7 Dealing with congestion efficiently

Steve Meyrick
GHD Australia

7.1 Defining the problem

As a motorist, I am inclined to regard any interference from other traffic that makes me travel more slowly than I would like to — or than the traffic laws will permit me to — as a 'congestion problem'. The Victorian Competition and Efficiency Commission (VCEC) captured this perspective well in its exploration of possible responses to increasing congestion:

> Road congestion is sometimes described as a situation where the number of vehicles using a road at any point in time causes vehicle speeds to fall below those experienced in freely flowing traffic. VCEC (2006)

But, as the VCEC goes on to point out, this is unhelpful from a policy perspective. If we define congestion in this way, then it is entirely appropriate to say, along with the Director of the Institute of Transportation Studies at UCLA, that 'Traffic congestion is evidence of social and economic vitality; empty streets and roads are signs of failure' (Taylor 2002).

When we are dealing with flows as variable as urban road traffic, if there is no congestion we can be pretty sure we have massively overinvested in infrastructure, so one of the key issues in dealing with congestion efficiently is to work out just how much congestion we ought to be willing to put up with.

The standard economist's response is that congestion — or more accurately a congestion problem — arises when congestion leads to inefficiency. This will be the case if the marginal social cost of a trip exceeds the benefit derived from making it. Since the benefit derived from the trip is customarily assumed to be reflected in the willingness of the individual to pay for the trip — or more accurately to incur private costs in making the trip — this reduces to the idea that a congestion problem arises when the marginal social cost of the trip exceeds the private cost of making it. In practice, this will often be the case, since when you or I decide to make a trip, we

take into account only the costs that we will bear; we do not worry about the fact that our decision may slow down everybody else's journey, and by doing so impose costs on them.

However, although the principle is straightforward enough, in practice, estimating the size of the congestion problem is trickier than it looks. Nevertheless, the work of the Bureau of Transport and Regional Economics (BTRE) on the cost of congestion gives us some indication of how much difference this definitional distinction makes to our understanding of the scale of the congestion problem (BTRE 2007). That work estimates that the total cost of traffic delays in 2005 is around $11.1 billion per year. However, the estimate of the 'avoidable social cost of congestion' — the cost that is relevant from the point of view of policy formulation — is a little smaller. The BTRE estimate (for 2005) is $9.4 billion per year. By implication, the desirable level of congestion costs, given the current road network, should be around $1.7 billion per year. Put another way, in 2005 the cost of congestion on Australian roads was roughly six times what it should have been.

