6.5 – Concession fares

Concession fares are generally half the full fare, but there are some notable exceptions.

- NSW seniors and pensioners fares are capped at \$2.50 per day, which is about 15 per cent of the adult full fare daily cap.
- Off-peak travel is free for seniors in South Australia, Western Australia and the ACT, and travel is free any time for seniors in the Northern Territory.
- Concession fares in the Northern Territory are about 30 per cent of the full fare.
- Commonwealth Health Care Card holders travel free in the ACT.
- All jurisdictions offer free travel to vision impaired people.

Department of Veterans' Affairs Gold Card holders with severe service-related impairments travel free in all States and Territories except South Australia.

Table 6.7 – Non-full-fare patronage in 2018-19

Jurisdiction ^a	Non-full-fare patronage (or boardings, if specified)	Total patronage	Share of total patronage (%)
Melbourne ^b	367,226,525	559,052,941	65.7
South East Queensland ^c	93,342,240	189,720,000	49.2
Adelaide	53,312,067	76,159,209	70.0
Perth ^d	40,485,580	78,466,194	51.6
Darwin ^e	2,911,520	3,634,357	80.1
Canberra ^f	12,406,914	20,170,932	61.5

a. Data not supplied for Sydney or Hobart. **b.** Melbourne figures are reported as number of trips **c.** South East Queensland figures are obtained by multiplying percentage of patronage attributed to concession card holders by total patronage **d.** Perth figures are reported as journeys (initial boardings only). Non-full-fare patronage is defined for the table as paid concession fare and joint ticketed event journeys, while total figures is non-full-fare patronage plus standard fare journeys. **e.** Darwin figures are reported as number of boardings. **f.** Canberra figures are reported as number of trips.

Source: Supplied by State and Territory transport departments.

The effectiveness of concession fares in promoting access to public transport depends on whether the eligibility criteria target the right people and the structure and level of the fares themselves.

Concessions should be targeted at those with lower ability to pay

The broad eligibility categories for concessions raise questions about the intended purpose of concession fares. The principal goal of State and Territory governments' concession policy is to assist people with less ability to pay for public transport and people who rely on public transport for their social participation. In practice, concession eligibility — and the generosity of concessions — varies by jurisdiction and some people with low (high) incomes are ineligible (eligible) for concessions. On this, Infrastructure Victoria said:

In most cases it is clear how each concession is related to improving equity or other social objectives; however a closer looks reveals inconsistencies. Inconsistent applications of

concessions runs the risk of creating confusion and inequity, resulting in individuals who could have benefitted from a concession missing out. (Infrastructure Victoria 2020b, p. 63)

In considering whether free travel should be granted to students and seniors (which it recommended against), the Victorian Legislative Council Economy and Infrastructure Committee was critical of the general approach of setting concessions too broadly:

In general, the majority of evidence received by the Committee suggests that if the Victorian Government wishes to assist people facing cost of living pressure, it should target those on a low income, not whole groups. The Committee believes that publicly funded concessions should only go to those who need them. When considering the application of across the board concessions to certain groups regardless of income, the Committee has reservations that some of the public funds would go to wealthy individuals who have less need of Government support. (Legislative Council Economy and Infrastructure Committee 2020, p. 63)

This rejection of concessions for all non-disadvantaged groups might miss some opportunities for efficient price discrimination, which could raise revenue and have flow on benefits for taxpayers in general. However, in practice, there is not strong evidence that there are many such groups (box 6.6).

Concession fare eligibility may not only be too broad, but also too narrow on other dimensions, as some people who have difficulty affording full fares are ineligible for concession fares. For example, the NSW Council of Social Service said it is 'inequitable that individuals with financial resources as limited as seniors and pensioners, namely those on Newstart [now called JobSeeker], do not get access to the same level of concessions' (NCOSS 2019, p. 8). Excluding seniors who are eligible for concession fares through holding a Seniors Card or through receiving the Aged Pension, the two groups of affected people are those who:

- receive means-tested transfer payments, but do not live in a state or territory where receipt of that specific payment confers eligibility for concession fares
- do not receive means-tested transfer payments, but still face some financial constraints, such as low-income workers.

Centrelink payments are subject to means testing (through income and/or asset testing) and are a good indicator of individuals with a low ability to pay for public transport. Most States and Territories, but not all, allow Centrelink recipients who have a Health Care Card to obtain concession fares (table 6.6). The Health Care Card is available to those receiving selected Centrelink payments (including Jobseeker and Youth Allowance) and/or the maximum rate of Family Tax Benefit A.⁶¹ There is also a Low Income Health Care Card, where eligibility is determined by an income test, with the exact limit depending on household composition.

IPART recommended expanding concession eligibility to holders of the Health Care Card in its fare review for 2020–2024, which it estimated would provide concession fares to up to 141 500 people. IPART estimated the additional cost of doing so would be about 0.6 to 1 per cent of existing fare revenue. IPART said that they considered that eligibility for a Health Care Card to be 'a good identifier for people who need access to discounted fares' (IPART 2020a, p. 8).

Some low-income workers who are ineligible for concession fares may still have little ability to pay for fares. From a consistency perspective, that suggests it might be desirable to extend concessional treatment to some social welfare recipients working limited hours, including those with the Low Income Health Care Card.

⁶¹ The full list of eligible Centrelink payments for receipt of a Commonwealth Health Care Card as of October 2021 includes ABSTUDY Living Allowance, Austudy, JobSeeker Payment, Partner Allowance, Parenting Payment (partnered), Special Benefit, Widow Allowance and Youth Allowance (Services Australia 2021).

Effective targeting of this kind could give government greater scope to re-structure fares that are consistent with efficiency and equity (such as higher peak fares — chapter 3).

It bears repeating that concessions should be the primary way that governments promote affordable public transport for vulnerable groups (rather than broad-based fare subsidies).

Box 6.6 – Sometimes it may pay to provide concessions to non-vulnerable users, but the evidence is thin

Concessions to non-disadvantaged groups may be a form of efficient price discrimination, by selecting prices that maximise the cost recovery from people with varying willingness to pay. Concessional pricing is common in many private markets. For instance, students and seniors pay lower prices at cinemas because they are more sensitive to ticket prices, and it is better to have seats filled than empty.

However, whether there are any groups for whom price discrimination alone is a strong basis for concessions in public transport is moot.

‘Full fare’ pricing for public transport is already highly subsidised given social marginal cost principles (such as addressing congestion externalities), so further discounts based on price discrimination may not be able to produce additional revenue.

Associated with this, the lower the price for a service, the lower the degree of price sensitivity of demand, and so the less likely that revenue will be increased by further price discounts.

Pricing already partly addresses price sensitivity of demand for some services without group concessions. For example, off-peak pricing discounts encourage demand spreading and is also consistent with the generally higher levels of price sensitivity outside of commuting periods.

There is little evidence about the price sensitivity by different groups of people (by age, income, wealth) that could be the basis for an evidence-based assessment of whether there are any group concessions that could be solely justified on price discrimination grounds. The capacity that many private businesses have for experimentation in prices and service types for optimal price discrimination is less applicable to public transport authorities given that such decisions can affect hundreds of thousands of customers and can add to price confusion. Small pilot pricing programs are harder to implement. Privacy concerns make it difficult for transport authorities to match price responsiveness to many personal and household traits.

Concessional fares that apply to non-disadvantaged people when transport is crowded would not generate additional revenue, but would displace people who valued travel at that time more highly. Worse, it might provide an impetus for additional costly investment that would be underutilised at other times. (However, if there is little demand by such concession-holders at crowded times, then it may still make sense to have a simple concession that applies across all periods, which has been the case for some concessions).



Finding 6.2

There is scope for better targeting of concessions

Concession fare eligibility could be better targeted in all jurisdictions.

Some people with low incomes pay full fares and some with high income or net wealth receive substantial fare discounts.

The most notable groups are seniors (for whom there is no means testing) and people on low incomes (either on Centrelink benefits or low-income workers).

State and Territory Governments should review public transport concession eligibility criteria to better target concessions to those who most need them.

Concession fare users can sometimes miss out on big discounts available to others

Governments have multiple ticket types that cap weekly or daily fares, provide discounts for card-based tickets over cash, and that give discounts for passes that cover different periods (such as the 14/28 day Adelaide metroCARD and the multiple options for Melbourne's myki passes). For any equivalent travel pattern, people eligible for concession fares either receive a discount (usually half the price of a non-concessionary fare) or pay nothing.

However, there are (rare) instances in which low frequency concession travellers will receive little or no fare reduction compared with frequent non-concession patrons.

For example, a non-concessional customer may pay less per trip than a concessional customer if their daily fare cap is reached. Such daily fare caps will rarely bind and may be justified on both marketing grounds and because any more than two trips in a day will probably involve non-peak travel, which has low marginal costs.

A potentially more significant issue arises from passes that provide 'all you can eat' travel over prolonged periods. For instance, the weekday maximum daily fare for a concession Melbourne myki money ticket is \$4.50. An annual full fare Melbourne myki pass costs \$1755 or as little as \$4.80 per day, if used every day. Under this scenario, the concession discount is only 6.25 per cent. If, however, the myki pass holder travelled 240 days per year (5 days a week for 48 weeks), then the daily fare would be \$7.31 and the concession discount would be about 38 per cent. Furthermore, some myki pass holders are eligible for 'commuter club' discounts of up to 10 per cent if they purchase their pass through their employer or associated organisation. If used every day the daily fare falls to \$4.30, which is *below* the concession fare (if used 240 days per year the concession discount falls to about 32 per cent). Myki passes are available for shorter durations, with a weekly pass being the shortest, although the cost of a weekly pass is the same as 5 daily fares (that is, it only represents a discount if the user were to also travel weekends). Of course, a person eligible for a concession could also purchase an even more discounted annual pass, but some would not have the cash to pay upfront, or would not have usage patterns that were sufficiently predictable to make this a useful option.

The rationales for the unlimited travel passes that give rise to these pricing anomalies are not strong. Discounts for avoiding traditional single trip paper tickets or cash on boarding make good sense given the transaction costs. However, while paper tickets are still issued by some jurisdictions, all customers can use transport-specific card-based systems (and increasingly credit cards) to pay for any combination of trip types or frequencies. So, the transaction costs of managing an infrequent card user over a frequent one are zero. Payments upfront for an annual pass increase revenue certainty for transport authorities, while also representing free finance, but sharing these savings with customers could justify only a small discount. It is

possible that the discounts could act as a form of price discrimination that allows higher fares to be charged for infrequent users (like tourists). But the desirability of such pricing is unclear given the diversity of people who use public transport irregularly. Most jurisdictions do not offer long-period passes. Infrastructure Victoria recommended that unlimited travel myki passes be discontinued (Infrastructure Victoria 2020a, p. 13).

An alternative approach would be to consider pricing options for customers who regularly use public transport, but with lower and less predictable frequency. This could benefit part-time workers and low-income users, while also covering workers with hybrid working arrangements (the number of which is likely to increase). For example, National Rail in the United Kingdom have created a 'Flexi season ticket', which offers return travel on trains for eight days over a twenty-eight day period, targeted at occasional commuters travelling between two to three days per week, while traditional unlimited travel season tickets still exist.

In its review of Opal fares for 2020–2024, IPART recommended that Opal discounts should be created for travel between three to four days, reflecting the fact that current discounts generally go to people travelling five days a week. Of the users that received frequency discounts (half-price travel after making eight trips in a week), 93 per cent travelled at least five days a week. Similarly, of those eligible for the weekly capped fare, 86 per cent travelled at least five days a week (IPART 2020c, p. 11). About 23 per cent of users travelled between three to four days per week (and 27 per cent travelled between one to two days per week), but more users are likely to travel on fewer numbers of days on public transport following the pandemic and changes to working arrangements.

Governments should investigate alternative ticketing for concession card holders so that they can more easily access usage discounts. For example, Victorian community groups and education providers can purchase in bulk discounted travel passes (of daily, weekly or monthly duration) for their clients and students at a price well below standard concession fares. The ticketholder is then able to access unlimited travel for the duration of the pass. (Governments might be reluctant to extend concession discounts because eligibility is not well targeted, but this is all the more reason to ensure eligibility is targeted properly and is not a reason not to provide discounts.)

Improving user comprehension and information provision, along with new ticketing systems, can help users pay the lowest fare. For example, more advanced account-based ticketing systems can automatically charge people the cheaper fare (finding 7.1). IPART noted the Opal Connect account-based system could be a flexible way to deliver discounts and suggested concession card holders could be able to access the discounts without the associated up-front fee (IPART 2020a, p. 13).



Finding 6.3

Fare discounts can disadvantage lower income users

Fare discounts that are based on travel volume may mean less frequent users of public transport, such as part-time workers, miss out. Likewise, fare discounts conditional on upfront fare payments may exclude public transport users who do not have the cashflow to buy such tickets.

Governments should investigate alternative ticketing products and technology that can improve the availability of fare discounts for concession card holders.

7. Technological progress and fares

Key points

- ✱ **Moving beyond card-based ticketing systems will change how passengers interact with fares and fare structures.**
 - Account-based ticketing can allow governments to implement more complex fare structures, 'best fare' mechanisms, or incentive structures based on travel credits. The latter would be particularly simple and useful to trial in jurisdictions with accounts-based systems, as shown by recent NSW trials of on-demand services.
 - The high fixed costs of ticketing upgrades suggests that jurisdictions with small patronage numbers should probably adopt these technologies later.
- ✱ **Apps that provide real-time information on crowding and fares could help smooth peak demand and improve behavioural responsiveness to fares.**
 - While timetables are well-integrated into travel apps, real-time location information is not available in all jurisdictions. Governments could also improve the salience of pricing in planning apps in order to better inform consumer choices.
 - Jurisdictions should consider higher functionality for trip planning apps, including the communication of real-time crowding information, as is currently available for Melbourne and Sydney.
- ✱ **Despite ongoing international trials, Mobility as a Service (MaaS) is as yet unproven as a model of service delivery. The benefits of MaaS largely depend on the extent to which it can shift commuters away from car use.**
 - Early Australian evidence suggests that subscription pricing is the most effective way to encourage MaaS take-up. However, subscription pricing generally does not provide incentives consistent with peak demand management and cost-based pricing. Achieving the full benefits of MaaS will require more sophisticated price- and subsidy-setting.
 - MaaS would not be a simple transition. It would require regulation of digital platforms and the transfer of data, which have not traditionally been a core task in public transport — there may be a role for a national regulatory framework.
- ✱ **Novel modes of transport will help resolve first and last mile issues, none more so than the (eventual) introduction of autonomous vehicle technology. Once the cost of autonomous vehicles is sufficiently low, it should reduce road congestion levels, but only if governments coordinate fare-setting, road pricing, regulation, and public provision.**

Australian cities will see significant increases in population, urban density and economic activity — pressures that will overtake the temporary stagnation of public transport patronage associated with the COVID-19 pandemic. A re-think of pricing for public transport and road use along the lines discussed in this report will help accommodate these pressures.

At the same time, some aspects of urban and public transport are likely to be significantly re-shaped by technological developments. On the one hand, technology will change what governments are able to do with pricing — for example, advanced ticketing systems and smartphone applications increase the effectiveness of pricing as a policy lever. On the other hand, the emergence of new modes and distribution models may change how public transport is conceived, the role of pricing, and the nature of pricing options.

7.1 Advanced ticketing and fare structures

Ticketing is the practical implementation of fares and one of the primary interfaces between passengers and public transport. The quality of ticketing systems contributes to the full ‘cost’ of public transport from a passenger’s perspective — both in terms of the convenience experienced (when making payments) and the effect of ticketing on travel times (through boarding and egress). It also has a bearing on the choice of fare structure.⁶² For all their potential benefits, the efficiency of investments in ticketing upgrades depends largely on the likely demand responses and considerable (fixed) costs.

Passengers’ heterogeneous preferences for ticketing

All Australian jurisdictions have well-established card-based ticketing, though with some differences in functionality. And while ticketing systems have become progressively more efficient, governments must consider how well such systems are suited to the heterogeneous population of passengers. For instance, paper ticketing and cash payments are the least efficient means of payment, though they remain in place in many Australian jurisdictions — in part due to concerns about the potential exclusion of those with less connection with the formal economy. In some cities, this trade-off is managed by allowing cash payment for off-peak services only (e.g. Sydney) while others have moved to permanently discontinue cash payments on boarding public transport (e.g. Melbourne and Canberra).

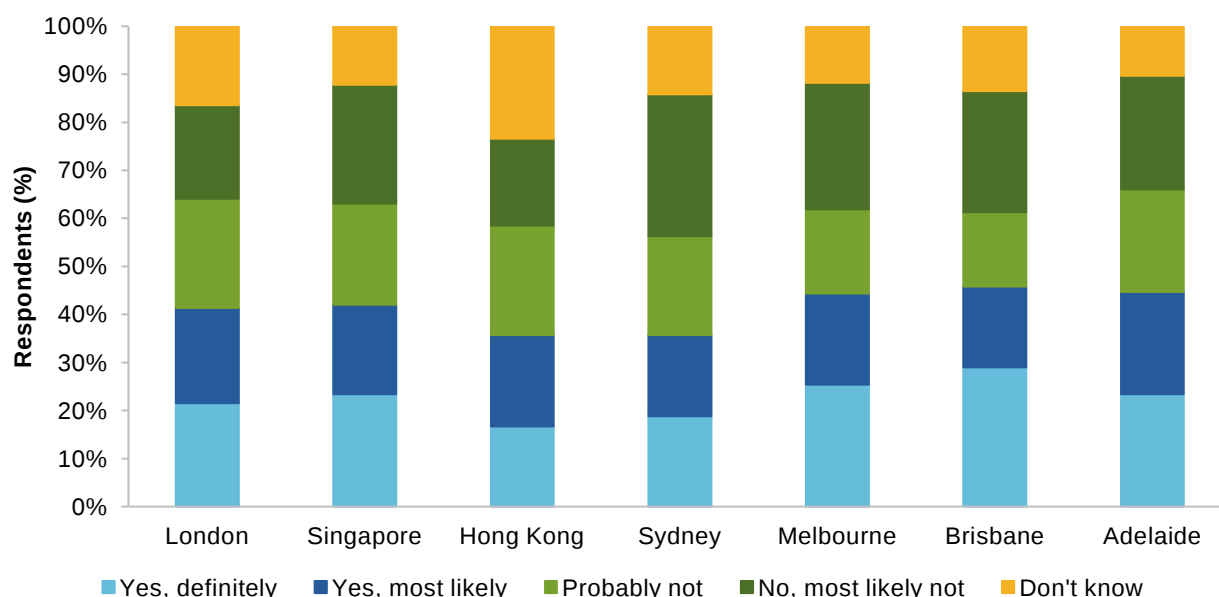
Preferences vary with regard to advanced ticketing solutions with, for example, significant resistance to the use of phone-based apps as a tool for payment, notwithstanding the widespread adoption of smartphones and general acceptance of apps for other purposes (figure 7.1). While it seems likely that paying via cash and paper tickets will soon disappear, the question for governments is how many ticketing systems can efficiently co-exist. The benefits of advanced ticketing rely on large-scale take-up, which requires them to be easy to use, accepted and offering functionality or other advantages that are not available to older ticketing systems.⁶³

⁶² Governments often simplify fare structures to facilitate the implementation of new ticketing technologies (Douglas 2009). In addition, each ticketing system presents technical limitations on the complexity of fare structures (UITP 2020). Distance-based pricing, for example, currently requires a tap-on tap-off functionality. Fare integration across modes requires ticketing systems to be integrated across modes.

⁶³ Many Australian jurisdictions give discounts to customers who adopt card-based technology over paper tickets (in part, because features like weekly caps and period-based passes must be card-based to function). For example, a single adult paper ticket for zone 1 travel in South East Queensland cost \$4.90 in 2021, while the *go* card price was \$3.37 (or more than 30 per cent less costly).

Figure 7.1 – Stated preferences for mobile payment

Survey responses on the question of whether people would like to pay for public transport using an app



Source: Moovit (2021).

Where ticketing changes are not universally applied, this limits the extent to which they can be linked with operational reforms. For instance, if all passengers were to shift to app-based ticketing, it would be feasible to switch the delivery of some services to a purely on-demand basis, rather than being forced to offer a mix of on-demand and ‘fixed-stop fixed-timetable’ services.

Accordingly, where advanced ticketing is optional, transport services need to operate in such a way that still meets the needs of non-adopters of the technology in the lowest cost way. This is relevant not only to ticketing but the use of apps and Mobility as a Service (MaaS) (discussed later in this chapter). A particular challenge is how to efficiently meet equity objectives for people who lack the confidence or capacity to use apps, or are without the financial resources for topping up a card, who do not own a mobile phone or have internet access, or do not have debit or credit cards. For example, in 2020, 23 per cent of adult Australians had not used an app in the last six months (ACMA 2020). In July 2019, an estimated 11 per cent of Australians aged 14 years or more did not own a smartphone (I&N 2019). Younger users of public transport will often not have devices and are prohibited from having credit cards. One solution is to still accept ‘old technology’ ticketing, but to provide pricing incentives to adopt more advanced ticketing. For example, single fares for a zone 1 travel in South East Queensland are about one third lower for go cards than paper tickets.

Significant potential benefits and costs

Australian jurisdictions have already achieved significant improvements over paper ticketing by implementing card-based systems.⁶⁴ Cities with multiple modes of public transport have already implemented integrated

⁶⁴ Card-based ticketing allows faster boarding and more convenient payment when compared with paper tickets. It allows integrated ticketing across multiple modes, which can improve journey times, flexibility and convenience for customers. While a causal relationship has not been established, the ITF (2020) noted that the introduction of integrated ticketing was

ticketing across modes and operators.⁶⁵ At the time of writing Tasmania is also in the process of developing a single consistent ticketing system across bus operators, as well as the trans-Derwent ferry service currently being trialled (Ferguson 2019).

More advanced ticketing options — particularly ‘account-based ticketing’⁶⁶ — would significantly change how passengers understand and interact with fares. Given that account-based systems involve the calculation of fares *after* the journey, this allows novel approaches to help passengers navigate fare structures and to provide more effective incentives. For example, ‘best fare finding rules’ automatically apply the best applicable fare for a passenger by navigating fare structures on their behalf and calculating any applicable discounts after the journey (Masabi 2019; UITP 2020). This requires passengers to trust the fare calculations undertaken by the ticketing system, as opposed to relying on more informed consumer choice (section 7.2). Some key implications for fares include:

- convenience for passengers, as they can leave the calculation of fares to their apps
- that governments would be able to implement more complex fare structures (if needed) without confusing passengers — although to the extent that fares are less salient, it may blunt incentives to choose the lowest-cost form of travel
- ensuring that people facing disadvantage (e.g. at risk of social exclusion) receive the best fare available — this could include awarding multi-use or longer-term discounts retrospectively, removing the disadvantage associated with liquidity constraints (chapter 6).

Account-based ticketing also enables the use of ‘travel credits’, which allows governments to provide various incentive structures for passengers. New South Wales has trialled an incentive program that provided additional travel credits to participants who made specified modal choices. This is effectively a form of individualised pricing (in the form of discounts) that is more easily achieved via accounts-based ticketing.

Travel credits could also play a role in strengthening operator incentives to improve the quality of passengers’ experiences. Operator performance is largely managed by contractual arrangements, which stipulate that service payments are partly contingent on meeting key performance indicators (box 7.1). Such systems are rarely linked to fares and often lack meaningful links with passengers’ perceptions of quality. Attempts to link fare levels and operators’ performance in the United Kingdom were largely abandoned due to problems with incentive design and implementation (box 7.2). However, where account-based ticketing exists, an option for governments would be to distribute travel credits to compensate passengers for their experience of poor performance. Such a system could, for example, directly compensate passengers who experienced late or absent services (as opposed to altering the overall fare level as was the case in the United Kingdom).

accompanied by an increase in public transport demand of 4 per cent over two years in Manchester and 33 per cent over 18 years in Paris.

⁶⁵ Integrated ticketing systems may also involve integrated tariffs, where common pricing structures exist across different transport modes and operators. While this too can improve convenience and modal integration, it has much wider implications for the efficiency of the network and is discussed more fully in chapter 4.

⁶⁶ Account-based ticketing is a fare-collection system in which payment records and proof of entitlement to travel are kept in a back-office server rather than on a card held by the passenger. The fare itself is calculated and billed after the trip is complete, while any card used to tap in and out of the system are used to identify the customer and link to their account (UITP 2020, p. 5).

Box 7.1 – Incentives for operator performance

An important aspect of franchising and contracting arrangements is to provide operators with incentives to deliver quality services — not simply cheaper ones. Incentive structures are often enforced against key performance indicators (KPI's). Reductions in service payments may occur when benchmarks are not met. For instance:

In 2019-20, the operator of the Sydney Metro Northwest received deductions from its service payments for all four operating quarters totalling \$448 000 for not meeting KPIs. The operator also received an availability and/or timeliness deduction from its service payments for 12 out of 12 months. The amount of the availability and timeliness deductions totalled \$2.0 million, accounting for 0.7 per cent of total service payments. (Audit Office of NSW, 2020, p. 6)

The strength of the incentive structures depends partly on enforcement and partly on the definition of the KPIs. In 2013, Hensher noted that a key aspect of this is the link between performance indicators and passengers' experiences of quality, claiming that:

... service quality as perceived by bus users, has in most instances been ignored in the definition of performance standards that are explicitly linked to cost efficiency — indeed there has been a very notable disconnect between the two elements of bus operations. (Hensher 2020b, p. 101)

Others argued that some performance indicators could be gamed — in violation of other contractual restrictions — where punctuality targets could be met by skipping stops or prematurely ending services (Donaldson 2017).

These challenges are common internationally. In the United Kingdom, one of the reforms put forward by the Williams-Shapps Plan for Rail was for a new central agency to implement 'Passenger Service Contracts' that provide stronger incentives for the delivery of quality as experienced by passengers (e.g. punctuality and safety) (Department for Transport, UK, 2021, p. 14).

Is advanced ticketing good value?

At the time of writing, several jurisdictions were in the process of pursuing upgrades to their ticketing systems (pers comms). Transport for NSW is trialling an account-based system called Opal Connect — largely for the use of On-Demand Bus Service fares and On-Demand Ferry Service Fares (TfNSW 2021a). Infrastructure Victoria has recommended using an account-based system, largely in order to allow a wider range of tokens to be used for validation (such as credit and debit cards) (Infrastructure Victoria 2020a).

The benefits of account-based ticketing systems would depend on the fare structures implemented in that jurisdiction. Moreover, estimating those benefits would require an understanding of the likely demand response (including take-up rates and usage patterns) and the implications for fare revenue and externalities. One complicating factor is MaaS, which requires advanced app-based ticketing and entails further potential benefits (which remain largely unproven) (section 7.3). However, unless more certainty can be established around MaaS, governments will likely need to consider more immediate costs and benefits when determining when to upgrade ticketing systems.

Box 7.2 – The UK experience of Fares Incentive Adjustment Payments

In the United Kingdom, an automatic link between commuter fares and train service performance was introduced in 1995. Known as the Fares Incentive Adjustment Payment (FIAP), it consisted of adjustments up to ± 2 per cent to the default annual increase in fares (RPI – 1 per cent), depending on whether operators' performance had improved or worsened in the preceding 12 months. However, the scheme was problematic in a number of ways.

FIAP involved a long time lag between the fares change and the related performance, and since it was based on relative performance, a performance improvement from bad to merely poor permitted a fares increase, whereas a worsening from excellent to merely good performance required a fares decrease. Almost all consultation responses from both train operators and passenger groups said that the FIAP automatic link between London commuter fares and performance has not worked well and should be abolished.

In addition, a performance-related fares adjustment will create inconsistency between [Strategic Rail Authority] and [Transport for London] fares policies. FIAP has sometimes required fares baskets to be reduced by RPI – 3%, when London Travelcard fares (which rise in line with inflation unless otherwise agreed with [Transport for London]) have been increased by RPI. Travelcards make up 70% of some operators' fares baskets, and these operators have had to make large reductions (over 20% in 1 year in some cases) in the non-Travelcard fares which they set in order to keep the total value of their fares basket within the regulatory cap. This meant that passengers using Travelcards saw little or no benefit from the FIAP fares adjustment while passengers using non-Travelcard rail-only tickets enjoyed a disproportionately large effect. (Smith 2004)

The Strategic Rail Authority noted that the policy had led to confusion and that passenger consultations were mostly in favour of its removal. The policy also had no additional incentive effects because operators were already held to account under their franchise agreements (Strategic Rail Authority, 2003, p. 6).

The FIAP was removed in January 2004. Since that time, the performance of rail operators has been regulated by incentives contained in operator contracts. Due to poor coordination and performance of private operators and public agencies, further reforms to the structure and regulation of the sector have been slated in the Williams-Shapps (2021) plan.

Source: Smith (2004); Strategic Rail Authority (2003).

The up-front investment is substantial. For example, the Queensland Government recently committed \$371.1 million over four years to upgrade the *go* card system (Queensland Government, 2021, p. 8). A further risk relates to unexpected cost increases that have affected large ticketing upgrades in the past. For instance, myki was expected to deliver benefits of between \$6.3 million and 10.8 million annually, but implementation problems dogged the rollout. The time taken to design and deliver myki increased from two to nine years and cost an additional \$550 million — more than 50 per cent above the original budget (VAGO 2015, p. ix).

These costs may have an impact on short-run marginal cost pricing depending on how ticketing upgrades and operation relate to capex and opex.⁶⁷ Given the large capital costs, the challenge facing governments is whether to augment traditional aspects of service quality such as service frequency (an important driver of patronage and equitable access) or to obtain the benefits of richer pricing and service bundling options, and better information about patronage.



Finding 7.1 **Investing in ticketing to improve pricing**

Account-based ticketing facilitates:

- improved convenience through the use of credit cards and/or smartphone applications in lieu of dedicated transport card media
- the use of more complex fare structures and ‘best fare’ technology to help match people to the fares that suit them
- the use of travel credits to create behavioural incentives for passengers and performance incentives for operators.

Given the fixed costs of advanced ticketing and that its benefits are more likely to arise in larger cities, major ticketing upgrades look less attractive for smaller jurisdictions in the medium run.

7.2 Improving informed consumer choice

The availability of information is relevant to passengers’ experiences of public transport quality. Timetables, routes, likely waiting and travel times, and fares are all communicated to passengers in some form or other, informing their travel plans and consumption decisions. The ease with which such information can be accessed and understood contributes to passengers’ convenience. Better coordination between passengers and timetabled services can reduce waiting times. In addition, informed user choice allows consumers to choose services that best meet their needs and preferences.

Informed user choice is often seen as a pivotal element in the efficient delivery of human services in markets with many competing suppliers, as empowered and informed users can drive the efficiency and quality of supply (PC 2016). The dynamics differ in public transport, where competition between operators is often confined to contract tendering, and governments tend to retain patronage risk. Still, the extent of *informed* choice affects how passengers react to changes in fares, service levels, or other aspects of quality, and therefore shapes the role of prices.

Informing passengers about routes, waiting times and crowding

The effectiveness of fares as a policy lever depends partly on their salience to passengers. While transparent publication of fares and the simplicity of fare structures contribute to greater salience, so too do passengers’ understanding of and response to fare information — which vary considerably (box 7.3). Smartphone apps can make information on fares and quality more salient, in ways that suit different consumers decision-making

⁶⁷ Governments can manage the costs of ticketing upgrades in different ways — most commonly as a mix of opex and capex, where the latter includes ticketing hardware and the former covers licensing, hosting, support and maintenance (UITP 2020, pp. 21–22). Other options include contracts that involve periodic payments, rental of services, or revenue-sharing.

processes. For instance, they can help customers to obtain 'best value' (i.e. the highest value-to-cost ratio); the highest quality of service regardless of price; or the lowest priced service (US Department of Transportation 2016).

Box 7.3 – Passengers take different approaches to fare information

Passengers vary in how they understand and use information on fare structures to plan their travel. One survey suggests that there are five archetypal consumer types (SGS Economics & Planning 2020), comprising those who are:

- *Problem solvers* — a large number of survey participants attempted to calculate the correct value of the fare to the cent, using a mathematical process to determine the cheapest option.
- *Motivated by a single fare element* — some participants assumed that one particular fare element would make a large difference to the total fare. They simplified their calculation by ignoring other parts of the fare structure (for example, assuming that off-peak is always cheaper, or that trams were always cheaper than trains).
- *Motivated by feeling* — some survey participants made their decisions according to what they assumed would be cheaper, without consulting the fare structure at all.
- *Those who filter out irrelevant information* — some participants ruled out what they perceived to be irrelevant information. For example, participants anticipated that some fare elements (such as the base fare) would be consistent across travel options, and so could be ignored in their comparison. Other participants perceived that an aspect of the fare would be trivial to the overall cost. These participants ignored seemingly trivial elements (such as distance) due to the 'overwhelming complexity' of the fare structure.
- *Those who filter out hard to understand information* — some participants completely ignored parts of the fare that they perceived would be most difficult to calculate (such as distance). They assumed that other elements would be sufficient for the calculation.

Like all frameworks that place people into pigeonholes, this probably misses other ways in which people think about price information and ignores that they can straddle more than one category. Nevertheless, the surveys of behaviour reveal distinct differences in how people interpret fare information, which is relevant to what and how information is provided.

All Australian jurisdictions now publish timetabling data in a common format (General Transit Feed Specification) that can be used by applications via the Google Maps API, while New South Wales and Victoria also provide their own APIs. Since 2008, transport data for Australian capital cities have progressively been made available on Google Maps, allowing comparisons with private and active modes.⁶⁸ This helps people consider the cost of fares alongside waiting times for the next service, as well as travel times and walking distances for alternative modes.

Fare information is notably absent from Google Maps for Australian jurisdictions — prices are only displayed for rideshare trips. Fare information is more complicated to display than travel times unless people are willing

⁶⁸ Public transport timetabling information has been progressively made available on Google Maps for Australian cities, including in Adelaide and Perth since 2008, Canberra and Cairns since 2009, Tasmania since 2010, Sydney since 2012, Brisbane since 2013 and Melbourne in 2016 (Ho 2010; Hutchinson 2008; Kidman 2012; Premier of Victoria 2016; Salek 2008; TfNSW 2012).

to divulge some of their personal details, such as eligibility for concessions, though nothing would stop this functionality being added. (Several State and Territory Governments provide trip-planning apps that include fare information, but are similarly limited to full adult fares).

The addition of fare information to trip planning apps would improve behavioural responsiveness to fares, in part by allowing a better comparison between public transport and other transport options. A secondary benefit of having more comprehensive planning apps — providing information on fares, scheduling, and trip duration — is that they would be integral to any future implementation of Mobility as a Service (section 7.3), along with app-based ticketing (section 7.1).

The provision of real-time information on crowding is also beneficial to passengers and is being increasingly taken up by transport authorities, such as by Transport for NSW (figure 7.2, left panel) and through the Melbourne Ridespace app (right panel). Demand for information about crowding has been accelerated by fear of COVID-19, but given more enduring aversion to crowding, will have ongoing value, including by diverting demand to periods where network capacity is under less strain. Such information reinforces the impact of off-peak pricing. Survey evidence suggests around 31 per cent of respondents across Melbourne, Sydney, Brisbane, and Adelaide would want to know how crowded their public transport vehicle is before they board (ITS Australia 2021). Progress is underway for real-time crowding data to be displayed on Google Maps in Melbourne (Visontay and Boseley 2021).

As with many other capital expenditures in public transport, the cost-efficiency of investments in transport apps depends on the (largely up-front) costs and utilisation rates. Greater provision of open data would further facilitate app development by third parties while minimising costs to government. Some commercial planning apps⁶⁹ have been developed in competition with Google Maps, although this is more commonly the case in larger cities where scale economies improve commercial viability.

Governments may wish to develop bespoke planning apps in order to ensure the desired functionality and to control parameters such as cost to users, treatment of personal data, and integration with ticketing. Google Maps may eventually develop ticketing functionality in Australian jurisdictions — as has recently been the case in the United States (Dutta and Araujo 2021) — albeit tied to the use of a proprietary payment system and the collection of personal data.

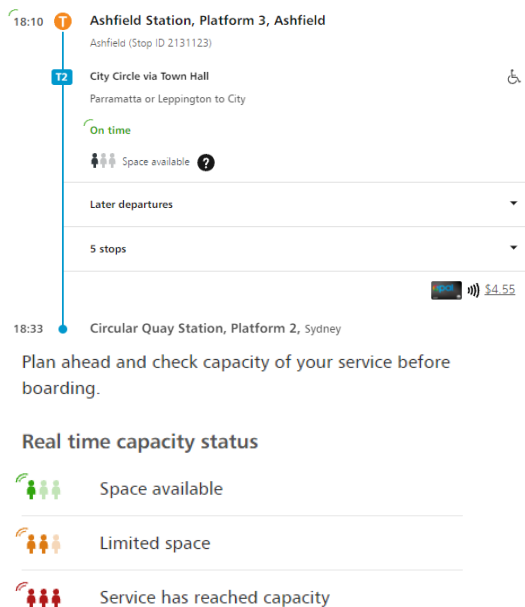
The cost to government of developing bespoke planning apps is generally trivial compared with most ICT investments — in 2016, tendering for the development of the Opal Card app (version 2) was reportedly won at \$1.1 million (Kiernan 2016). More recently, Transport for London cited their app development costs at £784 000 for iOS and £1.078 million for Android (TfL 2020).⁷⁰ Given such costs, app development appears to be a cost-effective option for all jurisdictions, as would be their continued evolution (and might be at lower cost with software sharing). Any associated ticketing functionality would likely still involve significant costs relating to physical tap-on tap-off infrastructure and back-office systems.

⁶⁹ For example, Trip View provides timetabling information via free (advertising-based) and paid versions of their app (TripView Pty Ltd 2021).

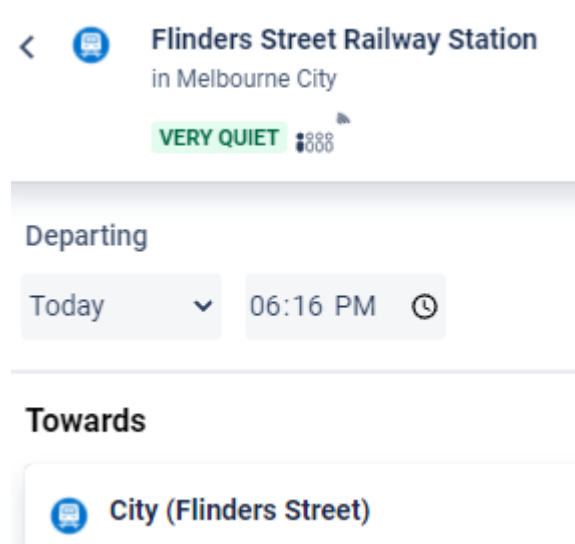
⁷⁰ Cost estimates do not include TfL staff time spent on the app's development (TfL 2020).

Figure 7.2 – Examples of real time information provision

Crowding levels at Sydney train stations



Crowding levels at Melbourne train stations



Source: Transport for NSW Trip Planner (2021b); Ridespace (2021b).

**Finding 7.3****Using technology to better inform consumer choice**

Smartphone applications already help passengers to better plan and make transport decisions, resulting in reduced travel times and lowering the effective 'cost' of transport. The provision of additional information could yield further benefits.

- All jurisdictions should ensure the availability of timetabling and real-time vehicle location information for passengers as this can reduce effective waiting times.
- The inclusion of pricing information within planning apps — or alternatively, in-app ticketing — could improve responsiveness to fare structures. It would improve the salience of fares, including of peak differentials or discounts, and would allow price comparisons between public transport and ridesharing.
- Jurisdictions that face significant crowding at peak times could consider following the examples of Victoria and New South Wales by providing passengers with real-time crowding information. This would allow self-selection into less crowded services, improving the effectiveness of peak pricing and in the short run provide some reassurance about using public transport as the pandemic retreats.

The potential for Mobility as a Service can only be realised through comprehensive app-based information on fares, scheduling, and trip duration across alternative modes, including ridesharing and other last mile services.

7.3 Changing the distribution model

The costs associated with accessing public transport nodes (in terms of time or walking distance) often overshadow the impacts of fares on-demand. For example, for the average patron, 15 minutes of walking to and from public transport is valued at about \$5.33, which compares with \$4.55 for an adult peak fare for a 0-10 km trip in Sydney.⁷¹ The ‘first and last’ mile problem is how to reduce the costs of accessibility to transport networks — a key objective — while avoiding perverse impacts on overall network costs and passenger convenience. Meandering routes with an abundance of stops incur higher travel times for passengers, higher costs of provision (due to greater service km and hours), and for a given set of resources, lower service frequencies. Every additional 10 minutes of in-vehicle travel time imposes an inconvenience cost on passengers of \$1.87–\$2.88 on average (with time more highly valued during peak periods).⁷² As such, network coverage has natural limits due to cost and practicality.

There is a tension between the social value of reasonable accessibility and the benefits of reduced travel time associated with direct ‘rapid transit’ systems, which increases the importance of feeder services and multi-modal public transport.⁷³ The potential efficiency gains from rapid transit depend on the viability of feeder services. Currently, around 28 per cent of public transport journeys to work in Australian capital cities involve multiple modes of (private or public) urban transport.⁷⁴

Two streams of technological development could significantly change multi-modal travel and the first and last mile problem. One is the development of new modes of transport that offer more efficient, convenient, or less costly ways of travelling (section 7.4). Another involves taking an innovative approach to existing modes of transport through an advanced ‘distribution model’ for transport supply. The most prominent example of the latter, Mobility as a Service (MaaS), could re-shape several aspects of urban transport including pricing.

Mobility as a service (MaaS)

Under MaaS, passengers are able to purchase transport services from various public and private modes (including mass transit, micro transit, and rideshare) using an integrated digital customer interface (International Transport Forum, 2021, p. 14). In effect, MaaS is the culmination of developments in ticketing, apps to improve consumer information, and the leveraging of novel, technology-enabled modal choices (as

⁷¹ Based on ‘user benefit parameter values’ in the *Australian Transport Assessment and Planning Guidelines* (Douglas 2021), in-vehicle time is valued (on average) at \$14.20 per hour (p. 3), while walking time to a station carries a loading factor of 1.5 (p. 5).

⁷² Based on ‘user benefit parameter values’ in the *Australian Transport Assessment and Planning Guidelines* (Douglas 2021), the value of in-vehicle time differs across modes and between peak and off-peak, ranging from \$11.20 (for off-peak bus) to \$17.30 (for peak rail) (p. 3).

⁷³ Rapid transit systems — particularly bus rapid transit (BRT) — have long been established in North America, Europe and China. Both the US and New Zealand Governments are increasingly investing in BRT systems (Duncan 2021; Waka Kotahi NZ Transport Agency 2021). In Australia, examples such as the Sydney Metro, Canberra Light Rail, and Perth Rail embody some aspects of rapid transit— providing direct routes at high service frequencies. Each relies on passengers being able to access the network by active transport, park and drive, or feeder services. In 2020, South Australia initiated moves to redesign its bus system under similar principles, but significantly scaled back its plans after public consultation. The plan would have resulted in passengers travelling ‘an extra 100 or 200 metres’, but would receive a service frequency several times higher than previously (Olle 2020).

⁷⁴ Includes public transport, private modes of transport (such as car use, taxis, or ridesharing) and active transport. Commission estimates based on ABS Census of Population and Housing 2016, TableBuilder, on method of transport to work based on counts of persons by place of enumeration.

discussed in the other sections of this chapter). The term MaaS encompasses several potential models, covering a continuum of operational, informational and transactional integration (box 7.4).

Trials of MaaS are ongoing internationally⁷⁵ and the desirable pricing and design of MaaS remains contested (Hörcher and Graham 2020; Mulley and Nelson 2020). Given that there are several potential models of MaaS, it is difficult to conclusively determine its policy implications or likely success in Australia. If implemented in Australia, particularly at higher levels of integration, MaaS would significantly alter the market conditions that serve as a context to this report and its findings.

Box 7.4 – What is MaaS?

While MaaS is a concept still in development, Hensher et al (2021) provide a comprehensive working definition:

MaaS is a framework for delivering a portfolio of multi-modal mobility services that places the user at the centre of the offer. MaaS frameworks are ideally designed to achieve sustainable policy goals and objectives. MaaS is an integrated transport service brokered by an integrator through a digital platform. A digital platform provides information, booking, ticketing, payment (as PAYG and/or subscription plans), and feedback that improves the travel experience. The MaaS framework can operate at any spatial scale (i.e., urban or regional or global) and cover any combination of multi-modal and non-transport-related multi-service offerings, including the private car and parking, whether subsidised or not by the public sector. MaaS is not simply a digital version of a travel planner, nor a flexible transport service (such as Mobility on Demand), nor a single shared transport offering (such as car sharing). ‘Emerging MaaS’ best describes MaaS offered on a niche foundation. This relates to situations where MaaS is offered on a limited spatial scale, to a limited segment of society or focused on limited modes of transport. The MaaS framework becomes mainstream when the usage by travellers dominates a spatial scale and the framework encompasses a majority of the modes of transport. (Hensher *et al.*, 2021, p. 5)

Governments can play different roles in MaaS. As outlined by the ITF (2021), some of the key models conceptualised in the prevailing literature include:

Walled gardens refers to a business model where a primary mobility service operator, for example a ride-sourcing company, retains the customer relationship/interface and integrates other modes or services, including digital wallets and payment services, that may interest their clients. ...

The *Public MaaS* model relies on a public transport operator or the public transport authority taking on the role of MaaS aggregator. The public entity acts as a gatekeeper to the MaaS ecosystem and sets the terms for integration of other mobility services onto the platform (and thus with public transport services).

The Regulated utility MaaS model explicitly splits the provision (and oversight) of public transport services with the public provision of a MaaS aggregation platform. Oversight of

⁷⁵ A trial of MaaS have run in Finland since 2017 (RAMBOLL 2019). More recent trials have been announced or commenced in Japan, Belgium, Austria, Italy, and Germany (Cerema 2019; Global Mass Transit Report 2020; Wray 2021).

Box 7.4 – What is MaaS?

the platform, including the setting and enforcement of platform access rules, is entrusted to the public entity with a broader remit than simply provision of public transport. This model is characterised by a shared back-office aggregation platform that is treated as public infrastructure and that can be used by private MaaS providers who develop their own customer interfaces and apps ...

[The] Mesh-y MaaS model is the least explored model of the four presented here. It builds on the distributed API model described above but integrates automated transaction processing, vetting and clearing on the basis of distributed ledger technology (DLT) and automated contracts (ITF, 2018). In this model, the role of aggregator is rendered obsolete through the execution of smart contracts directly between operators. (pp. 71–73)

Lyons, Hammond and Mackay (2019) explain that MaaS models vary in terms of the degree of integration between transport services. Each level of integration has its own implications for how fares are set and how passengers interact with the system:

Cognitive effort	Level of integration	Description
Higher level of effort required from passenger	0: No integration	No operational, informational or transactional integration across modes
	1: Basic integration	Informational integration across some modes
	2: Limited integration	Informational integration across some modes with some operational integration and/or transactional integration
Lower level of effort required from passenger	3: Partial integration	Some journeys offer a fully integrated experience
	4: Full integration under certain conditions	Some but not all available modal combinations offer a fully integrated experience
	5: Full integration under all conditions	Full operational, informational and transactional integration across modes for all journeys

What is the point of MaaS?

MaaS would not make public transport redundant. Rather, public transport would retain its roles in providing mass transit (which allows greater throughput with less congestion), and ensuring the accessibility and affordability of transport.

From a policy perspective, much of the value of MaaS depends on its ability to:

- *shift modal choice away from car use* — the potential social net benefits of MaaS depend largely on its ability to shift modal choice away from car use, particularly where this reduces road congestion. This presupposes that travel patterns under MaaS involves multi-modal trips that include mass transit (given that ride hailing or sharing would have similar externality effects as car use). Social benefits may be limited — or even negative — where MaaS results in modal shifts away from active transport (for example, walking and cycling).
- *improve accessibility of affordable transport* — for passengers with low incomes and/or greater transport needs (e.g. distance from existing public transport networks), a MaaS environment could improve first and last mile services feeding into public transport networks, due to the Mohring effect and economies of scale (chapter 2).
- *reduce the public cost of transport provision* — where increases in patronage lead to better asset utilisation, this could improve cost recovery.