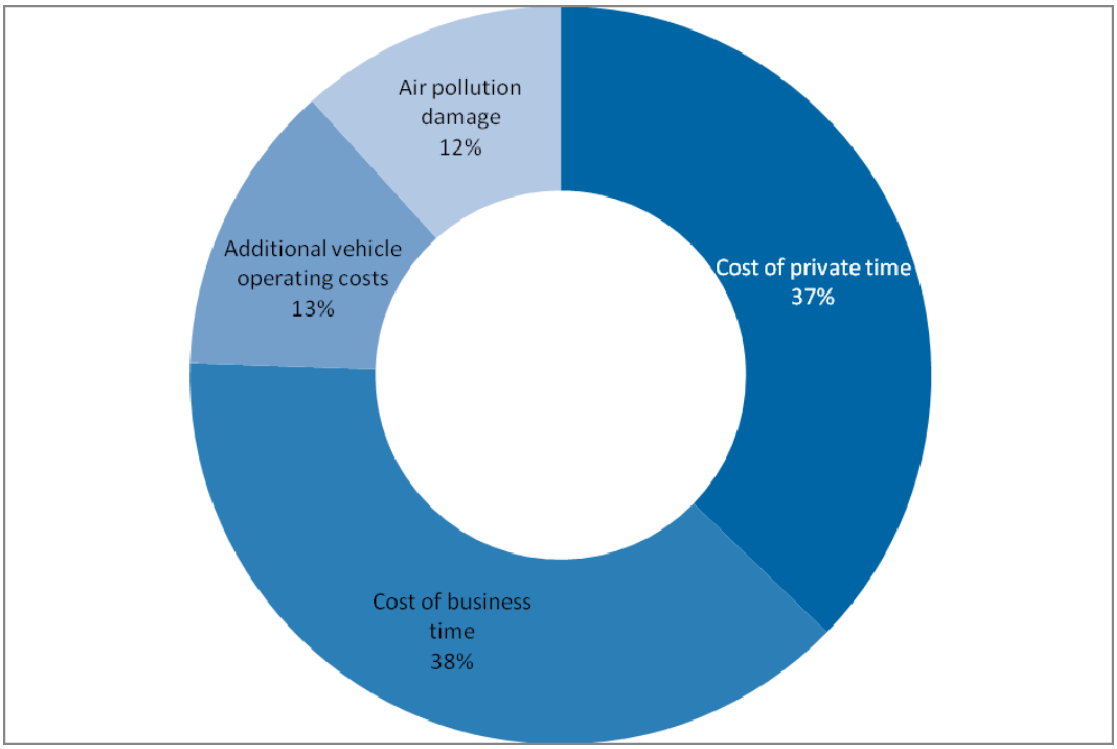
7.2 The structure of congestion costs

The BTRE's estimates of the magnitude of current and likely future congestion costs are, by its own admission, 'order of magnitude' evaluations — to help with considerations dealing with the likely aggregate costs of urban transport externalities for Australia, and their likely future trends' (BTRE 2007, p. 2). However, it seems to me that it is safe to assume that congestion is a sizable problem, and likely to get bigger — and for the purposes of this paper the structure and causality of congestion costs are more interesting than their magnitude.

In framing policies for dealing with this congestion problem, it is useful to have some idea of the nature of the costs that comprise the 'avoidable social cost of congestion'. A breakdown of those costs is provided in Figure 7.1.

Of some importance to the development of appropriate policies for addressing congestion is that for approximately half of these costs — the costs of private time and the damage caused by air pollution — there are no market prices on which we can base our estimates of costs. There are of course more or less well-established ways of inferring the value of these things, but they are indirect and imprecise. For business time, there is a market, but there are a number of steps involved in moving from wage rates to an estimated cost of business time lost due to congestion, and each step moves us away from a firm empirical foundation. These issues are less of a concern for additional vehicle operating costs, for most of the components of which there are directly observable market prices, but even so the problem of

Figure 7.1 **Breakdown of avoidable social costs of congestion**



Data source: GHD analysis, based on data in BTRE (2007).

estimating the extent to which the costs increase as a result of congestion is non-trivial.

To emphasise these measurement difficulties is not to deny that the problem of congestion is real, or that it is useful for us to have an estimate of the economic loss due to congestion, however imperfect. But it is important that we bear in mind the provisional and imprecise nature of such estimates when we try to devise appropriate policy responses to the problem of increasing congestion.

7.3 Population growth and the problem of congestion

The deadweight loss of congestion is forecast by the BTRE (2007) to more than double from $9.4 million per year in 2005 to $20.4 billion per year in 2020. This is a large number, and enough for the peak infrastructure industry body to conclude that 'urban congestion is a significant national challenge that requires an equally significant national response' (IPA 2009).

It is useful to look more closely at just what will drive the expected increase. There are a number of ways in which to look at this, but one is particularly instructive. We can decompose the total cost increase into three components:

- the component that results from an increase in the number of people making trips or causing them to be made; that is, the increase in population (x)
- the increase in the amount of travel — or, more precisely, the increase in the load on the road system — per head of population (y)
- the increase in the avoidable cost associated with each unit of traffic load (z).[1]

In principle, the component 'z' could itself be segregated into two components: the increase in the *quantity* of resources (mainly time) consumed with each unit of traffic load, and the increase in the *price* of those resources. However, although the BTRE report is not completely clear on this, it appears that congestion cost estimates are made on the assumption that the value of time remains constant over the analysis period. The component 'z' therefore reflects the decrease in network service quality over the analysis period.

Figure 7.2 shows the contribution that each of these factors makes to the expected increase in congestion costs for Melbourne (the picture is much the same for Sydney).

Figure 7.2 shows the proportion of the increase in congestion costs that is due to expected future population increase. If all other factors were held constant, population growth would lead to an increase of only 12 per cent in congestion costs.

Looked at another way, it is useful to consider a hypothetical situation in which:

- there is no increase in population in our major urban areas
- traffic per capita increases as anticipated by the BTRE
- the level of service on the road network deteriorates as anticipated by the BTRE.

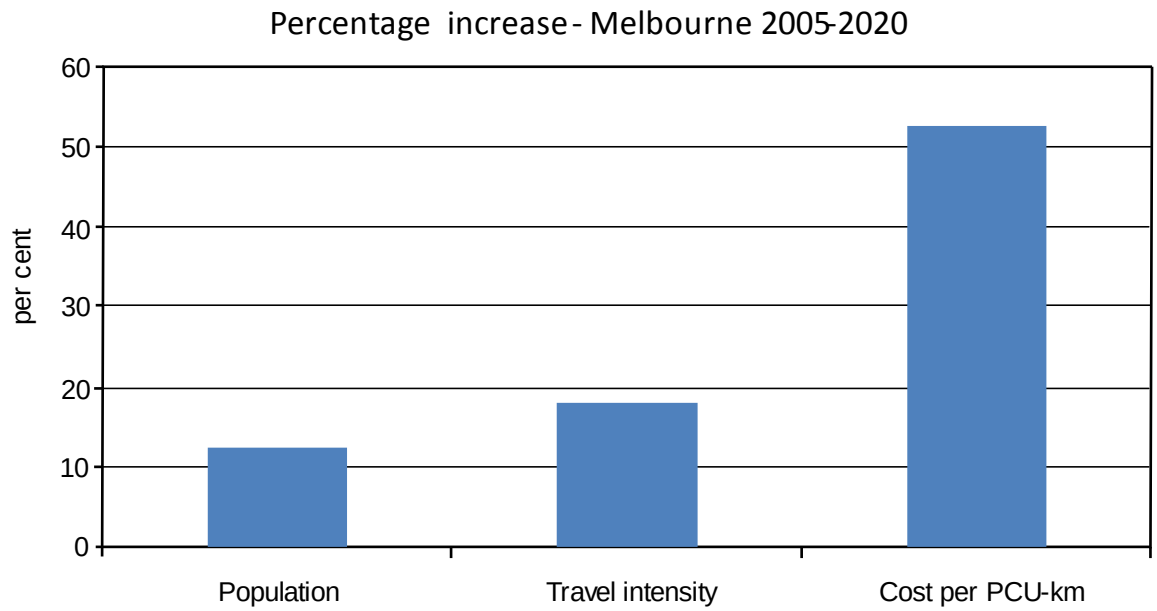
In this situation, the total cost of congestion would increase by over 80 per cent between 2005 and 2020.

The second component — the increase in traffic intensity — makes a slightly larger contribution. It is expected to increase by approximately 18 per cent between 2005 and 2010. That increase is equivalent to 1972 passenger car units (PCUs: kilometres per annum).[2] Of this total, most is commercial vehicle traffic; only 37 per cent is

1 The total increase is congestion costs (r) is given by the relationship: $r = (1 + x)(1+y)(1+z) -1$

2 Some vehicles, such as large trucks, have a greater impact than others on the flow of traffic and the load on the road system. To allow the mix of vehicles to be taken properly into account

Figure 7.2 **Causes of increases in congestion costs**



Data source: GHD analysis, based on data in BTRE (2007).

private vehicle traffic, of which a substantial share is business travel (see Figure 7.3).

By far the most significant element of the increase is cost per unit of traffic load. This reflects an expected decline in the average level of service on the urban road network, but that decline is not a fact of nature. It reflects expected future infrastructure investment policy: specifically, it reflects an assumption that investment in effective urban road capacity will not keep pace with the increase in demand — in fact, that it will fall far short of the increase in demand.