Each of these potential benefits is, in turn, dependent on the implementation of appropriate pricing.

Would MaaS work in Australia?

The suitability of MaaS to a particular city depends on several dimensions, including the presence of transport services and infrastructure, as well as consumers' willingness to adopt the technology (Corazza and Carassiti, 2021, p. 4).

The benefits of MaaS are likely to be higher in cities where congestion is greater, first and last mile services are critical to access mass-transit, and where there are constraints on public transport coverage (for example, the lack of corridors for heavy rail). MaaS is a more natural accompaniment to cities that already need to coordinate multiple modes of public transport. Overall, this suggests that MaaS would be more easily introduced, and perhaps more useful, in larger cities.

Some models of MaaS could still prove relevant to smaller cities, particularly if they facilitate the streamlining of public transport routes. Simulations undertaken by the CSIRO show that a relatively simple form of MaaS (involving PAYG pricing) could potentially reduce travel times and costs in the ACT, using taxis as a feeder service to a bus network (predating the introduction of light rail) (box 7.5). The CSIRO's proposed system made use of several city-specific parameters, such as the colocation of workplaces into 'hubs', and a prevalence of jobs that do not require own car use.

Of course, for MaaS to have any impact on policy objectives, it would need to achieve behavioural change — people must choose it over other travel options (International Transport Forum, 2021, p. 15). Survey evidence suggests that attitudes to MaaS in Australia vary with demographic and socioeconomic factors, travel needs, and car dependence (table 7.1). These factors would be key determinants of the likely take-up and success of MaaS in a given city.

Would people use MaaS?

Uptake of MaaS depends on the degree to which it improves convenience for passengers (through integrated ticketing, planning and information provision) and better value for money (through discounted and integrated pricing). The former is unlikely to be decisive, especially as apps and evolving payment methods would already allow reasonably convenient travel in a non-MaaS context (Hensher, Ho and Reck, 2020, p. 14).

Accordingly, the uptake of MaaS is likely to depend on value for money, and hence on pricing and willingness to pay. Survey evidence from Rome suggests that MaaS take-up in the city would be limited by low willingness to pay (Corazza and Carassiti 2021). A large proportion of respondents, for example, would only be interested in a MaaS subscription if it cost less than a conventional monthly transit pass (p. 18). In all likelihood, Australian passengers' expectations of the price of MaaS would likely be highly influenced by current and past fare levels for public transport.

Box 7.5 – Early simulations of MaaS for the ACT

In 2014, the CSIRO proposed a 'hub-and-shuttle' system for the ACT. Predating the implementation of light rail, the system involved the use of taxis as a feeder service to relatively high-frequency bus services between key hubs.

The idea is to replace many low-frequency, fixed-schedule services with a multi-modal bus/taxi combination. The buses run a high-frequency, fixed schedule service through a number of hub nodes, while multi-hire taxis shuttle passengers between their local bus stop and their nearest hub. Customers book 15 minutes ahead of desired departure, via a call centre or web app. A potentially shared taxi takes them from their local bus stop to the nearest hub. From there (if needed), they can take a bus to another hub. If needed, a final (shared) taxi trip completes the journey. ...

The system shared several common features with the MaaS models now being trialled internationally. Some of the key characteristics of the model were described as:

- Book and pay for service beforehand, using a phone app, web site or call centre.
- A single ticket covers all taxi and bus legs.
- Bus-stop to bus-stop service. Passengers [are] picked up at a bus stop, and dropped off at a bus stop, just like the current fixed-schedule service.
- Buses run between 'hub' nodes. A high-frequency service (every 10-15 minutes) is offered between hubs. In Canberra, the hub nodes will ... be busy areas such as Civic, Woden, Belconnen, Tuggeranong, Gungahlin and Kingston.
- Taxis used as shuttles. Taxis take passengers from their local bus stop to a hub. On the return, passengers are picked up at the hub and taken to their local stop.
- Multi-hire taxis. Taxis may deviate on the trip to pick up or drop off another passenger. Up to three passengers will share a taxi
- Taxis are called into service when required, and released when demand drops off.
- Taxis are paid at or near their usual rate.

Simulations showed that even where taxis were subsidised at or near their usual rate, the cost of taxis was largely offset by the savings from the removal of low-patronage timetabled bus routes. It also found that the main advantage of the system was that it reduced travel times, regardless of the origin and destination. Simulations in Canberra showed that the cost of taxis is largely offset by the savings in the cost of buses.

Source: CSIRO (2014).

Table 7.1 – Australian attitudes towards MaaS^a

	Market segments				
	Category 1: Most enthusiastic about MaaS	Category 2	Category 3	Category 4	Category 5: Least enthusiastic about MaaS
Share of the population	14 per cent	7 per cent	17 per cent	22 per cent	41 per cent
Average MaaS purchase probability	87 per cent	51 per cent	33 per cent	2 per cent	1 per cent
MaaS use	Likely to use for all travel	Most likely to use for on-off social trips		MaaS unlikely to have effect on car dependence or car ownership	
Attitudes towards MaaS	MaaS could help reduce car dependence and car ownership			MaaS unlikely to have effect on car dependence or car ownership	
Geography	Evenly spread	More likely metro		More likely regional and remote	
Demography	More likely younger, male, tertiary educated, employed, with children at home	More likely middle-aged, female, tertiary educated, high household income	More likely tertiary educated, single, living with parents, high household income	More likely older, female, not tertiary educated, retired	More likely older, not tertiary educated, retired
Current travel behaviour and attitudes	Higher overall travel needs, higher motorcycle ownership and use of mobility devices	Negative opinion of private car ownership and use; open to car sharing		Low opinion and infrequent use of public transport and carsharing	
Average self-reported travel costs	\$185 per week	\$121 per week	\$136 per week	\$98 per week	\$107 per week

a. Based on survey of 3985 respondents.

Source: Vij et al (2018).

Australia's first trial of MaaS was undertaken in Sydney over a two-year period from 2019, testing a range of subscription and pay as you go services (Hensher et al. 2021). Demand for use of the commercial services participating in the trial was stimulated through direct subsidies to consumers in the form of discounts for services.⁷⁶ They found stronger responses to subscription pricing than for pay-as-you-go, noting that:

... a subscription to monthly mobility bundle does influence monthly car use in a statistically significant way. ... Importantly, it is the combination of a subscription fee and a suite of mode-specific financial discounts that will ultimately determine the appeal of MaaS bundles and indeed Maas more generally. We would argue that having monthly mobility bundles for subscription will be the key influence on whether MaaS is to grow in a scalable way or remain a niche construct. (Hensher, Ho and Reck, 2020, p. 14)

As such, the impact of MaaS is likely to depend in part on demographics, preferences, and travel needs; the extent of latent demand attributable to inconvenient planning and ticketing; and the potential for passengers to receive better value for money. The latter has several implications for fare-setting.

⁷⁶ For example, in the Super Saver 25 bundle, people were charged \$25 a month and obtained 25 per cent off any Opal public transport trip, \$3 off any Uber ride (and \$5 off any trip to/from a train station), \$3 off a taxi ride.

Implications for pricing

If passengers expect MaaS to deliver better value for money, they may envisage:

- using new (or additional) services than previously, but with lower costs than would have otherwise been the case
- that their travel habits will remain largely unchanged, but that they would face lower overall costs.

In either case, if passengers' adoption of MaaS requires lower overall prices, MaaS could require similar or greater levels of subsidy than is currently the case. Unless MaaS increased patronage sufficiently, this would lead to worsening cost recovery. Much would depend on cross-price elasticities in Australian cities — about which there is a dearth of contemporary empirical evidence.

The distributional implications of MaaS pricing will also be worth considering. Australian survey evidence suggests that MaaS would be of most interest to people with relatively high weekly spends on transport — suggesting high transport needs and ability to pay (Vij et al. 2018). The results also show that many people are likely to partially change their travel behaviours, using MaaS for discretionary travel which is less likely to provide positive externalities or to occur during times of high congestion. If MaaS were to result in lower levels of cost recovery (e.g. in its initial stages), it is unclear whether those additional subsidies would improve social welfare (i.e. through additional social and economic participation).

MaaS fare structures

With regard to fare structures, integrated subscription pricing would be key to prompting adoption and use. While, in a non-MaaS context, forms of subscription pricing are commonly used internationally⁷⁷, it can present issues for the efficient use and provision of services. Given that it provides no link between usage and social marginal cost — particularly where it varies with time, distance, or mode of travel — it can lead to overconsumption. Indeed, Infrastructure Victoria recommended removing myki Passes⁷⁸, in part due to inconsistency with peak and mode-based pricing (Infrastructure Victoria, 2020, p. 61).

These issues are heightened in the context of MaaS subscriptions. For instance, if MaaS were to successfully increase public transport patronage, while at the same time removing peak fare differentials (dulling any incentive to shift away from peak travel), this could add significant pressure on capacity at peak times.

Moreover, given that MaaS subscriptions are not limited to public transport, there would be greater scope for subscribers to shift their usage to more costly (and individualised) modes. In this regard, Wong noted that:

This is one of the *greatest* risks in deploying MaaS as the provider nudges consumers onto more expensive and lucrative modes. Who wouldn't default to taxi (or an equivalent point-to-point option like Uber) as their first port-of-call if they had already purchased an unlimited transport bundle? (Wong 2019)

It is noteworthy that commercial modes of urban transport, such as taxis and rideshare, tend not to operate on a subscription basis. Uber has only recently implemented a partial subscription model, where passengers

⁷⁷ For example, 'season tickets' are available from UK rail covering a period of seven days, one month, or any length of time between one month and one year. Monthly tickets are available for the Hong Kong MTR, the Singapore MRT, and Auckland bus and rail.

⁷⁸ In Victoria, myki Passes allow regular passengers to purchase unlimited travel period of seven days, one month, or any length of time between one month and one year. These passes are effectively 'subscription' tickets of varying time periods, with additional discounts for up-front payment for longer periods.

pay a monthly fee in exchange for a flat discount on all fares (Uber 2021). For rideshare companies, a full subscription service would remove their ability to address scarcity via peak pricing.

As such, MaaS fare structures will have to manage the potential trade-off between take-up and demand management. This should be seen as an area for further research and experimentation, particularly as trials have not yet provided conclusive evidence on such questions. Even the longest running fully-fledged trial of MaaS in Helsinki has yet to clarify such issues, given a relatively limited number of fare types⁷⁹ and insufficient take-up of 'unlimited' subscriptions for statistical purposes (RAMBOLL, 2019, p. 54; Wong, 2019). It is likely, however, that a mix of subscription offers would serve (at least partly) as a way to price discriminate and influence behaviour (box 7.6).

Box 7.6 – Possible pricing and incentive structures under MaaS

While integrated subscription pricing may improve the take-up of MaaS, it would potentially be in conflict with attempts to manage demand. This is not to say that better outcomes are impossible. Several approaches could strike a balance between these objectives, each with its trade-offs.

- Lower priced subscriptions (or concessions) could apply for those only travelling off-peak. While this would target a relatively small section of passengers, it could provide some relief to peak crowding.
- Rather than unlimited, unregulated travel, subscriptions could provide incentives through a mix of pricing tools. Subscriptions could provide passengers with discounts to pay-as-you-go fares (as was the case in the Sydney trials); capped usage of more costly modes (as in Helsinki); or require additional charges relating to particularly costly modes or times of day.
- If crowding and congestion were extreme on particular routes or at particular times of day, those routes and times could be excluded from subscriptions and subject to pay-as-you-go pricing. This would remove negative impacts of MaaS on crowding, however, it may make subscriptions (and MaaS) less attractive for many passengers.
- Other possibilities include changing the role of consumer choice. For instance, just as account-based ticketing allows 'best fare' mechanisms, integrated subscription pricing under MaaS could allow for 'best journey' mechanisms, whereby passengers are able to choose their price level and destination, but not the modes available to them.

Subsidy and price regulation

Under MaaS, the economic justification for public subsidies and fare regulation would remain.⁸⁰ Governments could continue to serve this role through the provision and subsidisation of mass transit,

⁷⁹ The Whim trial involved three fare types: a pay-as-you-go system with no subscription fee ('Whim to Go'); a subscription involving unlimited public transport tickets and capped use of other modes ('Whim Urban'); and a subscription service with unlimited travel on all modes ('Whim Unlimited') (RAMBOLL 2019, p. 11).

⁸⁰ For instance, while private transport services may substitute for public transport for some passengers, the prices charged by an unregulated profit maximising operator would be unlikely to meet people's needs for affordability and, given the spatial characteristics of Australian cities, geographic coverage. A profit maximising operator has no inherent interest in meeting the needs of low-income customers (except to the extent that they can price discriminate) or in providing services to areas with thin demand, both of which are key roles of a public transport system. In addition, while transport operators generally cannot exercise standard monopoly pricing — given substitution from other transport forms — they may nevertheless be able to set

leaving the remaining elements of MaaS to largely regulate their own prices. However, governments may have cause to partially subsidise commercial (and unregulated) modes of transport.

- Subsidising commercial modes could help drive the take-up of MaaS and thereby patronage for public transport. This may be justified where, for example, the subsidy results in substitution away from car use to mass transit (and the subsidy is outweighed by the externality value of reduced congestion).
- Subsidies to private services for some disadvantaged groups may also be warranted to meet affordability objectives. Depending on the extent of modal integration, governments could increasingly rely on a mix of private feeder services to extend the effective coverage of public transport networks. To the extent that this leaves passengers captive to feeder services, there may be a role for additional subsidies.

At the same time, where MaaS involves full price integration, this would remove a divide that currently exists between markets with different levels of price regulation. While mass transit fares are centrally determined, commercial transport systems (such as rideshare) face much weaker forms of regulation.

The expansion of subsidies to commercial modes could warrant central purchasing of services or even tenders to leverage government buying power to achieve discounts for target groups of consumers, or an expanded role for price regulation. These questions would be particularly relevant were the urban transport network to rely heavily on commercial modes to meet coverage and affordability objectives. Given that prices for booked taxi trips and ride-sharing services are not regulated, broad subsidies could be ineffective at ensuring affordability (say, if prices at peak commuting times are set high).

These issues do not suggest that governments need to alter subsidisation or price regulation in advance of MaaS. However, governments adopting MaaS may need to be prepared to undertake more involved approaches to fare and subsidy setting than previously.

The road to MaaS

The evaluators of the Sydney trial warned that:

There is a lot of hype and rhetoric surrounding MaaS and very little evidence on whether it will be a feasible, viable or desirable way to investigate and undertake future travel.
(Hensher *et al.*, 2021, p. 9)

Given the uncertainty around the viability of MaaS, it would be reasonable for governments to approach with caution, while still positioning themselves to control its development. This would include several policy actions that are worth considering in their own right, regardless of any transition to MaaS, such as advanced ticketing and improved planning apps. Neither is MaaS a prerequisite for the use of microtransit, nor for encouraging feeder services to public transport — governments can encourage these modes in various ways, including by improving pick-up and drop-off points across urban environments (International Transport Forum, 2021, p. 15).

Above all, governments should note that achieving the full benefits of MaaS will require more sophisticated price- and subsidy-setting. Governments will need to ensure that expertise and institutional arrangements are sufficient for setting (or negotiating) integrated fares. Decision-making processes will need to be more informed about own- and cross-price elasticities than is currently the case. Fare structures would need to be designed to balance the attractive elements of convenient (e.g. subscription) pricing with efficient incentive structures (e.g. peak and modal differentials).

prices too high in some market segments. Moreover, an operator has no capacity to address the positive externalities of public transport, and no intrinsic incentive to address negative externalities of their services (such as contributions to congestion).

For governments convinced that MaaS would be suitable for their jurisdiction, they will first need to consider what model of MaaS would be appropriate. This not only requires identification of its policy objectives, but also consideration of the role of government. In situations where the aggregator (app) is publicly owned or operated, governments will need to build significant technical capacity. New regulatory tasks are also involved, including of data-sharing between businesses and of digital platforms more generally. These tasks are separate to economic regulation of pricing and are not traditionally core tasks for most public transport authorities. Indeed, there may be a role for federal or national regulatory frameworks, such is the case with the regulation of the Consumer Data Right, and of search engines and social media platforms.

For jurisdictions that are further progressed on the road to MaaS — in terms of transport, technological, regulatory and pricing infrastructure — it would be beneficial to conduct trials for analysis. The recent Sydney trials are a useful example. Alternatively, governments could trial MaaS for specific passenger groups, such as the University of Queensland's trial focusing on tertiary students (MaaS Alliance 2021). Tourists and visitors are another distinct category of traveller more likely to benefit from a service that simplifies trip planning, modal choice, and ticketing. They are also likely to have particular preferences with regard to cost, travel timing and simplicity (compared with regular commuters).



Finding 7.3 **Fares in a mobility-as-a-service context**

The main attraction of Mobility as a Service (MaaS) is its potential to attract more commuters to public transport by improving the efficient use of multi-modal journeys and resolving first and last mile issues.

While its viability remains unproven, early trials show that pricing will be a key driver of its adoption. Fully integrated subscription fares will present the strongest incentive for passengers to use MaaS, but at the same time, would present potential inconsistencies with other incentive structures including peak and modal pricing.

The transition to MaaS with integrated pricing is non-trivial. It would involve the regulation of both digital platforms and business-to-business data-sharing arrangements, neither of which are traditionally core tasks for most public transport authorities. There may be a role for national regulatory frameworks.

The pursuit of MaaS with fully integrated pricing should be considered as experimental — worthy of trials, with net benefits as yet unproven. Governments should consider, as a more immediate step, taking a cost-benefit led approach to integrated, app-based ticketing, account-based ticketing, and improved planning apps.

7.4 Leveraging novel modes

As noted above, new modes of transport could significantly alter how people resolve the 'first and last mile' problem, by providing new feeder services to public transport. However, they could also provide viable substitutes to existing public transport services in some cases. Moreover, new modes could be implemented in different ways, including through private ownership, shared services, or public provision. The way in which these technologies are used depends largely on their cost structures and the extent to which they meet consumer preferences — both of which are closely related to pricing.

Micromobility and microtransit

Shared micromobility services — (non-electric and electric) bicycles and electric scooters — are available in most Australian capital cities, and sometimes at zero cost to users. As shared services, they remove any user concerns about maintenance, theft or parking. Powered forms of micromobility also allow journeys to take place with reduced physical exertion during operation.

Micromobility services do more than connect people to public transport — for short journeys, they are a substitute for cars, active travel and (ironically) to an even greater extent, public transport (Fishman, Washington and Haworth 2014). However, their rollout has involved widespread problems, including poor safety, failure to meet traffic laws, vandalism, dumping and low usage. A review of bikeshare services in Sydney found helmets were often thrown away, up to 50 per cent of bikes were vandalised, and GPS tracking defects were common (Heymes and Levinson 2018). At least in initial trials, trips per shared bike per day in Australia were between 1/30th and 1/6th of global comparators (Fishman et al. 2014).

The micromobility market is (so far) tiny in size and its role as a ‘first and last’ mile service must be commensurately small (P&SI 2021). Similarly, privately owned bicycles and scooters have tended to play a small role in multi-modal urban commuting. Data from the ABS Census suggested that in 2016, only around 0.8 per cent of public transport trips to work in Australian capital cities involved cycling. Accordingly, while there is potential to make greater use of both active transport and micromobility in most cities, current travel patterns suggest that they would not suit the needs and preferences of a large proportion of commuters.

Perhaps the most significant addition to urban passenger transport in the past decade has been the emergence of on-demand ridesharing services. Such services have presented a lower cost alternative to taxis, and a higher quality substitute for public transport for some trips. They are increasingly relevant to the public provision and subsidisation of transport (for instance, ridesharing services have recently been deemed as eligible for the disability taxi subsidy in Victoria (Victorian Government 2021)). Ridesharing could play a greater role as a feeder service to public transport, contingent on pricing. A recent survey found that around 46 per cent of Australians would use public transport instead of cars if they could access a capped-price rideshare for the first 5 km (University of Sydney 2020). However, their prices mean that usage is skewed toward higher-income households.⁸¹

One of the limitations of on-demand services is that they tend to focus on individual transport. While this is more convenient and comfortable for passengers, it entails both higher prices and greater road congestion. Currently, ridesharing services implement peak pricing for their own commercial purposes (i.e. to address scarcity) which incidentally helps to reduce their effect on congestion, albeit while making the services less viable as options for most everyday commuters.

A useful middle-ground may exist in ‘microtransit’, which involves ‘multi-passenger/pooled shuttles or vans’ providing a ‘technology-enabled’ transport service (SAE International, 2018, p. 8). Microtransit is often used more for full journeys rather than feeder services, where it has the potential to improve asset utilisation in areas (or at times of day) where patronage is likely to be too low for efficient operation of mass transit.⁸² Such multi-passenger services could also be an efficient solution for first and last mile services, for instance,

⁸¹ The ratio between consumption by the top income quintile to the bottom quintile is more than 50 (based on the ABS 2017, *Household Expenditure Survey, Australia: Summary of Results, 2015–16*, Cat. no. 6530.0).

⁸² On-demand bus services are being trialled in both urban and regional areas of New South Wales. Publicly subsidised demand-responsive transport (DRT) have emerged in many countries (L.E.K. Consulting 2019), including Australia, such as Translink’s Logan City service in Queensland (Kaufman 2020) and the Norwest On Demand service in Sydney.

where the alternative would be more costly to public funds (e.g. rail network augmentation) or to road congestion (e.g. individual car use).

Microtransit is an area worthy of further exploration, either as a full or feeder service. Its provision will depend partly on consumer habits and preferences (with regard to app-based advanced ticketing) as well as the viability of comparable bus routes. The operational costs of both microtransit and buses largely centre on the driver⁸³ and, given the lower passenger capacities, microtransit would have higher driver-costs per passenger per km. Microtransit could only offer a more socially efficient option than mass transit if it were to achieve a much higher rate of asset utilisation, or if driver-related costs were greatly reduced. Autonomous vehicle technology would address the latter concern, but is unlikely to be implemented in the medium run except for some niche markets.

Autonomous vehicles and microtransit

It is beyond the scope of this report to estimate the timing (or even likelihood) of the safe implementation of autonomous (i.e. driverless) vehicle technology.⁸⁴ Assuming the technology is developed and implemented, the combination of autonomous vehicles and microtransit would provide a step-change in the provision of affordable and accessible transport. This could be as feeder services, sometimes as substitutes for public transport networks and sometimes as a new vehicle type operated as part of the public transport system.

Both the ITF (2015b) and Infrastructure Victoria (2018) have simulated scenarios where autonomous vehicles partly or fully substitute for other forms of urban passenger transport (box 7.7). Both find that the introduction of autonomous vehicles would have countervailing effects on road congestion. For instance, car kilometres would increase as autonomous vehicles replace travel by other modes, and due to the repositioning and (empty) return journeys.⁸⁵ At the same time, autonomous vehicles place downward pressures on road congestion due to a potentially large reduction in the number of cars in use; the increased road capacity due to removal of parking; and improved traffic flow via car-to-car communication (i.e. 'platooning'). On balance, both conclude that it is feasible and likely that the technology would significantly reduce road congestion.

⁸³ According to the *Australian Transport Assessment and Planning Guidelines: M1 Public Transport* (2021), on-vehicle crew costs vary between bus (\$51 per service hour), tram (\$101 per service hour), and train (\$371 per service hour). Direct vehicle operating costs (such as fuel and maintenance) are around \$1.08 per service km for buses. The share between driver-related costs and other operational costs depends partly on how far buses travel in a given hour.