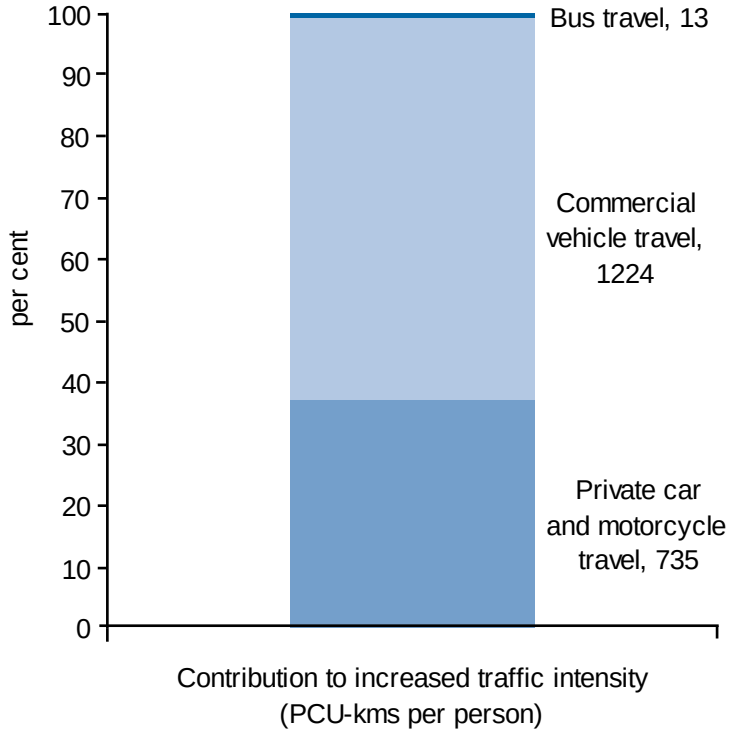
These observations justify three propositions, all of which are of some importance in meeting the challenge of congestion efficiently:

- The problem of increasing congestion is not primarily a problem of increasing population.
- The most important single factor in the expected increase in costs of congestion is the (assumed) decision not to expand the supply of road space at the same rate as demand.

when discussing the load on the road system, traffic load is customarily expressed in terms of the equivalent number of passenger cars (PCUs).

- Most of the expansion in demand for road space will come from the freight sector, and a significant share of the remainder will come from business-related private vehicle travel.

Figure 7.3 **Breakdown of increased travel demand (Melbourne)**



7.4 Addressing the problem

Congestion pricing

I have placed congestion pricing first on the list of possible response measures not because it will play the most important role, but because the response of most economists to any rationing problem is to fix it with prices. The great advocate of congestion pricing in the road sector (and many other sectors) was Nobel laureate William Vickery (Vickery 1963).

It is useful to distinguish between two concepts that are often unhelpfully intertwined:

- *road pricing*: recovering from road users the cost of providing the road infrastructure that they use

- *congestion pricing*: setting a price on road use at particular times and places, which is intended to reflect the impact that the decision to travel has on the costs faced by other road users.

I am not aware of any credible argument for not charging road users the full cost of providing, maintaining and operating the road infrastructure that they use, but that is not the concern of this paper. This paper is solely concerned with congestion pricing. Congestion pricing is not about recovering the cost of infrastructure.

The first important point to make about congestion prices is that they are not really prices at all but Pigovian taxes. This matters because one of the great attractions of prices is that they often function as an endogenous equilibrating mechanism that will bring demand and supply into optimal equilibrium; this happens, for instance, in the markets for bread or body-piercing services.

This is not applicable to taxes, including congestion pricing. We have to set the charge or charges through an administrative ruling. If we get this right, it may reduce the social cost of using road infrastructure. It will not automatically call forth an appropriate supply response. This characteristic is intrinsic rather than accidental: it cannot be fixed by institutional reforms, such as commercialising or privatising road provision.[3]

Aside from this fundamental limitation, there is a range of practical problems in setting appropriate congestion charges. The standard precept of setting the congestion charge equal to the marginal social cost of additional road use is beguilingly simple (Hau 1998), but of course road use varies by the minute and by the street. Moreover, the relationship between traffic load and delay is mediated by a variety of factors, many of which are specific to a particular road, and sometimes — as with clearways and school zones — specific to a particular time. Additionally, as discussed above, most of the cost associated with congestion relates to resources that are difficult to price with confidence and accuracy.

For all of these reasons, estimating the marginal social cost of additional road use — which will in any case vary greatly over time and space — is complex and prone to very great uncertainty. Any practical congestion pricing scheme is therefore likely to be only a very, very crude approximation of 'optimal' congestion pricing.

3 Some interesting and elegant work has been done to show that under certain assumptions an 'optimal' congestion tax will raise sufficient funds to finance an 'optimal' level of road capacity (Mohring 1976; Newbery 1989). However, as it seems that these conditions are unlikely to be even approximately true in an urban road environment, they are of little practical relevance to congestion policy.

But even very crude schemes can be pretty expensive. The highly publicised London congestion pricing scheme is about as crude as you can get — in essence, it is a single flat charge for operating a vehicle within the congestion charging zone during the daytime (TfL 2011). But even for this very simple scheme, the annual operating costs amount to approximately 50 per cent of the total annual revenue from the £10 /day[4] charge that is levied on vehicles entering the restricted area (TfL 2010). This is a problem because there are good reasons to expect that the revenue generated by a congestion pricing scheme will be many times larger than the efficiency gains from the reduction in congestion. If that is the case, and if it is also the case that the cost of operating the scheme equals a large proportion of the revenue, then it seems unlikely that the benefits will outweigh the cost.[5]

According to KT Analytics (2008), an *ex post* evaluation of the scheme yields an economic benefit–cost ratio of 1.4. Given the considerations outlined above, this seems surprisingly high. However, even if we accept it as accurate, it does not seem a particularly impressive figure for an initiative designed to address the problems of a notoriously dysfunctional CBD, and which is generally regarded as successful. Worth doing, perhaps, but I suspect that there are a number of road improvement schemes awaiting funding that would have yielded benefit–cost ratios of at least that magnitude.

Congestion is also expensive in another sense. Politically, the costs are usually high and can be insupportable — especially in cities, like Australian cities, whose form is premised on the use of private motor vehicles. Despite the enthusiasm of those who, during the past decade, have celebrated congestion pricing as an idea whose time has finally come, it is still common for such schemes to fail to gain political support — even when, as in the case of the failed New York initiative, central governments have tried to sweeten the deal by providing a large grant (EDF 2008).

Finally, there are risks involved in any 'sin tax', and they apply also to congestion pricing. The first is that governments become addicted to the revenue from them, and the desire to keep that revenue can undermine commitment to solve the problem (the obvious Australian example is revenue from gambling taxes). The second is that, in order to make the tax palatable, the government commits to spending it on things that have popular appeal but do little for economic efficiency or for any other worthwhile objective.

All of this is not to say that congestion pricing does not have a role to play in the future management of congestion. There are examples of congestion pricing

4 There is a 10 per cent discount for automatic payment.

5 I am grateful to Henry Ergas for making this point in his comments on the original version of this paper.

schemes that have made an important contribution to the management of congestion — the most sophisticated, celebrated and successful is Singapore's (BAH 2006). Time-of-day pricing on road links that are already tolled seems an obvious improvement, despite the fact that recent press reports suggest that the marked initial impact of Sydney's peak period toll surcharge has dissipated over time (Haynes 2010).

However, in general, pricing is likely to be a rather blunt instrument for dealing with congestion efficiently, and it would be very unwise to place all of our policy eggs in this particularly fragile basket. It is unlikely to be enough by itself, it will probably not be the main game, and it may not even be worth the effort. An adequate approach to congestion management may incorporate congestion pricing, but it is also likely to require a number of other measures, many of which are less likely to be embraced by econocrats.

The supply side

As we have seen, a very large part of the expected increase in congestion costs results from the assumption of the BTRE analysis that the ratio of demand for road capacity to supply will increase over time. I have not undertaken a detailed appraisal of the BTRE's supply-side assumptions, but intuitively I have no trouble in accepting this assumption as a reasonable depiction of what is likely to occur if we continue with our current policy settings. What is more questionable is whether we should accept this outcome as reflecting what we *ought* to do with the supply of road capacity.

There are two levels to this issue. The first level deals with what might be called road management initiatives. By this I mean things that can be done to increase the effective capacity of existing road space. There seems to me to be a general consensus that there are things — freeway ramp metering, improvements to information systems and the like — that can be done to get more out of our existing road infrastructure. Just how much can be gained from initiatives of this type is uncertain, but Booz Allen and Hamilton in its study for the Council of Australian Governments concluded that:

> The evidence indicates that the extended application and further integration of traffic management systems on a corridor basis could provide some real productivity and efficiency gains for the urban road network, and therefore these tools merit further consideration by Australian jurisdictions. (BAH 2006)

By and large, initiatives in this class require relatively modest levels of capital and are likely to generate few negative side effects. It seems sensible to give such

measures a high priority in addressing the challenges of increased traffic demand, and including them in our policy package is not likely to generate much debate.