⁸⁴ The gradual proliferation of autonomous vehicle technology includes lower levels of automation that are featured in many cars on the Australian market, including SAE Level 1 ('driver assistance' such as managing speed) or SAE Level 2 ('partial automation', such as changing lanes) (Dia 2021). Of greater relevance to first and last mile transit are higher levels of automation, where humans are not involved in the driving task (SAE Levels 4-6). Over the past two decades, various estimates have been made about the likely timeline for such 'driverless' technology, with some manufacturers suggesting widespread availability in the short or medium term and others estimating much longer lead times (ITF 2015a, p. 5; PC 2020b, pp. 250–251). While the implementation of depends on further development of the technology itself, trials have been run in every State and Territory (NTC 2020, p. 2). Still, many have pointed out the need for regulatory reforms, including by updating driving laws and urban planning regulations (with regard to parking and kerb access) (Infrastructure Victoria 2021). Others have noted that the technology may be much further away: one prominent transport expert warning that prognostications about its role could be a 'gigantic lot of nonsense' (Currie 2018).

⁸⁵ In addition, Litman (2021c) speculates on several possible behavioural responses to autonomous vehicles that could lead to increased vehicle km. These include: journeys of increased distances due to improved comfort; additional empty return journeys in order to avoid parking fees; and increased discretionary travel, given the higher fixed costs of purchase and lower per km costs of use (compared with conventional cars).

Box 7.7 – Simulations of autonomous microtransit show varying potential effects on congestion

The International Transport Forum (ITF) simulated the introduction of autonomous vehicles, which took the form of either individualised taxi services ('TaxiBots'), or multi-passenger taxi services ('AutoVots'). Using Lisbon as the basis for simulations, they tested several scenarios including where either TaxiBots or AutoVots replaced private car use (either in full or at 50 per cent), either in the presence or absence of mass transit. Broadly, they found that:

Nearly the same mobility can be delivered with 10% of the cars

TaxiBots combined with high-capacity public transport could remove 9 out of every 10 cars in a mid-sized European city. Even in the scenario that least reduces the number of cars (AutoVots without high-capacity public transport), nearly eight out of ten cars could be removed.

The overall volume of car travel will likely increase

A TaxiBot system with high-capacity public transport will result in 6% more car-kilometres travelled than today, because these services would have to replace not only those provided by private cars and traditional taxis but also all those provided by buses. An AutoVot system in the absence of high-capacity public transport will nearly double (+89%) car-kilometres travelled. This is due to repositioning and servicing trips that would otherwise have been carried out by public transport.

Impacts on congestion depend on system configuration

A TaxiBot system in combination with high-capacity public transport uses 65% fewer vehicles during peak hours. An AutoVots system without public transport would still remove 23% of the cars used today at peak hours. However, overall vehicle-kilometres travelled during peak periods would increase in comparison to today. For the TaxiBot with high-capacity public transport scenario, this increase is relatively low (9%). For the AutoVot car sharing without high capacity public transport scenario, the increase is significant (103%). While the former remains manageable, the latter would not be. (International Transport Forum, 2015b, p. 5)

Infrastructure Victoria also undertook simulations involving the introduction of autonomous vehicles. Several scenarios were used to test differences between private ownership and commercial on-demand services, as well as different rates of uptake. They found that:

The scenarios with high private automated vehicle ownership are projected to lead to an unprecedented increase in congestion in the inner urban areas of Melbourne if no action is taken to restrict them. This is due largely to the potential for privately owned automated vehicles dropping occupants at their destination and returning home to avoid parking costs before returning to pick up their owner when required, meaning the congestion-dampening effects of parking costs in the CBD are eliminated.

Alternatively, a fully on-demand vehicle fleet would not cause the same congestion issues in inner areas, but could lead to poorer access to services for Victorians on lower incomes or people in outer suburban and regional areas, depending on the commercial model deployed and availability of good public transport services.

Box 7.7 – Simulations of autonomous microtransit show varying potential effects on congestion

A more balanced outcome, in which a mix of different technologies and ownership models coexist (automated, non-automated, zero emissions, privately-owned and on-demand) as described earlier, shows all of the potential benefits of automated vehicles can be realised, with very few of the congestion costs. As such, if this outcome were to eventuate, which we consider more realistic than those outcomes discussed in our base scenarios, congestion could be very significantly reduced on Victorian roads by 2046. (Infrastructure Victoria, 2018, p. 30)

Importantly, the impacts of autonomous vehicles on congestion are highly dependent on how they are used and their role in the modal mix. Infrastructure Victoria found that high, unrestricted private ownership of autonomous vehicles would lead to ‘unprecedented increase in congestion’ (2018, p. 30). Conversely, under a ‘more realistic’ scenario where the adoption of autonomous vehicles is not absolute (i.e. where different technologies and ownership models coexist), the potential benefits of automated vehicles can be realised, and congestion could be ‘very significantly reduced’. (Infrastructure Victoria, 2018, p. 30)

Similarly, the ITF estimated, based on simulations in Lisbon, that even where autonomous vehicle transport took the form of shared microtransit (of 6, 8 and 16 passengers), were it to be used in the absence of any mass transit, this would lead to 89 per cent more car km overall and 103 per cent more car km during peak times — a situation they did not consider to be ‘manageable’ (2015b, p. 5). In addition, in the absence of bus services, the operation of autonomous vehicle services alongside privately owned conventional vehicles could lead to ‘even higher parking requirements than today’ (2015b, p. 26).

As such, the prevailing evidence suggests that the effects of autonomous vehicles on congestion externalities depends largely on their usage, particularly in relation to mass transit. This suggests that governments will need to continue to provide mass transit and to maintain its role in an efficient modal mix. There may be greater scope for substitution between conventional public transport and shared autonomous vehicles in smaller, less congested cities (International Transport Forum, 2015b, p. 6). However, in these cities, the provision and pricing of public transport is as much about achieving social goals as the efficient movement of people. In that case, shared autonomous vehicles might become part of the subsidised public transport network through targeted concessions for private provision or through the inclusion of autonomous microtransit in the public transport mix.

The role of pricing and regulation

It seems likely that if the remaining technological barriers are overcome, travel by autonomous vehicles would eventually be relatively affordable.

- Most major vehicle manufacturers are developing technologies on similar timelines (Productivity Commission, 2020, p. 251). Once autonomous vehicle technology is operational and obtains full regulatory approval, competitive pressures would likely lead to reduced vehicle prices. Manufacturers have the incentive to favour a low-margin, high-turnover model, recovering research and development costs over as many units as possible (International Transport Forum, 2018, p. 28).

- As was the case for conventional vehicles⁸⁶, purchase prices for autonomous vehicles will dictate proliferation. But even at modest rates of proliferation, autonomous vehicles would account for a large proportion of urban transport because they would replace standard cars. Simulations suggest that a fleet of autonomous vehicles could reduce the private car fleet by anything from 66 per cent (Infrastructure Victoria 2018) to 90 per cent (International Transport Forum, 2015b, p. 5). This implies that commercial interest in operating autonomous fleets would likely be high — given that a small fleet could provide a high volume of service km (at relatively low cost per km).
- With a relatively competitive market for vehicles and fleet services, the cost of autonomous vehicle trips (both to vehicle owners and to passengers of shared services) will eventually be low compared with conventional modes.

In conjunction with greater convenience and comfort, they would be an attractive option for end-to-end journeys, reducing the traditional role of public transport. The key policy challenge for governments would be about determining the scale and nature of a residual mass transit public transport network, the role of government in subsidising or providing autonomous vehicle services as part of a public transport network (particularly in smaller, less congested cities), and managing the negative externalities of vehicle use (particularly in larger cities).

Infrastructure Victoria noted that congestion risks of autonomous vehicles can be mitigated by ‘encouraging public and active transport and implementing transport network pricing’ (2021, p. 79). The ITF conclude that automation will make road pricing ‘increasingly important’, in addition to better transport planning and integrated land use (International Transport Forum, 2018, p. 15). As discussed in chapter 5, road user charging could be implemented well prior to the introduction of automated vehicles and should be coordinated with fare-setting for public transport.

While non-price tools could also be useful in regulating the use of automated vehicles, some may be fraught in the Australian context. For example, one lever for managing the negative externalities of autonomous vehicles would be to limit vehicle registration permits (International Transport Forum, 2018, p. 167). Indeed, pricing could be used to ration registration permits, as is already the case for conventional vehicles in Singapore.⁸⁷ However, such restrictions on car ownership may be unsuitable for cities that are built with cars in mind; for lifestyles that revolve around car ownership; and for travel patterns that may involve significant amounts of travel in uncongested suburban and regional areas. There is likely to be more gained by targeting car usage rather than ownership, particularly with regard to commuting at peak times in urban areas prone to congestion.

⁸⁶ Historically, the early proliferation of private cars in the United States was not simply the introduction of the Model T Ford in 1908, but the reduction from its initial price of US\$850 to US\$300 in 1920 (Litman 2021c).

⁸⁷ In Singapore, in order to register a car, owners are required to purchase a Certificate of Entitlement (COE) via a bidding system (One Motoring 2021). The system limits the number of registered cars by limiting the number of COEs and rationing them via a market price mechanism.



Finding 7.4

Novel modes of transport

Improved first and last mile services reduce the implicit price of public transport as travel costs to catch buses and trains have costs that can exceed the monetary fare. Novel modes of transport — such as micromobility and microtransit — could make further incremental improvements as feeder-services to mass transit routes but neither are transformative.

If the regulatory, technological and social obstacles are overcome, autonomous vehicles could be an attractive option for many end-to-end journeys. The key policy challenge for governments would be determining the scale and nature of a residual mass transit public transport network, the role of government in subsidising or providing autonomous vehicle services as part of a public transport network, and managing the negative externalities of vehicle use in larger cities.

8. Institutional arrangements for fare setting

Key points

- ✱ **Current institutional arrangements are a barrier to fare reform and contribute to inefficient prices and pricing structures.**
 - Most jurisdictions rely on simplistic annual reviews that tend not to assess the fundamental fare structures where reforms are most needed. Policy inertia has been widely observed in recent years, with the exception of ad hoc changes stemming from electoral commitments that frequently move further away from efficient pricing.
 - Fare levels have been stagnant in recent years — declining in real terms in some jurisdictions — despite increasing operating costs.
- ✱ **New South Wales has a good, but not perfect, institutional model for fare setting. The NSW Government determines transport pricing policy, but an independent body — the Independent Pricing and Regulatory Tribunal (IPART) — regulates prices, recommends improved fare structures, and publishes public information on fare decisions. This model reduces short-run pressures on governments, and improves transparency and accountability. Other jurisdictions, particularly those with cities experiencing crowding and congestion, could benefit from this approach.**
 - This model could be further improved by regulating minimum fare increases, in addition to the existing regulation of maximum fare increases.
- ✱ **Without an independent body, jurisdictions could still improve institutional arrangements by:**
 - publishing a long-term strategy for fare setting with explicit rationales for fare decisions,
 - retaining real fares by mandating that fares increase annually by at least the Consumer Price Index (if not already customary), or growth in public transport costs,
 - publishing the expected impacts of fare reforms including any distributional results, and holding open consultations with stakeholders.

As discussed in previous chapters, public transport fares improve or impede effects on network use, efficiency, and equity. It is important, then, that governments' fare setting processes are clear and well-defined, so they arrive at fares that best achieve their intended aims. This chapter discusses the institutional arrangements for public transport fare setting, defined broadly as the processes within government, formal or otherwise, that determine the fares that passengers eventually pay. It considers the suitability of current institutional arrangements, as well as how improvements to pricing discussed in previous chapters could be implemented in practice. It examines:

- practical challenges in how jurisdictions price their public transport services (section 8.1)

- different models of public transport fare setting (section 8.2).

8.1 Challenges in fare setting practices

Given that State and Territory governments are largely responsible for transport policy in Australia⁸⁸, it is unsurprising that there is significant variation between jurisdictions in how fares are set (table 8.1). Still, several challenges are common across jurisdictions, including:

- minimal processes for the formal review of fare structures
- little transparency about fare setting processes and objectives
- political incentives to avoid changes to fares, particularly fare increases
- resultant declining or stagnant real fares that create fiscal pressures, which can lead to financial barriers to investment in the service quality of the network.

Table 8.1 – How jurisdictions currently set fares

	Fare setting responsibility	Usual annual changes	Long-term fare setting institutions
NSW	The Minister for Transport, with advice from Transport for NSW, and subject to regulation from the Independent Pricing and Regulatory Tribunal (IPART). Through Cabinet processes.	Fare increases are capped by IPART's weighted average price cap model. Actual increases vary significantly, but have been below IPART's cap.	Under the <i>Passenger Transport Act 2014</i> , the Minister for Transport and Roads can ask IPART to determine maximum fares for public transport services.
Vic	The Head, Transport for Victoria, with the conditions published in the Government Gazette.	Metropolitan franchise contracts require fares to increase by at least CPI each year on 1 January. Fares have regularly increased by more than CPI.	No regular scheduled processes. Most recent review was by Infrastructure Victoria, Fair Move (2020).
Qld	The Minister for Transport and Main Roads, with advice by an independent 'Public Transport Fares Advisory Panel'. The Cabinet Budget Review Committee is not usually involved in annual changes unless there is a proposed fare reduction.	Default increase is the Brisbane September quarter CPI rate. Fares historically have fluctuated greatly.	No regular scheduled processes. Most recent review was a 2016 Fare Taskforce Report
SA	The South Australian Government undertakes an annual review of all government fees and charges, including public transport fares. Fares are given legal effect by the Minister for Infrastructure and Transport	Indexation rate applied to all government fees and charges.	No regular scheduled processes.

⁸⁸ Internationally, large local or city governments typically operate public transport. However, this is not suited to Australia as its system of local government is fragmented and covers smaller geographic areas, making transport provision and policy inefficient at this level (as highlighted by the Industry Commission as far back as 1994 (IC 1994)). However, there are exceptions where larger councils operate transport services, like the Brisbane City Council.

	Fare setting responsibility	Usual annual changes	Long-term fare setting institutions
WA	The Public Transport Authority prepares a submission to the WA Government Expenditure Review Committee, endorsed by the Minister for Transport, with input from Treasury. Part of the WA Government fees and charges budget process.	Set in line with changes to other government services, as part of the Government fees and charges budget process.	No regular scheduled processes. Infrequent internal reviews, for example a recent 'Public Transport Cost and Bus Service Optimisation Project'.
Tas	Fare changes are developed within the Department of State Growth, approved by cabinet, and signed off by the Minister for Infrastructure and Transport.	Reviewed as part of annual budget processes. Fare increases are normally restricted to CPI or less.	No regular scheduled processes. Tasmanian Economic Regulator held fare setting role until 2015. Stated intention to review fares on a five-yearly basis going forward.
ACT	Transport Canberra and City Services produce a regulatory proposal, which is endorsed by The Minister for Transport, and passed by the ACT legislative assembly.	Typically revised in line with CPI.	No regular scheduled processes. Most recent review was in 2017, as part of a trial to provide free off-peak transport to concession holders.
NT	Occurs as part of Northern Territory Government Decision processes, with the Department of Infrastructure, Planning and Logistics providing options to their Minister.	Fares have not changed since 2013.	No regular scheduled processes.

Source: IPART (2020c); Transport Canberra, pers comms, 9 Sept 2021; Northern Territory Department of Infrastructure, Planning, and Logistics, pers comms, 27 Sept 2021; Translink, pers comms, 5 Aug 2021; South Australia Public Transport Authority, pers comms, 5 June 2021; Tasmania Department of State Growth, pers comms, 1 Sept 2021; Victoria Department of Transport, pers comms, 24 June 2021; Transperth, pers comms, 9 June 2021.

Minimal review processes

While most jurisdictions update their fares annually, these reviews typically only consider whether there should be a flat percentage increase in fare levels for the following year. Fare levels often change only by the consumer price index (CPI) annually (meaning no change in real fares), or not at all (meaning that fares are declining in real terms) (table 8.2). In both Western Australia and South Australia, this annual assessment is integrated into reviews of broader government fees and charges, so public transport fares increase in line with the cost of other government services (for example parking levies).

These annual review processes generally do not examine holistically the interaction between:

- the *base fare* level — whether the current level of real fares is meeting a jurisdiction's needs, and reflects the overall social marginal cost (SMC) of transport provision, including the interaction with road transport and congestion
- the *fare structure* — whether the current mix of, and differentials for, peak, modal, and distance-based pricing are optimised, given the desirability of using network spare capacity, managing public transport crowding, reducing road congestion, and reflecting the varying costs of different services (as discussed in chapters 2 to 5)

- the *equity outcomes* of the transport network — whether overall price settings are consistent with the equity objectives of the jurisdiction, and in particular the alignment of eligibility requirements and price differentials for concessions with those objectives.

When jurisdictions do consider these factors, it is often on an ad hoc basis. Indeed, no jurisdiction other than New South Wales schedules regular reviews of base fare levels, fare structures, or concession policies. Several jurisdictions have reviewed some of these factors over the past decade (such as in Victoria and Western Australia), though these were one-off reviews targeted to a specific policy challenge. As a result, fare settings are largely historical artifacts, and, in many cases, the underlying fare structures have not been examined in several years.

Over a few years, the simple heuristic of CPI-based changes will often be a pragmatic option given the intricacies of informed price setting. However, most jurisdictions do not mandate that fare increases keep up with CPI, which means that real fares can gradually decrease — as has occurred in several jurisdictions over the past decade (discussed later in this section). If governments never increase fares above CPI (as has been the case in several jurisdictions since 2015), intermittent fare freezes or reductions lead to declining real fares and therefore declining cost recovery rates (chapter 1).

Table 8.2 – Fares often increase in line with inflation, or not at all
Jurisdictional price changes from 2015–2021, count of annual change

City	Fare increases above CPI	Fare increases by CPI (or function of) ^a	Constant in nominal terms	Changes to fare structures ^b
	No.	No.	No.	No.
Sydney	0	5	1	1
Melbourne	3	2	0	2
South-East Queensland	0	3	3	1
Adelaide	0	6 ^c	0	1
Perth	2	3 ^c	2	0
Hobart	3	1	2	1
Canberra	4	1	2	0
Darwin	0	0	7	0
Total (% of changes)	21%	38%	30%	11%

The first comparison year is 2015 changes relative to 2014. **a.** Based on the state level CPI change, or the CPI change of the recent quarter (rather than annualised rate). **b.** Includes broad reform or any general restructuring of several fare categories, such as the introduction of off-peak discounts, significant changes to price differentials, or major changes in zones. **c.** Perth and Adelaide's public transport fares usually increase by an 'indexation rate' which accounts for a bundle of factors, including the CPI.

Source: Commission analysis of public transport fares, unpublished ABS data, and jurisdictional media releases.

A lack of transparency and clearly defined objectives

Some aspects of fare setting are opaque, including:

- fare setting objectives — a recent report on fare setting identified that 'no Australian jurisdiction has clearly articulated its objectives for its urban public transport system in a holistic manner' (TTF 2016, p. 4).

Infrastructure Victoria (2020a, p. 26) reached the same conclusion in its review of Victoria's fare structures, stating that 'public transport fare setting currently lacks clear objectives and transparency'. The lack of transparency may relate to a general ambiguity about the objectives of public transport generally

- fare setting methods — limited information was publicly available about how prices are set across jurisdictions. The lack of public information may occur partly because fare setting is part of the budget process in most jurisdictions, where decisions may be subject to cabinet-in-confidence requirements. This problem is also exacerbated in jurisdictions that conduct little or no external stakeholder engagement or testing. As a result, constituents are informed of changes once fares are set, but are given little input on — or prior expectation of — fare setting processes and strategies. The lack of regular review (discussed above) reduces opportunities for public engagement and contributes to policy inertia. It may give the impression to constituents that changes are arbitrary and susceptible to lobbying
- the expected outcomes of pricing decisions — when implementing fare changes, most jurisdictions do not publish information on the expected consequences, including impacts on patronage, cost recovery, subsidy levels, and road congestion. This may reflect the lack of analysis underpinning fare decisions, where some jurisdictions do not undertake modelling or cost-benefit analysis of fare changes.

Notwithstanding, there are positive exceptions. For example, the Western Australian government announced that implementing proposed zone pricing reforms is expected to reduce road congestion by 5300 cars per day (Zimmerman 2021). The Government, and other stakeholders, can therefore attempt to quantify whether the policy has met expectations.

More transparent fare setting processes are valuable to public transport users and the broader community. As noted in previous chapters, pricing can require inherently subjective trade-offs between desirable system objectives, such as efficiency and equity. To the extent governments articulate how they conceptualise these objectives, this allows for a more informed public debate and greater understanding of policy decisions. Currently, no jurisdiction has public an explicit framework that explains how trade-offs are made between affordability goals and efficiency.

Transparency can also improve accountability of policy decisions. For instance, jurisdictions often emphasise the importance of improving 'affordability', 'access', or 'patronage', but these objectives would be more meaningful when clearly defined, measured, monitored and (potentially) subject to targets. Ultimately, this could improve public understanding of whether pricing and policy decisions are achieving their intended aims, and whether worthwhile trade-offs are being made.

Political incentives to avoid increasing — or changing — real fares

Reforms to increase cost recovery are politically difficult and rarely occur

The Commission has been consistently told that in all jurisdictions, fare setting is largely shaped by ministerial discretion. This contrasts with other networks like water, sewerage, and electricity, where pricing processes are more formalised and transparent (a reflection of the role of regulators in containing excessive and inefficient prices in such natural monopolies). Due to competing options for urban mobility (chapter 1), there is no capacity for public transport operators to charge prices that exceed the full efficient costs of supply, so the competition policy rationale for oversight does not exist.

In all jurisdictions, the responsible Transport Minister has discretion (often through cabinet processes) for final fare setting decisions (table 8.1 above). In many policy contexts, explicit allowance for ministerial (or administrative) discretion has the virtue of allowing flexible responses to unanticipated circumstances, which

prescriptive arrangements may not allow.⁸⁹ It also allows for community views to be represented when there are subjective trade-offs, for example between equity and efficiency. Nevertheless, ongoing unfettered discretion has considerable drawbacks, especially if not framed by clear guidelines and policy, and can leave governments exposed to short-term political pressures to meet one group's needs over another, and tends to arbitrariness. In public transport, the dilemma is that fare increases have immediate and adverse (and therefore politically unpalatable) financial impacts on customers, whereas budgetary pressures and system sustainability are less immediate and borne in less transparent ways by the community.

Ministerial discretion is often exercised as part of election commitments, which tend to lower public transport fares or fail to adapt to cost pressures (box 8.1). This is an indication of the political, social, and economic importance of public transport, but it leaves open the risk of ad hoc pricing decisions that are inconsistent with those that would be intrinsic to a long-term strategy for sustainable high-quality services.

Box 8.1 – Fare policy is often determined by electoral commitments

There have been several recent examples of fare changes during election periods.

- The Victorian Government introduced the free tram zone in Melbourne's CBD in response to an election commitment. Then Opposition leader Daniel Andrews stated that 'it won't matter who you vote for on [election day], our public transport system's going to be cheaper' (ABC News 2014).
- The NSW Government introduced a \$50 a week fare cap after committing to the policy at the 2019 State Election (NSW Liberal Party 2019).
- The Western Australian Government recently committed to reducing the number of fare zones from nine to two in its 2021 re-election campaign, which will be a large fare decrease for many users (Zimmerman 2021).

There is also some more systematic evidence that fares are affected by election cycles. Commission analysis of unpublished ABS data finds that, since 2000, real public transport fares in capital cities:

- declined in election years by an average of 0.3 per cent. In jurisdictions other than Western Australia and Tasmania, real fares declined during election years on average
- remained approximately constant on average in the year preceding an election
- increased by an average of 1.4 per cent in all other years.

While there has been some limited success in re-structuring fares, it has been difficult to raise the base level of real fares. For instance, a series of significant price increases took place in Brisbane from 2010 to 2012, but the anticipated rate increase in 2013 was halved, and in November 2014, fares were reduced and then subsequently frozen due to public backlash (TTF 2016, p. 8).

Advocates for fare increases have generally recommended change be gradual to make it more tolerable to constituents (for example, IC 1994; strategy& et al. 2015). It may be that public acceptance of fare increases would be greater if some of the increased revenue was also used to make low-cost improvements to

⁸⁹ At the Australian Government level, a recent example is the time-limited discretion granted to the Minister for Social Services to alter eligibility rates and payment rates for all social security matters — which allowed for great flexibility in response to the COVID-19 pandemic (under the *Social Services and Other Legislation Amendment (Extension of Coronavirus Support) Act 2020* (Cth)).

passenger experience, for example by better integrating services, or by using technology to better inform user choice (chapter 7).