The second level is likely to be more controversial. This involves building more and better roads to handle increased travel demand. It is now accepted wisdom that we cannot build our way out of a congestion problem. Dr Henry, for instance, asserts that 'the avoidable costs of urban congestion may grow to around $20 billion in 2020. This cannot be reduced simply by building more city infrastructure, as most new road space induces new traffic' (Henry tax review 2010).

It seems reasonable to make two points here:

- We need to be a little cautious about the claim that 'induced demand' negates the benefit of expanding capacity. In most other areas of economic endeavour, if we lower the effective price of something by providing better infrastructure or other efficiency improvements, and as a result we sell more units of it, we would regard that as a good thing. The same holds true when we invest appropriately in additional road capacity. If demand is not responsive to improved road conditions, the whole of the benefits of the improvement will show up as reduced congestion costs. If demand is responsive, then some of the benefit will show up in the form of reduced congestion costs; some will be in the form of consumer surplus on trips that would otherwise not have been made. It is not obvious that the total benefit in the latter case will always be lower than in the first, even in the absence of congestion pricing.
- The level of congestion on the network cannot by itself answer the question of whether or not the (assumed future) level of road investment is optimal. It is possible that the cost of congestion is high but that the cost of the infrastructure needed to reduce it would be even higher. But it is also possible that there are capacity-increasing investments that would result in reductions in the cost of travel that would more than justify the expense.[6] There are different views on which of these two conditions pertain, but this is an empirical issue, and it seems to me that the balance of evidence favours the view that investment in urban road systems at present is deficient rather than excessive.

Providing alternatives

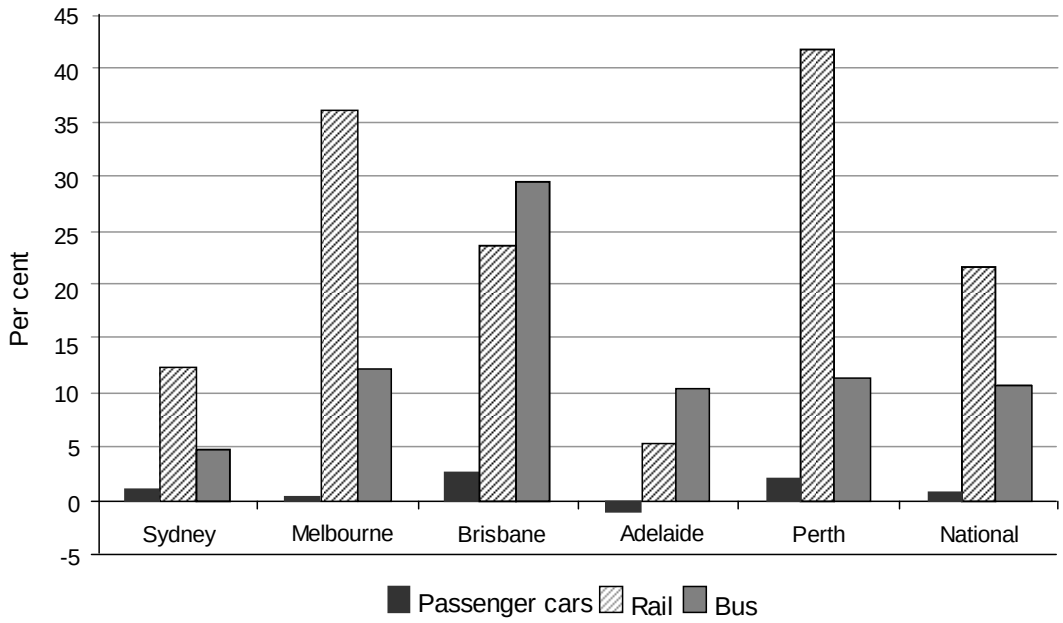
The third element of the portfolio of measures that would be required to tackle traffic congestion efficiently is the provision of attractive alternatives to the behaviours that lead to the congestion.

6 Of course, it is also possible that investments in additional road capacity would be justifiable in economic terms but rejected by the community on other grounds.

This will be harder than it may seem at first sight. One of the main reasons why it will be tough is the breakdown of future traffic growth shown in Figure 7.3. Much of the expected future growth is going to be in freight traffic. The alternatives for much of this traffic — the very large portion that is used in the distribution of goods within urban areas — are very limited, but there are elements of the urban freight task, such as port-related freight, inter-regional freight and interstate freight, for which rail alternatives are credible, even if not commercially attractive under present conditions. However, a switch to rail of even those components will depend on significant investment in freight rail infrastructure and intermodal terminals, and is very likely to require supplementary coercive or fiscal measures, at least during an initial period.

As far as personal mobility is concerned, for many years attracting people away from private motor vehicles was almost given up as a lost cause. However, a combination of push and pull factors has resulted in a partial reversal of this trend in more recent years. Figure 7.4 shows the increase in urban passenger travel between 2003–04 and 2007–08, by mode and major city. Nationally, there has been an 11 per cent increase in bus travel and a 22 per cent increase in rail travel (including light rail and trams) over that period, compared to a 1 per cent increase in passenger car travel.

Figure 7.4 **Increase in passenger kilometres of travel, 2003-04 to 2007-08**



Data source: BITRE (2009).

Despite the warnings issued in previous assessments of the potential for future improvements in public transport to make a meaningful contribution to the relief of congestion (BAH 2006), this reversal gives some reason for cautious optimism. Infrastructure Australia's selection of national infrastructure priorities is heavily weighted in favour of urban public transport projects, and it has forcibly expressed its view on the central importance of improved public transport to the future functioning of Australian cities:

> Infrastructure Australia believes that, to maintain the economic success and environmental sustainability of Australia's cities, the time has come for an unprecedented commitment to the creation of world-class public transport in our cities. Infrastructure Australia is therefore recommending, for the first time in Australian history, significant Australian Government investment in public transport in our cities. (Infrastructure Australia 2010)

This vision implies more than a program of cautious incremental improvements: it means that we are going to need to take significant leaps of faith by backing some very large investments in game-changing initiatives.

Reshaping cities

The fourth package of measures that we will need to bring to bear on the problem of ameliorating congestion relates to urban form.

The complex interaction between urban form and transportation is widely acknowledged but only imperfectly understood. From the perspective of congestion management, the most salient aspect is that low-density cities imply heavy reliance on private motor vehicles. At the same time, the assumption of private motor vehicle ownership — and in particular the availability of that vehicle for the journey to work — conditions decisions on housing and workplace choice.

Many commentators have concluded that changes to the form of Australian cities will be essential to the long-run management of congestion. The policy actions required to bring about those changes fall into two broad categories, one of which is likely to be embraced by economists and one of which is likely to receive a less enthusiastic reception. The first involves the removal of restrictions that currently limit the ability of the market to respond to the demand for more intensive development in and around transport nodes and corridors.

The second involves the use of zoning controls, land release mechanisms and other regulatory and coercive measures to constrain actions of the market that would lead to the perpetuation of dependence on the private motor vehicle. Of course, there is nothing new in limiting the action of the market in this way, but to argue that it is an

efficient approach to congestion management requires an indication of where the market failure lies that justifies this intervention. In my view, there are two sources of this failure. The first is imperfect information on the full implications of private location choices. The second is that those who make the decisions are not necessarily those who will bear the full consequences of them: cities (or at least cities that are growing at relatively modest rates) change their shape only slowly, and the decisions made today will have implications for generations to come.

Behavioural and attitudinal charges

Finally, we can tackle congestion by changing the way people behave, even if the objective conditions under which their choices are made do not change.

Once again, there are two levels of activity here, one of which is likely to be very palatable to orthodox economists and one of which is less likely to be so. The first is essentially about improving information. There are many ways that can be done, and many excellent initiatives that are already in place. They range from providing real-time information on bus movements to ensuring that travellers are fully aware of the real cost of private vehicle use.

The second — and perhaps more problematic — range of initiatives is aimed at changing what people do by changing what they want to do: changing not the information that people use in making their decisions, but the criteria that they use in evaluating that information.