Attempting to reduce or restrict concession discounts is also particularly contentious. The NSW Independent Pricing and Regulatory Tribunal's (IPART's) 2016 review into public transport fares received over 600 submissions regarding a proposed change to increase the fare cap for the Gold Opal card received by seniors (IPART 2016b, p. 79). The NSW Government did not adopt IPART's recommendation to raise the cap, and the Gold Opal fare cap has remained unchanged for the past decade.

How much do fares really matter to consumers?

Not surprisingly, *all other things being equal*, public transport users prefer lower fares, as they do for (almost) any product. This may be reinforced by some of the distinctive features of the role of, and demand for, public transport.

- Public transport fares are highly visible, given that most commuters pay for services regularly (although some jurisdictions offer weekly or monthly passes) which means that shocks to prices are obvious and salient.
- For some users, there are no feasible alternative options to public transport, as suggested by the low price elasticities of demand at current fare levels. So modest price increases translate to revenue gains for government and equivalent reductions in income for users.
- The role of public transport as a human service means that government subsidisation — and therefore 'low' fares — have community support (chapter 1).
- The fact that there is just one price setter (the government) may create the (mis)perception that price increases reflect the exercise of market power. (As noted in chapter 1, there is no realistic scope to increase fares to the very high level needed to recover the full costs of the service.) This may be accentuated by lack of awareness by passengers of the extent to which public transport is subsidised, so that people may not see existing fare levels as 'low'.

There may also be a broad community assumption that a public transport system can only function with low fare levels. Notwithstanding people's views about the desirability of low fares, the evidence suggests that they rate travel times and frequent services as more important (Hensher, Mulley and Rose 2015).⁹⁰ In addition, people give as much weight to 'value for money for the taxpayer' as low fares, suggesting some awareness that subsidies for public transport must be financed through taxes (or displace other services). Other survey evidence found about 75 per cent of people in 2021 were unwilling to pay more taxes for better transport services, a figure that has increased over time (Dawson and Lloyd-Cape 2021). And a sizeable share of the population think they already pay too much tax.⁹¹ However, it is important to acknowledge that surveys may suffer from response biases⁹².

If there is a perception that higher fare levels would significantly discourage public transport patronage, the facts belie this. Existing fare levels do not appear to comprise a major barrier to public transport access. For instance, in response to an Australian Bureau of Statistics (2012) survey, 6 per cent of respondents claimed that the reason they did not access public transport was it was 'too expensive', compared with over

⁹⁰ Surprisingly, while commuters value service quality more highly than low fares, 'higher fares to pay for higher quality services' was the least favoured option. This may reflect public distrust that higher fares would actually translate into improved service quality.

⁹¹ Successive surveys of adult perceptions from 2010 to 2021 show that between 45 and 35 per cent said they paid too much tax, while about two per cent said their taxes were too low (Dawson and Lloyd-Cape 2021, p. 13).

⁹² For example, a participant may state a preference for lower taxes without conceptualising the opportunity cost of this preference (reduced government spending or increased government debt).

52 per cent who claimed the reason was to do with service availability. A 2021 ACT government survey found that just 9 per cent of non-public transport users found cost a barrier, compared with 56 per cent who complained about travel times. A 2015 study of the travel preferences of university students in Queensland found that once travel time and distance were controlled for, cost had no impact on travel preferences (ACT Government 2021; Wang and Liu 2015).

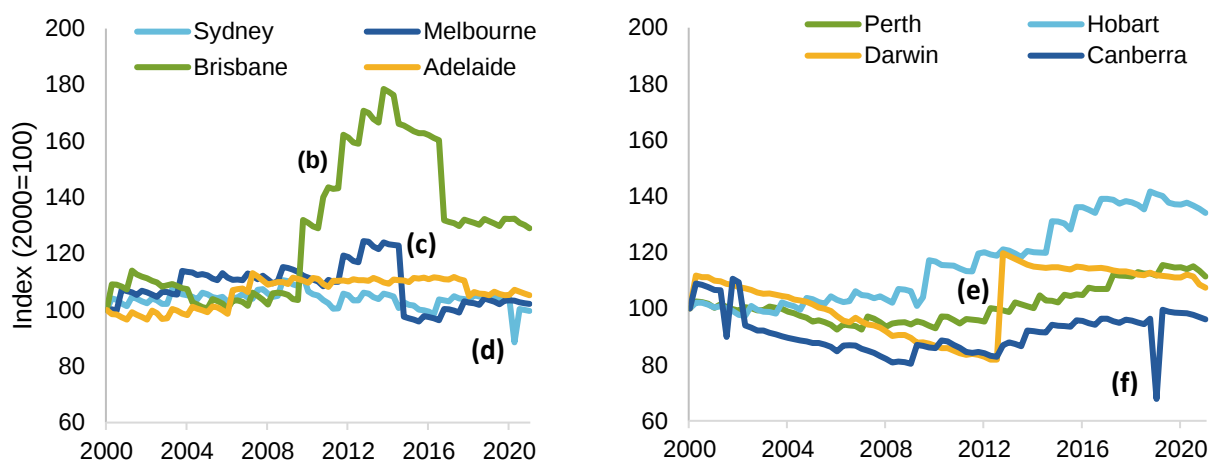
Overall, the evidence suggests that although the public expresses a preference for lower fares, it is not the most important public transport issue for the community. Therefore, they may not be as opposed to incrementally higher fares if they were partially offset with improved service conditions.

Real fares remain stagnant or are declining in most jurisdictions

The net effect of the three previous points — minimal review processes, transparency and accountability issues, and political incentives toward low fares — is that real fare levels tend to be stagnant and do not respond to changing conditions. Since 2000, the public transport fares index has only risen in real terms by 5.1 per cent across Australia's 8 capital cities (figure 8.1). More recently, real fares have *declined* in some jurisdictions. The cost of a short trip on the most common public transport mode is now lower in real terms than it was in 2013 in 5 major cities (figure 8.2).

Figure 8.1 – In most cities, real fares are similar to 20 years ago

ABS public transport price index in each major city^a, 2000–2021



a. Index is compiled by the ABS as one category in the Consumer Price Index. **b.** The price increase from 2008–12 in Brisbane reflects a series of fare increases made to increase cost recovery. **c.** The drop is the result of zone reform and the introduction of the free tram zone in Melbourne. **d.** The 2020 drop reflects the introduction of temporary COVID-related discounts and off-peak discounts for buses and light rail in Sydney. **e.** In 2013, a one off change in Darwin bus fares increased the base single fare from \$2 to \$3. **f.** Following the introduction of light rail in Canberra, free travel was offered for a month.

Source: Commission analysis of unpublished ABS data.

Where large fare changes have occurred, they have typically been a one-off change to fare structures resulting in a fare decrease (for example through zone reform).⁹³ Substantive fare reform increasing base fare levels is particularly rare – the backlash from attempts to raise fares in some jurisdictions may have

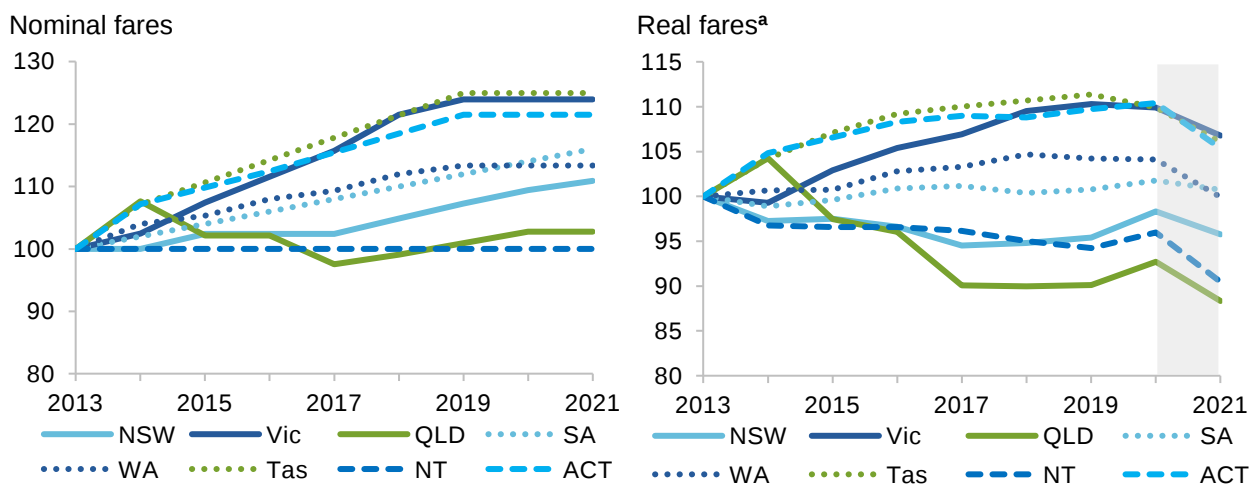
⁹³ Examples of this include Melbourne's free tram zone and zone reform in 2014, Queensland's zone reform in 2017, Canberra offering free light rail transport in 2019, and Sydney introducing a temporary off-peak discount in 2020 in response to the COVID-19 pandemic. Such reforms can sometimes lower the average costs borne by consumers by well over 10 per cent.

discouraged governments from pursuing real fare increases, and the COVID-19 pandemic also led to fare freezes in most jurisdictions.

Stagnant real fares are not a problem if fares were initially well-set and remain appropriate. However, independent modelling suggests that most fare levels are inefficiently low, particularly in peak periods (chapter 3; Infrastructure Victoria 2020a; IPART 2020c). Despite IPART consistently recommending fare increases over the past decade in Sydney, real fares are lower than in 2009 (IPART 2020c).

Figure 8.2 – Base fares have lately stagnated or declined in most cities

Change in the fare of a jurisdiction's shortest trip, 2013–2021, Index 2013=100



a. Finding comparative fares between jurisdictions is challenging due to different structures and factors. This chart reports: a) the shortest possible trip in a given time period, by zone or otherwise, b) where a jurisdiction has peak pricing, the peak fare is selected, c) where a jurisdiction has modal pricing (NSW) the most common mode is selected (train), d) where there is a price differential between a single ticket and a smart card, the smart card is selected. The nominal fares are converted to real values using the consumer price index for all groups for the relevant capital city. The shaded area on the right hand chart indicates that declines in 2021 were due to high inflation in the June Quarter.

Source: Commission analysis of jurisdictional public transport fares and ABS 2021, *Consumer Price Index, Australia, June*, Cat. no. 6401.0.

Furthermore, stagnant fares stand in contrast to increased public transport operating costs (chapter 1). In New South Wales for example, total operating costs have risen by 7 per cent per annum from 2014 to 2019. As fares are not responsive to changing service conditions that affect operating costs, either taxes must rise to meet the rising gap between costs and revenue, service quality must fall, or other government spending must be reduced. As noted in chapter 1, most jurisdictions have cost recovery rates well below 30 per cent of operating costs, and these rates have tended to decline over the past 5 years.

Despite these issues, periodically stagnant fares, low cost-recovery rates, and policy inertia are not concerns unique to Australia, nor are Australia's fares abnormally low by international standards. Cross-city analysis of fare levels (relative to purchasing power) find that Australia fares are mostly in line with other comparable cities (although some Australian cities, such as Darwin, rank among the cheapest) (NineSquared 2021). Further, Australia has largely avoided the temptation to offer city-wide free public transport, which has been implemented in several European and American cities (Papa 2020).

Nonetheless, the concerns identified thus far in this chapter are real. Australia could lead the way internationally on public transport fares by adopting a coherent long-run approach to fare setting, underpinned by stronger institutional arrangements designed to mitigate these issues.



Finding 8.1

Status quo fare setting institutions

Current arrangements in fare setting in most jurisdictions are characterised by minimal review processes, unclear objectives and a lack of transparency.

Most jurisdictions suffer from policy inertia; fare structures appear to be historical artifacts rather than based on a coherent long-run fare setting approach. Real fare levels have fallen in some jurisdictions and remained stagnant in others over the past few years, despite rising real operating costs.

8.2 Improving institutional arrangements

There are three different models to price setting that can overcome the challenges identified in the previous section (table 8.3).

Table 8.3 – Three institutional models for fare setting

Institutional model	Benefits	Risks
Ministerial decision with review process centralised within departments	- democratic accountability that reflects community preferences - flexibility for government policy to adapt to changing circumstances - centralised and integrated transport policy may increase likelihood that fare policy that is consistent with broader policy.	- limited review and insufficient assurance of efficient and equitable fares - lack of transparency and clearly-defined objectives - incoherent policy, given influence of electoral commitments and policy inertia - may erode long-term sustainability of networks, or lead to increasing subsidies with a mismatch between fares and costs.
An independent body conducting periodic review	- scheduled regular reviews acts as a check on policy inertia - use of social marginal cost principles establishes magnitude of benefits and helps frame trade-offs - independence provides a check on political incentives - stakeholder engagement results in a better understanding of community preferences.	- costs to establish institutional expertise may be significant relative to the benefits, particularly in smaller jurisdictions - some degree of imprecision in social marginal cost pricing - still need to consider weight given to efficiency and affordability objectives - mechanism to regulate government behaviour needs to be well-suited to address political pressures for low fares.
Operator autonomy in fare setting (subject to some degree of regulation)	- operators are well placed to understand demand characteristics for their services - counteracts political incentives toward low fares, and may result in higher quality services.	- incentive risks related to subsidy levels and 'gold plating' - would require governments to calculate externalities to determine subsidy levels - could result in fare inconsistencies where there are multiple operators.

Ministerial decision with departmental review processes

Across all jurisdictions the relevant transport Minister is responsible for setting fares, which is usually conducted through budget processes informed by advice from government transport departments. Though it has some disadvantages, this approach is flexible, entails some accountability through the political process, and recognises that decisions about the weight to give to efficiency versus equity is not a purely technocratic issue, but involves norms that partly reflect political perspectives.

Fare setting processes that are centralised within the transport department are also arguably less resource intensive to administer, and may increase the likelihood that fare policy is integrated with broader transport policy compared with a separate fare setting process. Moreover, transport departments are free to undertake analysis in a manner akin to IPART. The Commission has heard that several jurisdictions have undertaken internal modelling and policy analysis of fare changes to help inform network efficiency.

However, the evidence about fares suggests that the outcomes associated with the status quo have neither been efficient nor necessarily fair (chapters 3,4 & 6).

While this approach is common, it could be improved by identifying more clearly and publicly the measurable objectives of the price setting mechanism and relevant metrics on efficiency and equity, and then regularly assessing and publishing the degree to which policy has achieved its goals. This could provide a more coherent basis for fare setting (and for community understanding). Additionally, the assessment of outcomes could then feed through to new objectives and incentives to further align pricing to the long-run community interest.

Consider the example of free trams in the Melbourne CBD. This was costly for Victorian taxpayers at about \$10-13 million a year, clearly did not achieve equity goals (chapter 6), and led to overcrowding on trams, but with no real effect on road congestion (Legislative Council Economy and Infrastructure Committee 2020). This policy experiment may not have proceeded in the first place if different decision-making ‘infrastructure’ been in place.⁹⁴ (The open assessment by IPART of a free transport option in Sydney is telling, as discussed below.)

An independent agency

Independent agencies and regulators have been used in several jurisdictions globally to manage political incentives and transparency issues in fare setting processes. For example, Singapore has had an independent Public Transport Council since 1987, which sets fares based on estimates for input costs and inflationary pressures (Looi and Tan 2009). Similarly, New York city’s Transit Authority functions as a public-benefit corporation that has arm’s-length responsibility for setting fares (MTA 2021).

However, the exemplar (both in Australia and globally) is New South Wales, where an independent body, IPART, undertakes regular fare assessments for consideration by government but with the statutory authority to set a ceiling on the weighted average of fares (box 8.2). Legislation specifies a wide range of matters that IPART must consider in reaching its conclusions, so the basis for its conclusions are not narrow, adding to the credibility of its findings. Given the unique characteristics of public transport fare setting — such as the significant social benefits and costs associated with provision — the Commission considers that the preferred fare setting model involves an independent body, akin to IPART’s role. The critical difference in New South Wales compared with other Australian jurisdictions is that although the relevant transport minister still has the final say, the advice received is transparent through the IPART process.

⁹⁴ This is also highlighted when the policy was eventually reviewed ad hoc by an independent agency utilising SMC principles – Infrastructure Victoria’s *Fair Move* – they recommended the abolition of the free tram zone.

Box 8.2 – The IPART approach

The NSW Government uses an independent regulator to oversee public transport fare-setting: the Independent Pricing and Regulatory Tribunal of NSW (IPART). IPART's role in fare setting is determined by legislation (the *Passenger Transport Act 2014* (NSW)) and by government policy of the day. Under the Act, the NSW Government may ask IPART to determine appropriate maximum fares for broad passenger services or for specific fares or classes of fares. As a matter of policy (not legislation), the Government requires that IPART regulate Opal fares with a weighted average price cap. This is the annual increase allowed for the weighted average of fares purchased by passengers. The NSW Government has imposed a legislative constraint upon itself (s. 125) by requiring that it not set fares that exceed IPART's determination of the maximum growth rate. There are two implications of these arrangements. First, the NSW Government can set fares for any *given* fare higher than this maximum, but if it does so, must set lower growth rates for other fares such that the cap is not exceeded. Second, the NSW Government could move away from a weighted cap without legislation.

Under s. 124, the Act provides clarity about the matters that IPART *must* consider in reaching its conclusions, including:

- (a) the cost of providing the services
- (b) the need for greater efficiency in the supply of services so as to reduce costs for the benefit of consumers and taxpayers
- (c) the protection of consumers from abuses of monopoly power in terms of prices, pricing policies and standards of service
- (d) the social impact of the determination or recommendation
- (e) the impact of the determination or recommendation on the use of the public passenger transport network and the need to increase the proportion of travel undertaken by sustainable modes such as public transport
- (f) standards of quality, reliability and safety of the service
- (g) the effect of the determination or recommendation on the level of Government funding.

In meeting these requirements, IPART:

- conducts modelling that quantifies the financial costs of service provision (through a 'building block approach') and the external costs and benefits of public transport, such as road congestion, the marginal excess burden of taxation, and road accidents
- receives stakeholder and community feedback through submissions and user surveys
- provides forward estimates of cost recovery rates
- makes broader recommendations on fare structures and concessions
- considers affordability as an additional criterion in determining its final fare recommendations.

In this regard, IPART is the only government body that explicitly considers a social marginal cost framework — and undertakes to quantify these costs — in regular reviews of fares.

All reports and methodologies are also made public, albeit with differing levels of detail about the derivation of results. Nonetheless, this public information makes the NSW public transport system the most transparent in Australia.

Benefits of the IPART approach

There are three main benefits associated with the IPART approach.

First, its use of social marginal cost principles better frames fare setting decisions and trade-offs. SMC has long been established in the literature and in practice as a framework that can optimally consider the full benefits and costs associated with public transport decision and use, thereby providing a better basis for considering the trade-offs implicit in fare setting (chapters 2, 3, 4 and 5). For example, a policy maker may be considering a public transport fare cut to reduce road congestion (chapter 5). Intuitively, decreasing fares might increase public transport patronage, and therefore reduce road congestion. But *to what extent* the fare decrease will reduce road congestion, and whether it is a cost-effective solution, requires quantification of the costs of congestion, extent of modal substitution, and user responsiveness to fare changes — all of which are inputs to IPART's modelling approach. Such an approach supports governments to consider reform options with greater confidence of the consequences.

For example, Sydney did not have off-peak discounts for bus trips until 2020. While there is a strong in-principle argument for off-peak discounts (chapter 3), IPART's modelling provided a basis to estimate the magnitude of the costs and benefits of change — alongside the suitable price differentials — and to conclude that such a policy would deliver community benefits.

Second, a body like IPART brings into play a well-specified due process for fare determination, subject to broad policy parameters set by government. IPART's periodic review provides a transparent and independent check on government policy, as well as a sound evidence base to inform both the community and government decisions. It has also led to reform in practice — for example, the NSW Government accepted IPART's recommendations for off-peak buses and light rail pricing, and for a \$2 rebate upon switching transport modes (IPART 2016b, 2020c; TfNSW 2020a). IPART has also historically provided a strong rationale for modal, peak, and distance-based pricing (chapters 3 and 4). Indeed, Sydney is the only Australian city to implement this trifecta of pricing policy.⁹⁵

As an independent agency, IPART is shielded from political pressures and is asked to make recommendations in the longer-term public interest, even if they may risk being unpopular in the short term. For example, IPART recently published a report on the potential effects of city-wide free fares in Sydney, concluding that such a reform would have severe negative impacts on the network (IPART 2020b). As such, IPART's influence extends not just to recommending good policy, but pre-empting and discouraging ineffective policy solutions.

Third, its process of stakeholder engagement, and publication of its rationale and methodology for fare setting decisions can improve transparency and better inform community debates about policy choices. For example, IPART's 2016 review into fares received over 1200 submissions (IPART 2016b). Moreover, in conducting its reviews, IPART publishes a variety of data and estimates — such as cost recovery rates, time-of-day estimates for patronage, and efficient fares — that both informs researchers and the community, and supports meaningful engagement when considering fare setting trade-offs and policy.

Further enhancing the IPART approach to fare determination

There may be some scope to enhance IPART's approach. With the relatively recent use of SMC modelling, there is room for further iteration and improvement, and this will likely improve organically as part of further fare reviews and ongoing research. However, other possible directions for change are structural, and would

⁹⁵ However, despite consistently supporting modal pricing historically, IPART recommended the abolition of modal pricing in their 2020 review, which the Commission disagrees with (chapter 3).

require legislative amendment or a deliberate shift in IPART's approach to pricing recommendations. Other jurisdictions considering the creation of their own independent pricing body should note some of the present problems inherent to IPART's approach, discussed below.

Introducing a price 'band'?

IPART's legislated regulatory power is limited to setting maximum fares, which is administered through a weighted average price cap. The use of a price cap is a peculiar feature in the regulation of public transport. Its usual application is to suppliers of services that have clear market power,⁹⁶ and absent regulation, the discretion to set excessive prices that would generate supernormal returns for the business. As noted throughout this report, while mass transit is effectively a monopoly in each jurisdiction, services are contestable given alternative travel modes, and operators cannot and do not charge fares that are even remotely close to full cost recovery.

The risk — spelt out above — is of fares that are ill-informed, sometimes too low, and do not meet the overarching objectives of governments for an efficient, equitable and sustainable system.

This is observable in practice: the NSW Government usually sets fares significantly below IPART's weighted average fare cap. From 2016 to mid-2017 the Government did not raise fares at all, despite IPART capping fare increases at 4.2 per cent per year for this period. When it did eventually raise fares by CPI, the NSW Government (2018) justified this increase in its media release by comparing this to IPART's recommendation, as a tool to push fare affordability:

As a government, we don't support IPART's recommended average annual increase of 4.2 per cent as we believe it's more important to put commuters first and these changes show that we are continuing to do so.

This is not to say that the fare cap is never binding, or that IPART is always unsuccessful at influencing fare levels. In some instances, the NSW Government has raised fares to meet IPART's recommendations for individual fares. For example, in response to IPART's 2020 review, the NSW Government set Opal fares for 0-3 km bus and light rail trips exactly in line with IPART's recommendations, which resulted in a 42 per cent fare increase for this fare year-on-year (TfNSW 2020a). But these changes have been occasional and highlight deficiencies in the fare cap regulatory model.

An alternative pricing option would be to create a price band, best illustrated by its possible application to New South Wales. The maximum price (P_{opt}) could be based on IPART's determination of the 'optimal' fare growth rates that meet the criteria set out in the *Passenger Transport Act 2014* (and in box 8.2). This would typically be close to the maximum fare growth rates currently recommended by IPART, though the current requirement that IPART determine a weighted average price cap could be waived so that it could set fares at a more granular level, where that was warranted. Although this maximum would be rarely binding, it would be useful in signalling that the regulator is looking out for the interests of both passengers and taxpayers, and would avoid circumstances where the public subsidy was set too low (such as might occur if the price exceeded that arising from the SMC approach).

The minimum price (P_{min}) could be the minimum of P_{opt} and an objectively measured growth rate (P_g) that has a clear link to either the affordability of services or to the long-run budget sustainability of transport services. In the former case, the obvious candidate would be the consumer price index (CPI) as it is regularly

⁹⁶ For instance, energy and water suppliers. An Australian example of the use of price caps is regulation of the energy provider Evoenergy in the Australian Capital Territory (Evoenergy 2021).

and authoritatively measured, well understood, and has an established pedigree in price regulation.⁹⁷ In the latter case, one candidate would be the growth in the long-run incremental costs of public transport.

Consequently price growth would be between a low of $\text{Min}(P_{\text{opt}}, P_g)$ and a maximum of P_{opt} . If P_g was set at CPI growth, the only case in which prices would grow by less than the CPI would be if IPART determined that price growth was less than general inflation (say due to productivity improvements or to address some emerging externality). The preferred price growth factor would be P_{opt} , but adopting P_g would at least build in both maintenance of affordability and better cost recovery than excessively large price decreases. It would also improve fare predictability. It is notable that IPART's fare recommendation for 2020–2024 was premised on a rate that would, by 2024, bring fares up to the real value they were in 2009. More generally, the experience of fares across jurisdictions is that they can oscillate sharply between significant fare increases, cuts and freezes (most exemplified by fare variability in Queensland from 2010 to 2017 as discussed earlier), which could partly be addressed through price floors.

There may be merit, therefore, in a government 'tying its own hands' through a more binding mechanism for price regulation that would see nominal fares respond more to economywide costs. This approach would remove the direct pressure on governments to keep fares inefficiently low, and over time constituents could accept fare increases as a largely apolitical process, as is now accepted in other regulated utilities (such as water and electricity).

Governments could of course choose anywhere between the maximum and the minimum under this arrangement, taking account of their views about affordability, efficiency, and budgetary pressures. However, in considering the role of affordability in pricing, governments could:

- set out guidelines to any independent agency about its affordability goals and measures so that the agency is able to provide advice that is consistent with the equity goals of government
- focus on setting concessional fares or other targeted approaches to achieve affordability, and forgo control over prices generally, such that an independent agency would set fares directly.

Either option would still provide the government with some flexibility in fare setting to pursue its particular objectives.

The level of precision and underlying assumptions

Though social marginal cost pricing is a useful framework, it is dependent on estimated and imprecise parameters⁹⁸ and a variety of assumptions about what is important enough to include. For example, IPART wisely does not include agglomeration externalities or social inclusion benefits in their model because it would be difficult to formulate and justify the elasticities between fare levels and these externalities. Others give more prominence to the importance of these factors. For example, some argue that agglomeration externalities of public transport are material and should be incorporated in pricing (Horcher et al. 2020). This view implies that the omission of these externalities would result in IPART's recommended fares being too high. This example demonstrates how modelling choices can have significant effects on fares outputted.

⁹⁷ There are alternatives such as the wage price index, which would keep the number of minutes of work to purchase a standard ticket at the same level, or average household equivalised income, which would keep fares at a fixed share of household income. But the CPI is the simplest and well-understood.

⁹⁸ The significant variations in price elasticities for public transport are testimony to the dilemma. Estimates can often vary by a factor of two or more and strongly influence the importance of congestion externalities associated with road use — a core feature of social marginal cost pricing.

While estimates of demand elasticities and the marginal excess burden of tax are imprecise (as shown for example, in box 8.3), there is at least a large body of work that gives a reasonable idea of their likely range. This means that it is possible to assess the impact of lower public transport fares on the congestion externalities of road use and the economic costs of raising revenue to subsidise public transport — both essential factors in determining optimal prices.

Box 8.3 – Estimating the marginal excess burden of taxation

The marginal excess burden of taxation (MEBT) is the societal deadweight loss through raising an additional dollar of taxes that distort consumption, investment, or labour supply. The MEBT is a key input for social marginal cost modelling because fares set below the marginal financial cost requires government subsidies to meet the shortfall.

There is no consensus about the MEBT for a given tax, nor the right tax to be used for additional funding. IPART uses an 8 per cent MEBT (i.e. every dollar raised costs society 8 cents in lost economic activity) based on the deadweight loss of raising additional revenue through increasing the Goods and Service Tax (GST) (IPART 2014). They argue:

... it is more reasonable to use the marginal excess burden associated with the GST rather than the weighted average of NSW state taxes or NSW total revenue. Using the most efficient tax for the estimate of excess burden is consistent with our current approach to fare setting of calculating the efficient cost for delivery of public transport services, and deducting the government subsidy from this. (p. 70)

This is a contentious choice. 8 per cent is one of the lowest estimates of the MEBT for GST in the economic literature — a 2015 Treasury working paper suggests the MEBT of GST may be more than twice as much, at about 17 per cent (Cao et al. 2015). Other estimates vary between 15 and 18 per cent (Murphy 2016; Nassios et al. 2019). Moreover, State and Territory governments do not control the rate of the GST because it is levied by the Australian Government, so it is difficult to conceive how an additional dollar of transport subsidy could be levied through the GST. Taxes fully within the control of State governments usually impose greater marginal economic costs on society, such as conveyancing duty which have MEBTs that are close to, or sometimes exceed, one dollar of efficiency loss per dollar of revenue raised (Murphy 2016; Nassios et al. 2019).

Infrastructure Victoria's modelling took a different approach to the MEBT, using a 'bundle' of taxes to estimate the deadweight loss from the marginal tax to fund services (CIE 2020a). While it is debatable which approach is more appropriate, it is important to note that these judgements affect the headline results. IPART's estimate would systematically return a lower efficient fare than Infrastructure Victoria's modelling, holding all else constant.

Fare estimates will likely be imprecise and may vary widely, as modelling social marginal cost depends on subjective decisions about included externalities (exemplified by the agglomeration example), and the parameters that should be used for variables included in the model (exemplified by the marginal excess burden). This variation may justify a regulator setting a range for the likely socially optimum fare, rather than a point estimate. A range would also align with the principle of introducing a price 'band', rather than regulating a single maximum fare, discussed above.

A price band would also have several other useful outcomes. It would remove the illusion that there is just one unquestionably ‘right’ number. And it would give governments a greater capacity to consider the consequences of different plausible pricing choices. An understanding of what generates the variations in SMC modelling could also help motivate and direct further research. Over time, this could be expected to result in more robust estimates.

The impact of fares on disadvantaged groups and social inclusion

The equity consequences of fare setting (chapter 6) may clash with efficiency objectives, requiring a trade-off between the two. In this regard, a positive feature of the New South Wales approach is that IPART, as part of its mandate, assess how its proposed fares will impact affordability for the public. It also makes recommendations for fare concessions — for example, IPART recommended increasing the Gold Opal concession fare cap from \$2.50 to \$3.60 in 2016 (IPART 2016b). Both are valuable contributions, and all jurisdictions would benefit from undertaking such analysis.

More generally, governments have often insufficiently examined the equity impacts of fare changes, which risks policies that do not genuinely promote equity, while undermining efficiency. The Commission heard examples of fare reductions or freezes in the name of ‘affordability’ for commuters, and to benefit people experiencing disadvantage — despite negative impacts on efficiency — without supporting evidence about their equity impacts. Sometimes fare changes are both efficient and meet the needs of low-income users, but where this is not the case, information on the distributional and social impacts of public transport pricing (and service provision) would help guide government decision making about the right balance. More specific jurisdictional analysis of the kind undertaken in chapter 6 would be a starting point for progress in this regard.

In addition to analysing the distributional and social effects of fare changes, a key question is whether an independent body should make judgements — indeed, binding price regulatory decisions — about the appropriate fare structures and levels based on *affordability* as well as efficiency criteria. A risk of doing so would be that a government could set fares below the regulated price on affordability grounds, despite the regulated fare imposed by the independent body already accounting for affordability — meaning it is ‘double counted’. Though this risk might be partly ameliorated through the introduction of a regulated minimum price, it also raises the concern that independent bodies may not be best placed to consider efficiency and equity trade-offs, as these are often subjective and require an assessment of community values (chapter 6). It may be better for an independent body to instead provide a supporting empirical assessment of different fare *options* and the impacts of fare changes on people experiencing disadvantage. Governments could then draw upon this assessment to inform how they respond to fare recommendations. An alternative approach might be for governments to specify — in their directions on the conduct and remit of an independent body reviewing fares — measurable criteria for affordability to guide independent advice on these trade-offs.

How applicable is the IPART model to other jurisdictions?

Currently New South Wales is the only jurisdiction globally to combine the rigour of SMC pricing with the benefits of an independent regulator. Other jurisdictions could consider adopting a similar approach.

Infrastructure Victoria (IV) (2020a) has recommended that the Victorian Government should implement an advisory body akin to IPART that regularly monitors, researches, and advises on transport fares, which has merit given the size and complexity of Melbourne’s public transport network. Either the Essential Services Commission (Victoria’s utility regulator), or IV itself could assume this role. Indeed, IV developed an SMC model in its recent *Fair Move* report, so the decision-making infrastructure is already in existence.

For other jurisdictions, it may also be possible to leverage their existing independent economic regulators that already operate in utility regulation (such as electricity or water). Given their expertise in utility pricing,

including calculating private delivery costs, they would be well-placed to take on the task of public transport fare setting in addition to their current obligations — though it would require investments in novel techniques for the quantification of externalities. To assist with this, these regulators could draw upon the foundational work undertaken and made public by IPART when first undertaking SMC modelling.

Some smaller jurisdictions may be hesitant to adopt this model, as the benefits of an independent body likely increase with jurisdictional size. This is for two reasons.

- The problems that fare setting is intended to address, particularly crowding and road congestion externalities, are less significant in smaller cities like Canberra, Darwin, and Hobart. For these jurisdictions, the potential benefits of estimating socially efficient fares might be more marginal.
- The institutional knowledge and data required to undertake the detailed modelling used by IPART is significant, as are the resources that underpin that capability. Smaller jurisdictions may therefore incur proportionally greater costs when setting up modelling capability.

Undertaking SMC modelling does involve costs, but would likely be a worthwhile investment. The cost of developing a SMC model would only be incurred once, as fare reviewers would likely only need to tweak models gradually for subsequent reviews (as IPART does). Additionally, they could draw upon existing internal resources, such as city-wide transport models, as well as published estimates of road externalities (chapter 5).

Where jurisdictions are concerned about the time and financial costs of an independent fare review, they could still use a simpler methodology like cost benefit analysis, while still drawing upon SMC principles. Just using estimates of the full economic costs and benefits — both private and public — to inform fare settings would likely be a significant improvement on current arrangements.



Finding 8.2 **Independence in fare setting**

Independent fare regulators may help to overcome many of the issues inherent in other institutional approaches to fare setting.

While already operational in New South Wales, the involvement of an independent agency in fare setting could be valuable to other jurisdictions. Specifically, social marginal cost modelling or cost benefit analysis by an independent agency could help overcome structural policy inertia and fare stagnation.

Should transport operators have a role in setting fares?

The prices charged by a non-regulated profit maximising operator offering 'public' transport would be unlikely to meet people's needs for an affordable and universal system, especially given the spatial characteristics of Australian cities. Profit maximising operators' motivations for meeting the needs of low-income customers would be limited to profitable price discrimination, and they would have no incentive to in providing services to areas with thin demand, both of which undermine key roles of a public transport system. While passenger transport services cannot use traditional monopoly pricing given substitution from other transport forms, they may nevertheless be able to set prices too high in some market segments. Moreover, an operator has no motivation to address the positive externalities of public transport. In markets where there are multiple operators — for example, Metro Trains Melbourne, Yarra Trams, and various bus services in Melbourne — unregulated pricing could also lead to a complex suite of prices and poor service integration.

In that broad context, giving much latitude to mass transit operators for pricing autonomy appears unpromising, which is reflected in existing policy. Under current service contracts between transport authorities and operators, governments retain pricing, network planning and investment, and timetabling, while day-to-day operations are left to operators. Service contracts are complex and their design is largely premised on allocating risk to those parties best able to bear it, while avoiding unintended impacts on service quality (Allens 2021). (Whether these contracts reflect best practice is beyond the scope of this report.)

However, the question is whether there is *any* scope for operators to have a hand in pricing decisions. Operators are well-placed to understand the characteristics of the demand for their services, including to better understand passengers' preferences between prices and quality. Options for flexible fare setting could be trialled with some operators or for parts of the network. For example, transport operators could propose different fare structures and incentives if they can provide a sound business case.

One ostensibly attractive option would be for an operator to be able to offer lower prices than those set by the transport authority, which, depending on demand, may increase farebox revenue while also improving affordability. With the exception of off-peak services, it seems unlikely there would be much scope for such a win-win scenario given the existing low fares, though that option should not be relinquished.

Alternatively, operators may be given the option to set fare levels for a subset of fare types, for example, higher fares for express bus services, while subject to regulation of the broader fare level and concessions. However, such a shift would require a sophisticated revenue sharing arrangement, departing from the typical gross cost contracts⁹⁹ used between transport authorities and operators. Oversight of exemptions from price control would need to ensure that the service offering was genuinely a higher quality one and not just an attempt to extract value from the most profitable peak segments. In this report, the Commission have not found a practical way in which either of the above two pricing options could be undertaken without complex contracting arrangements, but more work is most likely warranted in this area, given the potential gains to efficiency and system responsiveness.

The capacity for increased competition, and cooperation, between different urban transport modes through developing technologies (such as Mobility as a Service) is discussed further in chapter 5.

Other institutional reform

Though the Commission has identified that involving an independent body would better serve the Australian community, there are several processes that could improve outcomes irrespective of underlying institutional arrangements, including if governments continue with status quo arrangements. These include:

- publishing the rationales for fare decisions, and their expected outcomes, to improve transparency and accountability of government actions against clearly defined objectives
- linking fare setting processes and outcomes to an overarching long-term fare setting strategy that encapsulates the future directions for the public transport system. A long-term strategy would provide a clear vision of governments' view on the role of public transport fares. It could also include pricing principles, such as those recommended by IV (box 8.4), or set measurable fare setting targets that embody governments' vision
- moving to legislate default increases in fares based on the CPI or cost growth pressures, such that political incentives do not result in declining real fares (section 8.1)

⁹⁹ Under such contracts, the transport authority retains farebox revenue, but pays the operator service fees for running the service, with sharing of ancillary service revenue such as advertising on buses (Allens 2021)

- publishing modelling or cost benefit analysis of fare reform proposals, including forward estimates of cost recovery rates and any distributional effects for different user groups
- holding open submissions processes with key stakeholders, including ongoing direct engagement with academics and other researchers.

Box 8.4 – Infrastructure Victoria’s pricing principles

Infrastructure Victoria (2020a) have recommended five pricing principles to inform public transport fare setting, and provision of transport infrastructure (including roads) more generally. These are:

All modes, routes, and parking, are priced	Prices should be the central tool for allocating trips within the transport network. A trip that isn’t priced is effectively under-priced, distorting the choice made by travellers to take that trip instead of a more efficient one. This principle also implements the beneficiary pays equity principle.
All costs are priced	Prices should take into account all costs and benefits for trips, including road congestion, public transport crowding, pollution, contribution to road trauma and the costs of raising revenue through taxation. This principle ensures that prices include the social marginal costs linked to externalities related to each mode and trip.
Provide choices, but not too complex	There should be a range of products that provide choices to consumers. It should be possible to use the transport system without it being too hard to choose and make informed decisions.
Different prices for different products in different markets	Prices should reflect demand and cost conditions, and permit different prices to be charged by mode, time of day or location.
Equity	This principle implements vertical equity (where different groups of people are treated differently) and also permits different prices to be charged in different locations where possible. Lower prices are set for groups of people identified as less able to pay.

Many of these processes are conducted by IPART to the benefit of the community, and if implemented where ministerial decision is retained, would still improve fare setting processes.

Data availability and privacy

Public transport researchers told the Commission that a lack of access to data in Australia remained a key barrier to more rigorous analysis. Transport authorities are providing open data on *aspects* of their services — such as data on schedules and the location of vehicles in real time (for example, TRANSLink in Queensland and Transport for NSW provide real time data on fleet locations). One recent study of Greater Sydney transport patterns used publicly available data on 850 million unique GPS points of vehicle locations gathered over a year to identify hotspots of service delay (Lock, Bednarz and Pettit 2021). Another study

used TransLink go card data to estimate the impact of a reduction in zones and in fare levels — revealing only a small increase in the number of transport users, but a 10 per cent increase in journey numbers (Liu, Wang and Xie 2019). Existing data provide a resource for research into the effects of pricing, improved services and the development of consumer apps.

Nevertheless, the full potential of public transport data collected with the advent of Smart Card technology is not being achieved. In principle, a SmartCard database (augmented by schedule information and real time fleet movements) could include the timing of any trip, its duration, distance travelled, time, crowding, intermodal changes, fares paid, originating and destination locations, and delays. The data would enable assessment of the impact of any changes in any attribute of the system — such as fares, service frequency, crowding, bus stop location, and service predictability — which is integral to service quality and informed pricing. While a transport authority itself could use such data, there are several practical obstacles to its wider availability, which loses opportunities for consumer apps and for more rigorous analysis of pricing or other aspects of public transport policy. The provision of data to external parties provides scope for diverse and innovative analysis beyond that of resource-constrained government agencies.

The concern to maintain adequate privacy protection is one of the most important obstacles to data release. This concern was brought into sharp relief recently by the apparent capacity to identify individuals from anonymised publicly-disclosed records of touch-on and touch-off of 15.1 million Victorian public transport myki cards over a three year period up to June 2018 (OVIC 2019). The data were provided to Data Science Melbourne as part of a Datathon to encourage innovative use of the data — an exemplar of the benefits of data release. However, once it became apparent that the travel patterns of some individuals could be identified, the Office of the Victorian Information Commissioner issued a compliance notice to Public Transport Victoria claiming it had contravened the *Privacy and Data Protection Act 2014* (Vic). While this was contested by Public Transport Victoria and the Victorian Department of Premier and Cabinet, the notice can only have led to greater risk aversion by data holders to releasing information when ideally the benefits of privacy should be set against the costs of lost opportunities. In this example, it is not clear that any significant harm arose (or could arise) from some limited capacity for identification of some people using public transport (in contrast to tax or health records).

Researchers have little interest in particular individuals. As noted by the Commission in its inquiry into data availability and use:

... there is a profound lack of interest amongst most researchers in government and academia in identifying particular individuals from large datasets; for them, de-identified datasets about large groups of people hold the answer to many pivotal questions. (PC 2017a, p. 12)

Nevertheless, the release of large datasets with any significant potential to reveal individuals — however innocuous that identification may be — may undermine the social license to release and analyse big data generated by smart card in public transport (and other data collected by government). The Commission recommended a range of approaches, including Accredited Release Authorities (which would make decisions about data release) and accredited trusted users (who would need to meet standards to access data), that would provide strong privacy protection, but also allow much greater scope for data analysis (PC 2017a, p. 23). Whatever the approach to data release, pricing recommendations are likely to be better if underpinned by the kind of evidence that only big and detailed data can now provide.

A. Consultation

During this review the Commission engaged with department officials from all State and Territory Governments, as well as regulators, service operators, and academics. The Commission thanks everyone who participated in this review.

Table A.4 – Consultations

Participant

Clifford Winston, Brookings Institute

Daniel Hörcher, Centre for Transport Studies

David Hensher, Institute of Transport and Logistics Studies, University of Sydney

Department of Infrastructure, Planning and Logistics (Northern Territory)

Department of State Growth (Tasmania)

Department of Transport (Victoria)

Department of Treasury (NSW)

Department of Treasury (Western Australia)

Department of Treasury and Finance (Victoria)

Derek Scrafton, University of South Australia

Graham Currie, Public Transport Research Group, Monash University

Grattan Institute

Independent Pricing and Regulatory Tribunal (NSW)

Infrastructure Victoria

International Transport Forum

South Australian Public Transport Authority

TransLink, Department of Transport and Main Roads (Queensland)

TransPerth, Public Transport Authority of Western Australia

Transport Canberra and City Services Directorate (ACT)

Transport for New South Wales

Treasury (ACT)

Abbreviations and explanations

Abbreviations

ABS	Australian Bureau of Statistics
API	Application Programming Interface
BITRE	Bureau of Infrastructure and Transport Research Economics
Capex	Capital expenditure
CPI	The Consumer Price Index
CSIRO	Commonwealth Scientific and Industrial Research Organisation
GPS	The Global Positioning System
IA	Infrastructure Australia
IAC	Industries Assistance Commission
IC	Industry Commission
ICT	Information and communications technology
IPART	Independent Pricing and Regulatory Tribunal of NSW
ITF	International Transport Forum
IV	Infrastructure Victoria
IVT	In-vehicle time
KPI	Key performance indicator
MaaS	Mobility as a Service
OECD	Organisation for Economic Co-operation and Development
Opex	Operating expenditure
PAYG	Pay as you go
PC	Productivity Commission
RPI	The Retail Price Index (UK equivalent of Consumer Price Index)
SMC	Social marginal cost

Explanations

Autonomous vehicles	A vehicle operated by a driving system that either assists or replaces humans in the driving task. Automation can be of different degrees according to the portion of the operations the driving system can conduct without human intervention.
Active transport	Travel undertaken by human-powered modes including, but not limited to, walking or cycling.
Billion	The convention used for a billion is a thousand million (10^9).
Congestion	Where the number of road users on a section of road approaches physical capacity, such that it leads to delays and reductions in speed.
Crowding	Where the number of public transport users in a vehicle approaches physical capacity, such that it leads to delays, discomfort, or other inconveniences.
Fare	The financial price of a public transport trip as paid by the user.
Mass transit	Transport services designed to carry large numbers of users, such as by train, bus, tram, or ferry.
Micromobility	Personal transportation using devices and vehicles weighing up to 350 kg and whose power supply, if any, is gradually reduced and cut off at a given speed limit which is no higher than 45 km/h.
Microtransit	IT-enabled multi-passenger transportation services, typically with using dynamically generated routes, designed to carry smaller numbers of users than mass transit.
Mobility as a Service (MaaS)	MaaS is a framework for delivering a portfolio of multi modal mobility services. It is an integrated transport service brokered by an integrator, through a digital platform that provides information, booking, ticketing, payment.
Mode	Method of transport service (e.g. car, rail, light rail, or bus).
Social exclusion	A multidimensional concept that relates to the inability of individuals to participate or engage in key economic, social and political activities.