To put it bluntly, I am talking here about social engineering. Between 1986 and 1996, the number of journeys to work made by bicycle fell by 15 per cent; between 1996 and 2006, the number increased by 21 per cent. Between 1986 and 1996, the number of journey-to-work trips made on foot fell by 8 per cent; between 1996 and 2006, the number increased by 17 per cent. So what has changed? Well, a lot of things perhaps — more expensive petrol, more cycle paths, better information on the health benefits of exercise and so on — but I am willing to bet that the biggest single factor is quite simply a change of attitude. In 1996, it was ‘uncool’ to cycle or walk to work; in 2006, it was very cool. And, as Steve Jobs has amply demonstrated, what is cool is not decided autonomously or endogenously by individual economic agents: it is a social construct, and one that can be formed by clever and well-resourced marketing initiatives. There is no obvious reason that the same tools should not be used to reduce the costs of congestion — economic, health and environmental.

References

ATC (Australian Transport Council) 2009, *Australian Capital City Congestion Management Case Studies*, report of the Urban Congestion Working Group, ATC.

Australia's Future Tax System Review Panel 2010, *Australia's Future Tax System: Report to the Treasurer*, (Dr Ken Henry, Chair), The Treasury, Canberra.

BAH (Booz Allen and Hamilton) 2006, *Review of Urban Congestion Trends, Impacts and Solutions*, report prepared for the Council of Australian Governments.

BITRE (Bureau of Infrastructure, Transport and Regional Economics) 2009, *Urban Australian Transport Statistics Yearbook 2009*, BTRE, Canberra.

BTE (Bureau of Transport Economics) 1999, *Urban Transport: Looking Ahead*, Information sheet 14, BTE, Canberra.

—— 2000, *Urban Congestion: Implications for Greenhouse Gas Emissions*, Information sheet 16, BTE, Canberra.

BTRE (Bureau of Transport and Regional Economics) 2007, *Estimating Urban Traffic and Congestion Cost Trends for Australian Cities*, Working Paper 71, BTRE, Canberra.

EDF (Environment Defense Fund) 2008, *State Nixes NYC Congestion Pricing Plan*, www.edf.org/article.cfm?contentID=6618 (accessed 22 February 2011).

Haynes, R. 2010, 'Motorists shrug off higher time-of-day tolls', *Daily Telegraph*, 18 January.

Hau, T.D. 1998, 'Congestion pricing and road investment', in Button, K.J. and Verhoef, E.T. (eds), *Road Pricing, Traffic Congestion and the Environment*, Edward Elgar Publishing Limited, Cheltenham, pp. 39–78.

Henry tax review. *See* Australia's Future Tax System Review Panel 2010.

Hubbard, P. 2009, 'Urban congestion: why free roads are costly', *Economic Roundup*, issue 2, downloaded from Australian Treasury website, www.treasury.gov.au (1 March 2011).

Infrastructure Australia 2010, *National Infrastructure Priorities: Infrastructure for an Economically, Socially, and Environmentally Sustainable Future*, Infrastructure Australia, Canberra.

IPA (Infrastructure Partnerships Australia) 2009, '$8.5 billion investment in urban rail to ease congestion, evolve cities — process rigorous, independent', Media release, 12 May.

KT Analytics 2008, *Lessons Learned from International Experience in Congestion Pricing*: *Final Report*, report prepared for United States Department of Transportation, Federal Highway Administration.

Lawphongpanich, Siriphong, Yin Yafeng and Hearn D.W. 2007, 'Congestion pricing: gaining public acceptance', paper presented at Sixth Triennial Symposium on Transportation Analysis (ITRISTAN VI), Phuket, 10–15 June.

Mohring, H.D. 1976, *Transportation Economics*, Balinger Press, Cambridge MA.

Newbery, D.M.G. 1989, 'Cost recovery from optimally designed roads', *Economica*, vol. 56, May, pp. 165–85.

Taylor, B.D. 2002, 'Rethinking traffic congestion', *Access*, vol. 21, Fall.

TfL (Transport for London) 2010, *Annual Report 2009-10*, TfL.

—— 2011, *Congestion charging: when to pay*, TfL website, http://www.gov.uk (accessed 7 March 2011).

VCEC (Victorian Competition and Efficiency Commission) 2006, *Making the right choices: options for managing transport congestion*, Final report, VCEC.

Vickrey, W.S. 1963, 'Pricing in urban and suburban transport', *American Economic Review Papers and Proceedings*, May, pp. 452–65.