References

- AAA (Australian Automobile Association) 2021, *Transport Affordability Index Q2 2021*.
- ABC News 2014, 'Victorian Government to cut cost of train, tram travel between zones one and two'.
- ABS (Australian Bureau of Statistics) 1951, *Year Book Australia, 1951*, Cat. no. 1301.0.
- 2009, *Environmental issues: waste management and transport use, Mar 2009*, Cat. no. 4602, Canberra, 20 November.
- 2012, *Environmental issues: waste management, transport and motor vehicle usage, Mar 2012*, Cat. no. 4602.0.55.002, Canberra, 26 October.
- 2017, *Household Expenditure Survey, Australia: Summary of Results, 2015–16*, Cat. no. 6530.0, Canberra, 29 September.
- 2018a, *Census of Population and Housing: Commuting to Work - More Stories from the Census, 2016*, Cat. no. 2071.0.55.001, Canberra, 22 May.
- 2018b, *Socio-Economic Indexes for Areas (SEIFA), 2016*, Cat. no. 2033.0.55.001, Canberra, 27 March.
- 2019a, *Australian Historical Population Statistics, 2019*, Cat. no. 3105.0, Canberra.
- 2019b, *Disability, Ageing and Carers, Australia: Summary of Findings, 2018*, Cat. no. 4430.0, Canberra, 24 October.
- 2019c, *Regional Population Growth, Australia, 2017-18*, Cat. no. 3218.0, Canberra, 27 March.
- 2020a, *Australian Demographic Statistics, Sep 2019*, Cat. no. 3101.0, Canberra, 19 March.
- 2020b, *Regional Population Growth, Australia, 2018-19*, Cat. no. 3218.0, Canberra, 25 March.
- 2021a, *Consumer Price Index, Australia, June 2021*, Cat. no. 6401.0, Canberra, 28 July.
- 2021b, *Household Impacts of COVID-19 Survey, March 2021*, Canberra, 14 April.
- 2021c, *Motor Vehicle Census, Australia, 2021*, Cat. no. 9309.0, Canberra, 30 June.
- 2021d, *National, state and territory population, Dec 2020*, Cat. no. 3101.0, Canberra, 17 June.
- 2021e, *Regional Population Growth, Australia, 2019-20*, Cat. no. 3218.0, Canberra, 30 March.
- ACMA (Australian Communications and Media Authority) 2020, *Trends in online behaviour and technology usage: ACMA consumer survey 2020*, September, Australian Government.
- ACT Government 2021, *YourSay Community Panel: Transport & City Services Survey - Summary Report*.
- Adnan, M., Nahmias Biran, B., Baburajan, V., Basak, K. and Ben-Akiva, M. 2020, 'Examining impacts of time-based pricing strategies in public transportation: A study of Singapore', *Transportation Research Part A: Policy and Practice*, vol. 140, pp. 127–141.
- Allens 2021, *Frameworks for our networks: A review of public transport service contracts in Australia and New Zealand*, International Association of Public Transport.
- Anderson, M.L. 2014, 'Subways, strikes, and slowdowns: The impacts of public transit on traffic congestion', *American Economic Review*, vol. 104, no. 9, pp. 2763–2796.
- Anupriya, Graham, D., Horcher, D., Anderson, R.J. and Bansal, P. 2020, 'Quantifying the ex-post causal impact of differential pricing on commuter trip scheduling in Hong Kong', *Transport Research Part A: Policy and Practice*, vol. 141, pp. 16–34.
- ATAPSC (Australian Transport Assessment and Planning Steering Committee) 2018, *Australian Transport Assessment and Planning Guidelines: M1- Public Transport*, May, Australian Government.
- 2021, *Australian Transport Assessment and Planning Guidelines: M1- Public Transport*, August, Australian Government.
- Audit Office of NSW 2020, *Transport 2020*, Auditor-General's Report, Sydney.
- Basso, L. and Jara-Díaz, S. 2010, 'The case for subsidisation of urban public transport and the mohring effect', *Journal of Transport Economics and Policy*, vol. 44, no. 3, pp. 365–372.
- Bastiaanssen, J., Johnson, D. and Lucas, K. 2020, 'Does transport help people to gain employment? A systematic review and meta-analysis of the empirical evidence', Routledge, *Transport Reviews*, vol. 40, no. 5, pp. 607–628.
- , — and — 2021, 'Does better job accessibility help people gain employment? The role of public transport in Great Britain', *Urban Studies*, pp. 1–22.
- Beck, M.J. and Hensher, D.A. 2020, 'Insights into the impact of COVID-19 on household travel and activities in Australia – The early days under restrictions', *Transport Policy*, vol. 96, pp. 76–93.
- BITRE (Bureau of Infrastructure, Transport and Regional Economics) 2014, *Urban public transport: updated trends*, Information Sheet, 59.
- 2015, *Traffic and congestion cost trends for Australian capital cities*, 2 November.
- 2016, *Lengthy commutes in Australia*, Report 144.
- 2017, *Urban Passenger fares*, 2 April, Bureau of Infrastructure and Transport Research Economics.
- 2019a, *Relationship between transport use and income in Australia*, Information Sheet 102.
- 2019b, *Yearbook 2019: Australian Infrastructure Statistics*, Canberra.
- 2020, *Yearbook 2020: Australian Infrastructure Statistics*, Statistical Report, Canberra.
- Boiteux, M. 1960, 'Peak-load pricing', *The Journal of Business*, vol. 33, no. 2, pp. 157–179.
- Borjesson, M., Fung, C.M. and Proost, S. 2016, 'Optimal prices and frequencies for buses in Stockholm', *Economics of Transportation*, vol. 9, pp. 20–36.

- Burke, T., Stone, J., Glackin, S., and Scheurer, Jan 2014, *Transport disadvantage and low-income rental housing*, AHURI Positioning Paper 157, p. 62.
- Cao, L., Hosking, A., Kouparitsas, M., Mullaly, D., Rimmer, X., Shi, Q., Stark, W. and Wende, S. 2015, *Understanding the economy-wide efficiency and incidence of major Australian taxes*, Treasury Working Paper 2015-01, Australian Treasury.
- Carta, F. and Philippis, M.D. 2018, *Commuting time and family labour supply decisions*, VoxEU.org, <https://voxeu.org/article/commuting-time-and-family-labour-supply-decisions> (accessed 30 November 2021).
- Cats, O., Susilo, Y.O. and Reimal, T. 2017, 'The prospects of fare-free public transport: evidence from Tallinn', *Transportation*, vol. 44, no. 5, pp. 1083–1104.
- Centre for Population 2020, *Population Statement*, December, Australian Government, Canberra.
- CEPA & HGroup (Cambridge Economic Policy Associates and the Hensher Group) 2018, *Elasticity of Demand for Sydney Public Transport*, 10 October.
- Cerema 2019, *MaaS in Europe: Lessons from the Helsinki, Vienna and Hanover experiments*.
- CIE (Centre for International Economics) 2001, *Subsidies and the social cost of public transport*, March.
- 2020a, *Estimating the Social Marginal Cost of Public Transport in Victoria*, Canberra.
- 2020b, *Measuring cost recovery of NSW public transport services*, Prepared for IPART, 19 February.
- City Futures Research Centre and Astrolabe Group 2019, *Australia's Household Infrastructure Bill*, April, p. 39.
- Clifton, G.T. and Mulley, C. 2016, 'A historical overview of enhanced bus services in Australian cities: What has been tried, what has worked?', *Research in Transportation Economics*, vol. 59, pp. 11–25.
- Corazza, M.V. and Carassiti, G. 2021, 'Investigating maturity requirements to operate mobility as a service: The Rome case', *Sustainability*, vol. 13, no. 8367, pp. 1–31.
- Corpuz, G. 2007, 'Public Transport or Private Vehicle: Factors That Impact on Mode Choice', presented at Australasian Transport Research Forum 2007, Melbourne.
- Cozens, P., Neale, R., Hillier, D. and Whitaker, J. 2004, 'Tackling crime and fear of crime while waiting at Britain's railway stations', *Journal of Public Transportation*, vol. 7, no. 3, pp. 23–41.
- Croxon, W., Davies, M., Mackie, F. and Millner, K. 2020, *Non-Discretionary and Discretionary Inflation: Uses CPI data to present experimental measures of Non-Discretionary and Discretionary inflation*, 11 December, Australian Bureau of Statistics, Canberra.
- Currie, G. 2018, 'Lies, damned lies, avs, shared mobility, and urban transit futures', *Journal of Public Transportation*, vol. 21, no. 1, pp. 19–30.
- , Delbosc, A. and Mahmoud, S. 2010, 'Perceptions and realities of personal safety on public transport for young people in Melbourne', presented at ATRF 2010: 33rd Australasian Transport Research Forum, Canberra.
- , — and Pavkova, K. 2018, 'Alarming Trends in the Growth of Forced Car Ownership in Melbourne', presented at Australasian Transport Research Forum.
- and Stanley, J. 2008, 'Investigating links between social capital and public transport', Routledge, *Transport Reviews*, vol. 28, no. 4, pp. 529–547.
- Dale, S., Frost, M., Ison, S. and Budd, L. 2019, 'The impact of the Nottingham workplace parking levy on travel to work mode share', *Case Studies on Transport Policy*, vol. 7, no. 4, pp. 749–760.
- , —, —, Quddus, M. and Warren, M.P. 2017, 'Evaluating the impact of a workplace parking levy on local traffic congestion: The case of Nottingham UK', *Transport Policy*, vol. 59, pp. 153–164.
- Dawson, E. and Lloyd-Cape, M. 2021, *The Per Capita Tax Survey 2021*, May, Percapita.
- Delbosc, A. and Currie, G. 2011, 'Using Lorenz curves to assess public transport equity', *Journal of Transport Geography*, vol. 19, no. 6, pp. 1252–1259.
- Department for Transport, UK 2021, *Great British Railways: The Williams-Shapps Plan for Rail*, White Paper, London.
- Department of State Growth 2019, *Greater Hobart Household Travel Survey – Transport Services*.
- Department of Transport 2013, *Public transport: Guidelines for land use and development*, Public Transport Division, Melbourne.
- 2018, *Victorian Integrated Survey of Travel and Activity*, Dataset, Melbourne.
- Dia, H. 2021, '"Self-driving" cars are still a long way off. Here are three reasons why', *The Conversation*.
- DIPL (Department of Infrastructure, Planning and Logistics) 2016, *Darwin Regional Transport Plan*, July, p. 4.
- Dobes, L., Argyrous, G. and Leung, J. 2016, 'Appendix 7: Deadweight economic loss caused by raising revenue for projects and programs', *Social cost-benefit analysis in Australia and New Zealand*.
- Dodson, J., Mees, P., Stone, J. and Burke, M. 2011, *The Principles of Public Transport Network Planning: A review of the emerging literature with select examples*, Issues Paper 15, March, Griffith University, Brisbane.
- Donaldson, D. 2017, 'Franchising: why privatising public transport doesn't live up to the hype', *The Mandarin*.
- Douglas Economics 2012, *Modelling the Ability of Fare Incentives to Spread AM Peak Passenger Loads*, May, for Infrastructure NSW.
- Douglas, N. 2009, *A Discussion and Update on Integrated Fares and Electronic Ticketing in NZ*, Douglas Economics.
- 2021, *Australian Transport Assessment and Planning Guidelines: M1 Public Transport: Parameter Values Technical Report*, August, Australian Government.
- DTF (Vic) (Department of Treasury and Finance (Victoria)) 2010, *Review of the effectiveness of the Congestion Levy*, May, Melbourne.
- Du, B., Ma, J., Benavent, R., Birtchnell, T., Harada, T., Strahilevitz, M., Perez, P. and McGuirk, P. 2019, 'Revealing seniors' travel patterns and concerns using public transport - A case study in Wollongong', *Journal of Transport & Health*, vol. 14, Supplement.
- Duncan, I. 2021, 'Cities are turning to supercharged bus routes to more quickly and cheaply expand transit services', *Washington Post*.
- Dutta, V. and Araujo, F. 2021, *All aboard: More ways to pay for parking and transit*, <https://blog.google/products/maps/more-ways-pay-parking-and-transit/> (accessed 4 December 2021).
- Enoch, M. and Ison, S. 2006, 'Levying charges on private parking: Lessons from existing practice', *World Transport Policy and Practice*, vol. 12, no. 1, pp. 5–14.

- Faggio, G., Silva, O. and Strange, W.C. 2020, 'Tales of the city: What do agglomeration cases tell us about agglomeration in general?', *Journal of Economic Geography*, vol. 20, no. 5, pp. 1117–1143.
- Farre, L., Jofre-Monseny, J. and Torrecillas, J. 2020, *Commuting Time and the Gender Gap in Labor Market Participation*, SSRN Scholarly Paper, ID 3596679, Social Science Research Network, Rochester, NY, <https://papers.ssrn.com/abstract=3596679> (accessed 30 November 2021).
- Fatima, K. and Moridpour, S. 2019, 'Measuring public transport accessibility for elderly', Montemanni, R. (ed), *MATEC Web of Conferences*, vol. 259, p. 03006.
- Fearnley, N. 2013, 'Free fares policies: impact on public transport mode share and other transport policy goals', *International Journal of Transportation*, vol. 1, December, pp. 75–90.
- , Currie, G., Flugel, S., Gregersen, F.A., Killi, M., Toner, J. and Wardman, M. 2018, 'Competition and substitution between public transport modes', *Research in Transportation Economics*, vol. 69, pp. 51–58.
- Ferguson, M. 2019, *Ticketing solution for Tasmanian public transport users*, https://www.premier.tas.gov.au/releases/ticketing_solution_for_tasmanian_public_transport_users (accessed 27 October 2021).
- Figg, H. 2021, *Free passenger transport - exploring the benefits and disadvantages*, June, The Urban Mobility Observatory.
- Fishman, E., Washington, S. and Haworth, N. 2014, 'Bike share's impact on car use: Evidence from the United States, Great Britain, and Australia', *Transportation Research Part D: Transport and Environment*, vol. 31, pp. 13–20.
- , ——, —— and Mazzei, A. 2014, 'Barriers to bikesharing: An analysis from Melbourne and Brisbane', *Journal of Transport Geography*, vol. 41, pp. 325–337.
- Fouquet, R. 2012, 'Trends in income and price elasticities of transport demand (1850–2010)', *Energy Policy*, vol. 50, pp. 62–71.
- Gates, S., Gogescu, F., Grollman, C., Cooper, E. and Khambhaita, P. 2019, *Transport and Inequality: An Evidence Review for the Department of Transport*, London, UK.
- Gimenez-Nadal, J.I. and Molina, J.A. 2014, 'Commuting time and labour supply in the Netherlands a time use study', *Journal of Transport Economics and Policy*, vol. 48, no. 3, pp. 409–426.
- Giuliano, G., Kang, S. and Yuan, Q. 2019, 'Agglomeration economies and evolving urban form', *The Annals of Regional Science*, vol. 63, no. 3, pp. 377–398.
- Gkiotsalitis, K. and Cats, O. 2021, 'Public transport planning adaption under the COVID-19 pandemic crisis: Literature review of research needs and directions', Routledge, *Transport Reviews*, vol. 41, no. 3, pp. 374–392.
- Global Mass Transit Report 2020, *MaaS in Japan: Ambitious and promising plans*, <https://www.globalmasstransit.net/archive.php?id=39263> (accessed 27 October 2021).
- van Goeverden, C., Rietveld, P., Koelemeijer, J. and Peeters, P. 2006, 'Subsidies in public transport', ISTIEE, Institute for the Study of Transport within the European Economic Integration, *European Transport*, no. 32, pp. 5–25.
- Gomez-Lobo, A. 2011, 'Monopoly, subsidies and the Mohring Effect: A synthesis', *Transport Reviews*, vol. 34, no. 3, pp. 297–315.
- Government of Western Australia 2021, *Media Statements - Election commitment delivered on household fees and charges*, <https://www.mediastatements.wa.gov.au/Pages/>
- McGowan/2021/05/Election-commitment-delivered-on-household-fees-and-charges.aspx (accessed 4 October 2021).
- Grzelec, K. and Jagietto, A. 2020, 'The effects of the selective enlargement of fare-free public transport', *Sustainability*, vol. 12, August, p. 19.
- Hamer, P., Currie, G. and Young, W. 2009, 'Exploring travel and parking impacts of the Melbourne CBD parking levy', presented at the *Proceedings of the 32nd Australasian Transport Research Forum (ATRF)*.
- , —— and —— 2011, 'Parking Price Policies – A review of the Melbourne congestion levy', presented at the *Australasian Transport Research Forum 2011 Proceedings*, Adelaide.
- He, S.Y., Thøgersen, J., Cheung, Y.H.Y. and Yu, A.H.Y. 2020, 'Ageing in a transit-oriented city: Satisfaction with transport, social inclusion and wellbeing', *Transport Policy*, vol. 97, pp. 85–94.
- Henn, L., Douglas, N. and Sloan, K. 2011, 'Surveying Sydney rail commuters' willingness to change travel time', presented at 34th Australasian Transport Research Forum (ATRF) Proceedings, Adelaide, 28 September, pp. 1–15.
- , Karpouzis, G. and Sloan, K. 2010, 'A review of policy and economic instruments for peak demand management in commuter rail', *Australasian Transport Research Forum Conference*, pp. 1–21.
- Hensher, D.A. 2020a, 'Assessing sources of variation in public transport elasticities: some warnings', *Bus Transport*, Elsevier Science Publishing Company.
- 2020b, 'The Relationship Between Bus Contract Costs, User Perceived Service Quality and Performance Assessment', *Bus Transport: Demand, Economics, Contracting, and Policy*, Elsevier, pp. 101–117.
- and Ho, C. 2020, 'Obtaining direct and cross-fare elasticities from Opal e-data in Sydney, Australia', *Journal of Transport Economics and Policy*, vol. 54, no. 4, pp. 289–315.
- , ——, Reck, D., Smith, G., Lorimer, S. and Lu, I. 2021, *The Sydney Mobility as a Service (MaaS) Trial: Design, Implementation, Lessons and the Future*, Institute of Transport and Logistics Studies, University of Sydney, Sydney.
- , —— and Reck, D.J. 2020, *Mobility as a service and private car use: Evidence from the Sydney MaaS trial*, Institute of Transport and Logistics Studies, University of Sydney.
- , Mulley, C. and Rose, J.M. 2015, 'Understanding the relationship between voting preferences for public transport and perceptions and preferences for bus rapid transit versus light rail', *Journal of Transport Economics and Policy*, vol. 49, no. 2, pp. 236–260.
- , Rose, J.M. and Collins, A.T. 2011, 'Identifying commuter preferences for existing modes and a proposed Metro in Sydney, Australia with special reference to crowding', *Public Transport*, vol. 3, no. 2, pp. 109–147.
- Heymes, C. and Levinson, D. 2018, 'Stationless in Sydney: the rise and decline of bikesharing in Sydney', *Transport Findings*.
- Ho, C. 2010, *Google powers Tassie transport*, <https://www.zdnet.com/article/google-powers-tassie-transport/> (accessed 25 August 2021).
- Holmgren, J. 2007, 'Meta-analysis of public transport demand', *Transportation Research Part A: Policy and Practice*, vol. 41, no. 10, pp. 1021–1035.
- Horcher, D., De Borger, B., Seifu, W. and Graham, D. 2020, 'Public transport provisions under agglomeration economies', *Regional Science and Urban Economics*, vol. 81, no. 103503.

- Hörcher, D. and Graham, D. 2020, *Pricing and Efficient Public Transport Supply in a Mobility as a Service Context*, International Transport Forum Discussion Papers, 2020/15, OECD, Paris.
- Horcher, D., Singh, R. and Graham, D.J. 2021, 'Social distancing in public transport: mobilising new technologies for demand management under the Covid-19 crisis', *Transportation*.
- Hotelling, H. 1939, 'The general welfare in relation to problems of taxation and of railway and utility rates', *Econometrica*, no. 6, pp. 224–269.
- Hutchinson, J. 2008, 'Google Transit launches in Adelaide', *PC World*, 1 December.
- IBISWorld 2020, *Toll Road Operators in Australia - Market Size 2007–2027*, November.
- IC (Industry Commission) 1991, *Rail Transport*, Report no. 13, Canberra.
- 1994, *Urban Transport*, Report no. 37, Canberra.
- I&N (IAB Australia and Nielson) 2019, *Device ownership and trends*, July.
- Infrastructure Australia 2018, *Outer Urban Public Transport: Improving accessibility in lower-density areas*, October, Reform Series.
- 2019a, *An Assessment of Australia's Future Infrastructure Needs: Australian Infrastructure Audit 2019*.
- 2019b, *Urban Transport Crowding and Congestion: The Australian Infrastructure Audit 2019 Supplementary Report*, June.
- and L.E.K. Consulting 2020, *Infrastructure beyond COVID-19: A national study on the impacts of the pandemic on Australia*, December.
- Infrastructure Victoria 2018, *Advice on Automated and Zero Emissions Vehicles Infrastructure*, Melbourne.
- 2020a, *Fair Move: Better Public Transport Fares for Melbourne*, Melbourne.
- 2020b, *Fair Move: Public Transport Fares Reform Technical Report*, Melbourne.
- 2020c, *Good Move - Fixing Transport Congestion*, March, Melbourne.
- 2021, *Victoria's Infrastructure Strategy 2021-2051*, Melbourne.
- IPA (Infrastructure Partnerships Australia) 2012, *Integrating Australia's Transport Systems: A Strategy for an Efficient Transport Future*.
- IPART (Independent Pricing and Regulatory Tribunal) 2014, *Review of external benefits of public transport*, Sydney.
- 2015, *Cost recovery*, Draft Information Paper 12, Sydney.
- 2016a, *Medium-run marginal financial costs*, Final Report-Information Paper 5, Public Transport Fares - Final Information Papers, Sydney.
- 2016b, *More efficient, more integrated Opal fares*, Sydney.
- 2016c, *Weekday peak and off-peak fares*, Public Transport Fares Final Report, Information Paper 1, Sydney.
- 2020a, *Information paper - Ensuring affordability*, Sydney, p. 18.
- 2020b, *Investigating fare-free public transport*, Sydney.
- 2020c, *Maximum Opal Fares 2020-2024*, February, Sydney.
- 2020d, *Opal Fares 2020-2024: External Benefits and Costs*, Technical Paper, February, Sydney.
- 2020e, *Patronage and Elasticity Estimates*, Technical Paper, February, December, Sydney.
- ITF (International Transport Forum) 2015a, *Automated and Autonomous Driving: Regulation Under Uncertainty*, OECD, Paris.
- 2015b, *Urban mobility system upgrade: How shared self-driving cars could change city traffic*, Corporate Partnership Board, OECD, Paris.
- 2018, 'Cooperative Mobility Systems and Automated Driving: Summary and Conclusions', presented at the *ITF Roundtable on Cooperative Mobility Systems and Automated Driving*, 2016, Ottawa, OECD.
- 2020, *Integrated ticketing*, Transport Climate Action Directory, OECD, Paris.
- 2021, *The Innovative Mobility Landscape: The Case of Mobility as a Service*, International Transport Forum Policy Papers, 92, OECD, Paris.
- ITLS (Institute of Transport and Logistics Studies) 2021, *Transport Opinion Survey (TOPS)*, March 2021, University of Sydney Business School, Sydney.
- ITS Australia (Intelligent Transport Systems Australia) 2021, *Moovit Unveils its 2020 Global Public Transport Report*, <https://its-australia.com.au/news/moovit-unveils-its-2020-global-public-transport-report/> (accessed 25 August 2021).
- IV (Infrastructure Victoria) 2020, *Fair Move Better Public Transport Fares for Melbourne Fact Sheet*.
- 2021, *Transporting Melbourne's Recovery: Immediate policy actions to get Melbourne moving*, January, Melbourne.
- Jaaskela, J. and Windsor, C. 2011, 'Insights from the Household Expenditure Survey', *RBA Bulletin*, December, pp. 1–12.
- Jansson, K. 1993, 'Optimal public transport price and service frequency', *Journal of Transport Economics and Policy*, vol. 27, no. 1, pp. 33–50.
- Johnson, D., Ercolani, M. and Mackie, P. 2017, 'Econometric analysis of the link between public transport accessibility and employment', *Transport Policy*, vol. 60, pp. 1–9.
- Kaufman, B. 2020, '1 million rides and counting: on-demand services bring public transport to the suburbs', *The Conversation*.
- Kerin, P. 1987, 'Why subsidise state transport authorities?', *The Australian Quarterly*, vol. 59, no. 1, pp. 60–72.
- Kidman, A. 2012, *Google Maps adds Sydney public transport directions (At last!)*, Lifehacker, <https://www.lifehacker.com.au/2012/07/google-maps-adds-sydney-public-transport-directions-at-last/> (accessed 25 August 2021).
- Kiernan, S. 2016, *NSW Transport spends \$1.1m on Opal app from Outware*, <https://www.crn.com.au/news/nsw-transport-spends-11m-on-opal-app-from-outware-413809> (accessed 25 August 2021).
- Kilani, M., Proost, S. and van der Loo, S. 2013, *Road pricing and public transport pricing reform in Paris: complements or substitutes?*, October, DPS13.18.
- Kolomatskiy, A., Baranov, D., Korchagin, V. and Volotskiy, T. 2020, 'Assessing the effect of different parking pricing policies on DRT demand using multiagent traffic simulation, case study of St. Petersburg', *Procedia Computer Science*, vol. 170, pp. 799–806.
- Krizek, K.J. and El-Geneidy, A. 2007, 'Segmenting preferences and habits of transit users and non-users', *Journal of Public Transportation*, vol. 10, no. 3, pp. 71–94.

- Lattman, K., Friman, M. and Olsson, L.E. 2016, 'Perceived accessibility of public transport as a potential indicator of social inclusion', *Social Inclusion*, vol. 4, no. 3, pp. 36–45.
- Lee, J., Agdas, D. and Baker, D. 2017, 'Cruising for parking: New empirical evidence and influential factors on cruising time', *Journal of Transport and Land Use*, vol. 10, no. 1, pp. 931–943.
- Legislative Council Economy and Infrastructure Committee 2020, *Inquiry Into Expanding Melbourne's Free Tram Zone*, Melbourne.
- Lehner, S. and Peer, S. 2019, 'The price elasticity of parking: A meta-analysis', *Transportation Research Part A: Policy and Practice*, vol. 121, pp. 177–191.
- L.E.K. Consulting 2019, *On-Demand Public transport: Key Learnings from Global Pilots*, Special Report.
- Litman, T. 2020, *Transit Price Elasticities and Cross-Elasticities*, Victoria Transport Policy Institute, Melbourne.
- 2021a, *Evaluating public transit benefits and costs: Best practices guidebook*, Victoria Transport Policy Institute, Melbourne.
- 2021b, *Evaluating Transportation Equity*, 21 April, Victoria Transport Policy Institute, Melbourne.
- 2021c, *New Mobilities: Smart Planning for Emerging Transportation Technologies*, Island Press.
- 2021d, *Parking Pricing Implementation Guidelines: How More Efficient Parking Pricing Can Help Solve Parking and Traffic Problems, Increase Revenue, and Achieve Other Planning Objectives*, 22 April, Victoria Transport Policy Institute, Melbourne.
- 2021e, *Understanding Transport Demands and Elasticities: How Prices and Other Factors Affect Travel Behavior*, 14 June, Victoria Transport Policy Institute, Melbourne.
- Liu, Y. and Charles, P. 2013, 'Spreading peak demand for urban rail transit through differential fare policy: A review of empirical evidence', presented at the *Australasian Transport Research Forum 2013 Proceedings*, 2 October, pp. 1–35.
- Liu, Y., Wang, S. and Xie, B. 2019, 'Evaluating the effects of public transport fare policy change together with built and non-built environment features on ridership: The case in South East Queensland, Australia', *Transport Policy*, vol. 76, pp. 78–89.
- Loader, C. 2017, *Trends in journey to work mode shares in Australian cities to 2016 (second edition)*, *Charting Transport*, 24 October.
- 2019a, *How radial are journeys to work in Australian cities?*, *Charting Transport*.
- 2019b, *Update on Australian transport trends*, December, *Charting Transport*.
- 2021, *How has motor vehicle ownership changed in Australian cities for different age groups?*, *Charting Transport*.
- Lock, O., Bednarz, T. and Pettit, C. 2021, 'The visual analytics of big, open public transport data – A framework and pipeline for monitoring system performance in Greater Sydney', *Big Earth Data*, vol. 5, no. 1, pp. 134–159.
- Looi, T.-S. and Tan, K.-H. 2009, 'Singapore's case of institutional arrangements for fare affordability', presented at the *11th Conference on competition and ownership in land transport*.
- Luk, J. and Hepburn, S. 1993, *New Review of Australian Travel Demand Elasticities*, December, Research report 249.
- Lyons, G., Hammond, P. and Mackay, K. 2019, 'The importance of user perspective in the evolution of MaaS', *Transport Research Part A: Policy and Practice*, vol. 131, pp. 20–34.
- MaaS Alliance 2021, *University of Queensland explores how MaaS schemes enhance personal mobility*, <https://maas-alliance.eu/2021/09/24/the-university-of-queensland-explores-how-maas-schemes-enhance-personal-mobility/> (accessed 9 October 2021).
- Mackett, R. 2017, 'Older People's Travel and its Relationship to their Health and Wellbeing', *Transport, Travel and Later Life*, Emerald Publishing Limited.
- Masabi 2019, *Everything You Need to Know About Account Based Ticketing*, <https://www.masabi.com/2019/11/29/everything-you-need-to-know-about-account-based-ticketing/> (accessed 25 August 2021).
- Mattey, C., Russell, R., Sibilio, N. and Wong, D. 2020, *The Expectation Gap in the Future of Work*, Boston Consulting Group.
- Mayeres, I. and Proost, S. 2003, 'Reforming transport pricing: an economic perspective on equity, efficiency and acceptability', *Acceptability of Transport Pricing Strategies*, Dresden, Germany, pp. 93–106.
- McLachlan, R., Gilfillan, G. and Gordon, J. 2013, *Deep and Persistent Disadvantage in Australia*, Productivity Commission Staff Working Paper, Canberra.
- Melo, P.C., Graham, D.J. and Noland, R.B. 2009, 'A meta-analysis of estimates of urban agglomeration economies', *Regional Science and Urban Economics*, vol. 39, no. 3, pp. 332–342.
- MetroTas (Metro Tasmania Pty Ltd) 2020, *Annual Report 2019-20*, Hobart.
- Meyrick, S. 2011, 'Dealing with congestion efficiently', 'Sustainable' Population? — Key Policy Issues, *Roundtable Proceedings*, Productivity Commission, Canberra.
- Millard-Ball, A., Weinberger, R.R. and Hampshire, R.C. 2014, 'Is the curb 80% full or 20% empty? Assessing the impacts of San Francisco's parking pricing experiment', *Transportation Research Part A: Policy and Practice*, vol. 63, pp. 76–92.
- Mohring, H. 1972, 'Optimization and scale economies in urban bus transportation', *The American Economic Review*, vol. 62, no. 4, pp. 591–604.
- MRCagney 2015a, *Action Expenditure Review*, Chief Minister, Treasury and Economic Development Directorate, ACT Government.
- 2015b, *ACTION Expenditure Review: Final Public Report*, 26 March, Report for the Chief Minister, Treasury and Economic Development Directorate, ACT Government.
- MTA (Metropolitan Transportation Authority) 2021, *The MTA Network*.
- Mulley, C. and Nelson, J. 2020, *How Mobility as a Service Impacts Public Transport Business Models*, International Transport Forum Discussion Papers, No. 2020/17, OECD.
- Murphy, C. 2016, *Efficiency of the tax system: a marginal excess burden analysis*, TTPI-Working Paper 4/2016, Tax and Transfer Policy Institute, Australian National University.
- Nassios, J., Madden, J., Giesecke, J., Dixon, J., Tran, N., Dixon, P., Rimmer, M., Adams, P. and Freebairn, J. 2019, *The economic impact and efficiency of state and federal taxes in Australia*, g-289, Victoria University, Centre of Policy Studies, IMPACT Centre.
- NCOSS (NSW Council of Social Service) 2017, *Turning off the lights - The Cost of Living in NSW June 2017*, Sydney.
- 2019, *Maximum Opal Fares 2020-24: NCOSS Response to the IPART Issues Paper*, Sydney.

- Nguyen-Phuoc, D.Q., Currie, G., De Gruyter, C. and Young, W. 2018, 'Congestion relief and public transport: An enhanced method using disaggregate mode shift evidence', *Case Studies on Transport Policy*, vol. 6, no. 4, pp. 518–528.
- Nicholas, J. 2021, 'How Covid changed the way Australians move: more traffic jams, less public transport', *The Guardian*, 18 May.
- NineSquared 2021, *2020 Fares Benchmark Report*, 28 January.
- NSW Government 2018, *Future Transport Strategy 2056*, Sydney.
- 2019, *\$50 weekly public transport cap starts Monday*, <https://www.nsw.gov.au/media-releases/50-weekly-public-transport-cap-starts-monday> (accessed 4 October 2021).
- NSW Liberal Party (New South Wales Liberal Party) 2019, *\$50 Weekly cap for public transport*.
- NSW PC (NSW Productivity Commission) 2021, *Rebooting the economy*.
- NSWIPC (NSW Innovation and Productivity Council) 2020, *Our experience during COVID-19 and what it means for the future of work*, November, NSW Government, Sydney.
- NTC (National Transport Commission) 2020, *Guidelines for Trials of Automated Vehicles in Australia 2020*.
- Olle, E. 2020, 'About 500 Adelaide bus stops to be axed as state government simplifies public transport', *Australian Associated Press*.
- van Ommeren, J.N., Wentink, D. and Rietveld, P. 2012, 'Empirical evidence on cruising for parking', *Transportation Research Part A: Policy and Practice*, vol. 46, no. 1, pp. 123–130.
- One Motoring 2021, *Certificate of Entitlement (COE)*, <https://onemotoring.lta.gov.sg/content/onemotoring/home/buying/upfront-vehicle-costs/certificate-of-entitlement--coe-.html> (accessed 9 October 2021).
- O'Sullivan, M. 2021, '\$4.3 billion cost blowout in Sydney's metro rail project', *Sydney Morning Herald*, 4 February.
- OVIC (Office of the Victorian Information Commissioner) 2019, *Disclosure of myki travel information Investigation under section 8C(2)(e) of the Privacy and Data Protection Act 2014 (Vic)*, 15 August, Melbourne.
- Papa, E. 2020, 'Would you ditch your car if public transport was free? Here's what researchers have found', *The Conversation*.
- Passenger Transport Executive Group 2010, *Transport & Social Inclusion: Have we made the connections in our cities?*, Leeds, UK.
- Paulley, N., Balcombe, R., Mackett, R., Titheridge, H., Preston, J., Wardman, M., Shires, J. and White, P. 2006, 'The demand for public transport: The effects of fares, quality of service, income and car ownership', *Transport Policy*, vol. 13, no. 4, pp. 295–306.
- PC (Productivity Commission) 2014, *Public Infrastructure*, Report no. 71, Canberra.
- 2015, *Tax and Transfer Incidence in Australia*, Commission Working Paper, Canberra.
- 2016, *Introducing Competition and Informed User Choice into Human Services: Reforms to Human Services*, Study Report, Canberra.
- 2017a, *Data Availability and Use*, Report no. 82, Canberra.
- 2017b, *Introducing Competition and Informed User Choice into Human Services: Reforms to Human Services*, Report no. 85, Canberra.
- 2017c, *Shifting the Dial: 5 Year Productivity Review*, Report no. 84, Canberra.
- 2020a, *Mental Health*, Report no. 95, Canberra.
- 2020b, *National Transport Regulatory Reform*, Report no. 94, Canberra.
- 2021a, *Working from home*, Commission Research Paper, Canberra.
- 2021b, *Working from home*, Commission Research Paper, Canberra.
- Politis, I., Georgiadis, G., Papadopoulos, E., Fyrogenis, I., Nikolaidou, A., Kopsacheilis, A., Sdoukopoulos, A. and Verani, E. 2021, 'COVID-19 lockdown measures and travel behavior: The case of Thessaloniki, Greece', *Transportation Research Interdisciplinary Perspectives*, vol. 10, p. 100345.
- Premier of Victoria 2016, *Victorian public transport joins Google Maps*, <https://www.premier.vic.gov.au/victorian-public-transport-joins-google-maps/> (accessed 25 August 2021).
- Proost, S. 2018, *Reforming Private and Public Urban Transport Pricing*, International Transport Forum Discussion Papers, OECD Publishing, Paris.
- P&SI (Prescient & Strategic Intelligence) 2021, *Australia Micromobility Market Research Report: By Type - Industry Analysis and Growth Forecast to 2030*, October.
- PTUA (Public Transport Users Association) 2020, *Fares discussion welcome, but better service is still the main game*, <https://www.ptua.org.au/2020/09/25/iv-fair-move/> (accessed 17 November 2021).
- PTV (Public Transport Victoria) 2019, *Public transport fares in 2020*, Public Transport Victoria, <https://www.ptv.vic.gov.au/news-and-events/media-releases/2019/12/20/public-transport-fares-in-2020/> (accessed 4 October 2021).
- PwC (PricewaterhouseCoopers) 2015, *Managing & Mitigating Peak Public Transport Demand*.
- 2017, *Potential cost savings from rail and bus franchising: Technical Report*, April, Report prepared for Infrastructure Australia.
- Queensland Government 2021, *Budget Paper 3: Capital Statement 2021-22*, Brisbane.
- Rabe, T. and Gladstone, N. 2021, 'Thousands of vehicles flooding Sydney roads to avoid toll', *Sydney Morning Herald*, 28 January.
- RACQ 2021, *Car Running Costs - Owning & Maintaining a Car*, <https://www.racq.com.au/cars-and-driving/cars/owning-and-maintaining-a-car/car-running-costs> (accessed 21 July 2021).
- RAMBOLL 2019, *WHIMPACT: Insights from the world's first Mobility-as-a-Service (MaaS) system*.
- Reinhard, E., Courtin, E., van Lenthe, F.J. and Avendano, M. 2018, 'Public transport policy, social engagement and mental health in older age: A quasi-experimental evaluation of free bus passes in England', *Journal of Epidemiology and Community Health*, vol. 72, no. 5, pp. 361–368.
- Roy Morgan 2021, *Public transport use increases in March quarter 2021 – up by 2 million from the lows of late 2020*, No. 8752, July.
- SAE International 2018, *Surface Transportation Recommended Practice J3163*.
- Salek, N. 2008, *Google rolls-out Google Transit in Perth other states to follow*, <https://www.itnews.com.au/news/google-rolls-out-google-transit-in-perth-other-states-to-follow-106090> (accessed 25 August 2021).

- Scheurer, J., Curtis, C. and McLeod, S. 2017, 'Spatial accessibility of public transport in Australian cities: Does it relieve or entrench social and economic inequality?', *Journal of Transport and Land Use*, vol. 10, no. 1, pp. 911–930.
- Services Australia 2021, *Health Care Card - Who can get a card*, <https://www.servicesaustralia.gov.au/individuals/services/centrelink/health-care-card/who-can-get-card> (accessed 4 October 2021).
- SGS Economics & Planning 2020, *How People Respond to Complexity in Public Transport Fares*, Prepared for Infrastructure Victoria, p. 70.
- Smith, M. 2004, 'Fares and fares regulation on Britain's railways', *Japan Railway & Transport Review*, vol. 38, pp. 41–49.
- Social Exclusion Unit 2003, *Making the Connections: Final Report on Transport and Social Inclusion*, London, UK.
- Somenahalli, S.V.C. and Taylor, M.A.P. 2010, 'Ageing and transport mobility issues: A case study for Adelaide', June, p. 12.
- SRA (Strategic Rail Authority) 2003, *Fares Review Conclusions 2003*.
- Stanley, J. and Stanley, J. 2015, 'Equity in transport', *Handbook of Research Methods and Applications in Transport Economics and Policy*, Edward Elgar Publishing, pp. 418–436.
- and — 2021, 'Public transport and social inclusion', *The Routledge Handbook of Public Transport*, New York, NY, USA, pp. 367–380.
- Storchmann, K. 2003, 'Externalities by automobiles and fare-free transit in Germany - A paradigm shift?', *Journal of Public Transportation*, vol. 6, no. 4, pp. 89–105.
- Straub, D. 2020, 'The effects of fare-free public transport: A lesson from Frydek-Mistek (Czechia)', *Sustainability*, vol. 12, no. 21, p. 9111.
- Terrill, M. 2017, *Stuck in traffic? Road congestion in Sydney and Melbourne*, October, Grattan Institute.
- , Moran, G. and Ha 2019, *Right time, right place, right price - A practical plan for congestion charging in Sydney and Melbourne*, October, Grattan Institute.
- TfL (Transport for London) 2020, *TfL Go - Travel App: Development Time and Cost*, <https://tfl.gov.uk/corporate/transparency/freedom-of-information/foi-request-detail?referenceId=FOI-1120-2021> (accessed 9 August 2021).
- TfNSW (Transport for NSW) 2012, *Customers to benefit from public transport on Google Maps*, <https://www.transport.nsw.gov.au/newsroom-and-events/media-releases/customers-to-benefit-from-public-transport-on-google-maps> (accessed 25 August 2021).
- 2018, *Opal fares capped at CPI*.
- 2019a, *Older Persons Transport and Mobility Plan 2018–2022*, February, p. 2.
- 2019b, *Travel Forecasts*, <https://data.gov.au/dataset/ds-nsw-ba0ce484-fdd6-4b78-b92f-115809f356c9/details> (accessed 29 July 2021).
- 2020a, *Fact Sheet - Information on Opal fare changes from July 2020*.
- 2020b, *Household Travel Survey (HTS) - Data by Region*, <https://www.transport.nsw.gov.au/data-and-research/passenger-travel/surveys/household-travel-survey-hts/household-travel-survey-0> (accessed 6 July 2021).
- 2020c, *Opal patronage*.
- 2020d, *Peak Trains Load Report 02-06 September 2019*, Transport Performance and Analytics (TPA).
- 2021a, *Opal Connect Travel Credit terms and conditions*, <https://transportnsw.info/opal-connect-credit-terms> (accessed 25 August 2021).
- 2021b, *Technical Note on assessing the impacts of COVID-19 for business cases*, Technical Note Version 1.0, June, Sydney, NSW.
- Tirachini, A. and Cats, O. 2020, 'Covid-19 and public transportation: current assessment, prospects, and research needs', *Journal of Public Transportation*, vol. 22, no. 1, pp. 1–21.
- TMR (Department of Transport and Main Roads) 2012, *Travel in south-east Queensland: An analysis of travel data from 1992 to 2009*, Queensland Government, Brisbane.
- 2019, *Terms of Reference Public Transport Fares Advisory Panel*, September, Queensland Government, Brisbane.
- 2020a, *Queensland Transport Strategy—our 30 year plan for transport in Queensland*, Queensland Government, Brisbane, p. 60.
- 2020b, *Queensland Travel Survey*, Queensland Government, Brisbane.
- TomTom 2021, *TomTom traffic indices*.
- Transurban 2016, *Changed Conditions Ahead: Melbourne Road Usage Study - Initial Findings September 2016*.
- TripView Pty Ltd 2021, *TripView - Sydney & Melbourne*, <https://apps.apple.com/au/app/tripview-sydney-melbourne/id294730339> (accessed 19 November 2021).
- TTF (Tourism and Transport Forum) 2016, *Ticket To Ride: Reforming Fares and Ticketing for Sustainable Public Transport*.
- Uber 2021, *Unveiling Uber Pass a new membership to unlock the best of rides and delivery*, <https://www.uber.com/en-AU/newsroom/uberpass/> (accessed 27 October 2021).
- UITP (Union Internationale des Transports Publics) 2020, *Demystifying Ticketing and Payment in Public Transport*, Report, Brussels.
- University of Sydney 2020, *Capped Uber and taxi fares to boost public transport: new survey*, www.sydney.edu.au/news-opinion/news/2020/04/15/capped-uber-and-taxi-fares-to-boost-public-transport-new-survey.html (accessed 23 July 2021).
- US Department of Transportation 2016, *Smartphone Applications to Influence Travel Choices: Practices and Policies*, Federal Highway Administration, Washington D.C.
- VAGO (Victorian Auditor-General's Office) 2015, *Operational Effectiveness of the myki Ticketing System*, Victorian Auditor-General's Report, Melbourne.
- 2020, *Accessibility of Tram Services*, Victorian Auditor-General's Report, Melbourne.
- Van Reeve, P. 2008, 'Subsidisation of urban public transport and the Mohring Effect', *Journal of Transport Economics and Policy*, vol. 42, no. 2, pp. 349–359.
- Vichiensan, V., Hayashi, Y. and Kamnerdsap, S. 2021, 'Covid-19 countermeasures and passengers' confidence of urban rail travel in Bangkok', *Sustainability*, vol. 13, no. 16, p. 9377.
- Vickrey, W.S. 1963, 'Pricing in urban and suburban transport', *American Economic Review*, vol. 53, no. 2, pp. 452–465.
- Victorian Government 2010, *Transport Integration Act*.
- 2021, *Multi Purpose Taxi Program*, <https://cpv.vic.gov.au/passengers/mppt> (accessed 27 September 2021).

- Vij, A., Ryan, S., Sampson, S. and Harris, S. 2018, 'Consumer preferences for Mobility-as-a-Service (MaaS) in Australia', presented at the *Australasian Transport Research Forum 2018 Proceedings*.
- Visontay, E. and Boseley, M. 2021, 'Google Maps to show Melbourne commuters how crowded trains are', *The Guardian*.
- VLC (Veitch Lister Consulting) 2019a, *Transport Modelling Report for ACT and Queanbeyan for the Transport Planning for the Australian Infrastructure Audit*, Project No. 18-025, March.
- 2019b, *Transport Modelling Report for Adelaide for the Transport Planning for the Australian Infrastructure Audit*, Project No. 18-025, March.
- 2019c, *Transport Modelling Report for Melbourne for the Transport Planning for the Australian Infrastructure Audit*, Project No. 18-025, June.
- 2019d, *Transport Modelling Report for Perth for the Transport Planning for the Australian Infrastructure Audit*, Project No. 18-025, March.
- 2019e, *Transport Modelling Report for South East Queensland for the Transport Planning for the Australian Infrastructure Audit*, Project No. 18-025, March.
- 2019f, *Transport Modelling Report for Sydney for the Transport Planning for the Australian Infrastructure Audit*, Project No. 18-025, March.
- W3C Web Accessibility Initiative (WAI) 2021, *Older Users and Web Accessibility: Meeting the Needs of Ageing Web Users*, <https://www.w3.org/WAI/older-users/> (accessed 5 October 2021).
- Waka Kotahi NZ Transport Agency 2021, *Rapid Transit*, <https://www.nzta.govt.nz/roads-and-rail/rapid-transit/> (accessed 9 October 2021).
- Wang, B. and Crovato, P. 2017, 'Comparing travel costs of wheelchair and other passengers in Sydney train network', presented at the *Australasian Transport Research Forum 2017 Proceedings*.
- Wang, D. and Liu, Y. 2015, 'Factors Influencing Public Transport Use: A Study of University Commuters' Travel and Mode Choice Behaviours', presented at State of Australian Cities Conference.
- Wang, S., Liu, Y. and Corcoran, J. 2021, 'Equity of public transport costs before and after a fare policy reform: An empirical evaluation using smartcard data', *Transportation Research Part A: Policy and Practice*, vol. 144, pp. 104–118.
- Whitzman, C., Marathe, R. and Thompson, J. 2019, *Tertiary Students' Public Transport Safety in Melbourne, Australia*, The University of Melbourne.
- Wilkins, R. and Lass, I. 2018, *The Household, Income and Labour Dynamics in Australia Survey: Selected Findings from Waves 1 to 16*, Melbourne Institute: Applied Economic & Social Research, The University of Melbourne, p. 150.
- Wilkins, R., Laß, I., Butterworth, P. and Vera-Toscano, E. 2019, *The Household, Income and Labour Dynamics in Australia Survey: Selected Findings from Waves 1 to 17*, Melbourne Institute: Applied Economic & Social Research, The University of Melbourne, Melbourne.
- Wong, Y.Z. 2019, *Whimpack: More questions than answers*, <https://www.sydney.edu.au/business/news-and-events/news/2019/04/30/whimpack--more-questions-than-answers.html> (accessed 7 October 2021).
- Wray, S. 2021, *Turin to run one-year MaaS trial*, <https://cities-today.com/turin-to-run-one-year-maas-trial/> (accessed 27 October 2021).
- Xia, J., Nesbitt, J., Daley, R., Najnin, A., Litman, T. and Tiwari, S.P. 2016, 'A multi-dimensional view of transport-related social exclusion: A comparative study of Greater Perth and Sydney', *Transportation Research Part A: Policy and Practice*, vol. 94, pp. 205–221.
- Yeh, C.-F. and Lee, M.-T. 2019, 'Effects of Taichung bus policy on ridership according to structural change analysis', *Transportation*, vol. 46, no. 1, pp. 1–16.
- Zhu, Y., Ye, X., Chen, J., Yan, X. and Wang, T. 2020, 'Impact of cruising for parking on travel time of traffic flow', *Sustainability*, vol. 12, no. 8, p. 3079.
- Zimmerman, J. 2021, 'WA Premier Mark McGowan promises to cap Perth train fares at \$4.90 if re-elected', *PerthNow*.