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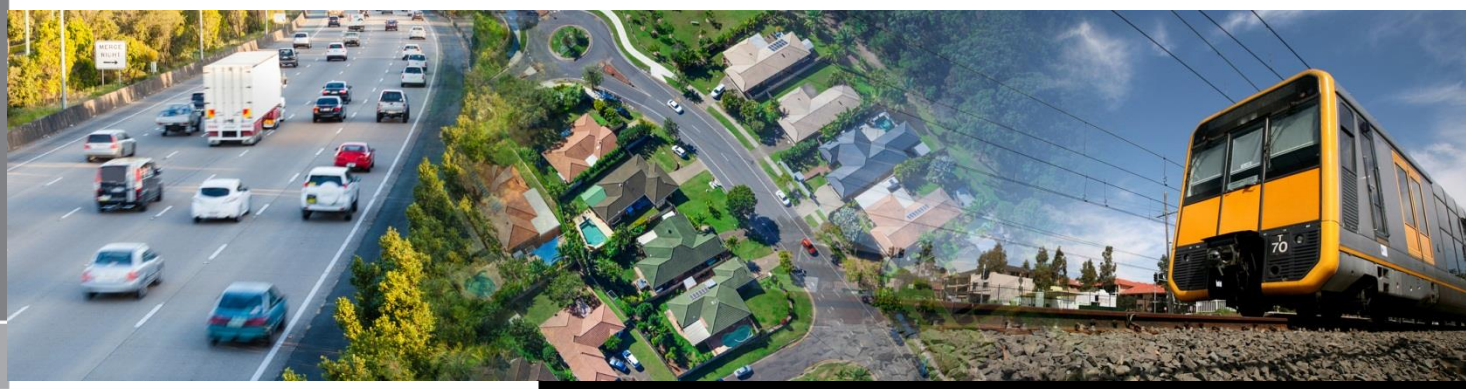

Transport infrastructure and land value uplift

At a glance

- Land value uplift capture involves governments levying a proportion of the increase in the unimproved capital value of private land due to public sector transport infrastructure investments.
- It addresses the problem of unearned benefits of public sector investments flowing disproportionately to individuals and is a potential new source of investment for transport infrastructure.
- There are more than a hundred studies on value uplift around mass transit nodes. Although on average land values often increase, there is considerable variation in timing and amount.
- There are too few publicly available studies of the effect of road infrastructure investment on land values to make an assessment.
- There are a number of factors that make assessing land value uplift difficult. Among them are sampling errors in land prices, separating out the effects of transport infrastructure from other factors and determining the shape of the catchment of beneficiaries of the transport investment. However, the greatest problem is that the transport system is a network and localising the benefit from new links in the network is often very difficult.
- This has led some to propose a broad based land tax as an alternative.

What is value uplift?

There are many definitions of value uplift but they can be summed up by the following;

Value uplift is the process whereby the value flows[1] on the transport network are capitalised into land values.

There are three elements of this definition that are important to the following discussion; value flows, transport networks and capitalisation.

Why has it become important?

With rare but notable exceptions, value uplift has not been used to fund transport infrastructure in Australia. In recent years, a number of factors have led to a consideration of this financing method. First, equity concerns. If publicly funded transport infrastructure is provided with a positive cost/benefit ratio, a portion of the benefits are capitalised into land values. Under current arrangements, the increase in values flow largely to private individuals. For example, a government might fund a new freeway to improve the connection between a capital city and a regional city. This also has the effect of reducing travel times for locations along the freeway. This may make it economically attractive for developers to turn former rural land into a housing estate. In this process, the increase in land values bought about by public investment in the freeway flows

[1] Value flows refer to the economic value of a trip on a particular segment of the transport network.

mostly to developers and their clients. This raises serious equity concerns, particularly in the current circumstances of above trend land price growth.

Second, the funding of mass transit systems in Australia is unusual in that fare box revenue, i.e. what the user pays, is generously subsidised by state governments. However, these governments are also relatively parsimonious with capital expenditure (Miller and Hale 2011). Value uplift financing is seen as a way to maintain the fare box arrangements but gain another source of capital by levying those properties that are seen to benefit from mass transit investments.

How does value uplift financing work?

There are numerous variants of value capture around the world[2]but the four main ones are:

Tax Increment Funding (TIFs)

Widely used in the United States especially for urban renewal projects, TIFs are an example of hypothecated value uplift. In their most common form, a public agency issues infrastructure bonds based on the expected or hypothecated increase in property tax revenue (the increment) that will be generated by the project. TIFs are now also used in Canada, Puerto Rico and in recent years, the United Kingdom (Langley 2013). The main value of TIFs is that project developers do not have to bear the upfront costs at the start of the development (McIntosh et al 2015). TIFs are well suited to developments that involve a number of smaller integrated projects such as improving blighted areas of inner cities. In general, Treasuries in Australia have been resistant to any form of hypothecated funding and the TIF model has not been adopted for any major project (PwC 2008).

Betterment Tax

In its most common form, land owners thought to be direct beneficiaries of infrastructure development pay a levy usually based on unimproved capital value (Medda and Modelewska 2010). The most well-known example in Australia is the use of a sophisticated version of betterment tax to fund a third of the construction of the Sydney Harbour Bridge (Ergas 2014). More recently, a quarter of the funding for the construction of Melbourne's City Loop rail system, completed in the early 1980s, was from a betterment tax on properties in the City of Melbourne (Lee 2007, Mares 2012). Currently, the Gold Coast Rapid Transit Light Rail is being partly financed by a form of city wide betterment tax (McIntosh 2012). This project is discussed further on page 5. While betterment taxes are normally used to help fund large pieces of infrastructure, a form of betterment tax has been used in Western Australia since the 1950s to purchase land for future infrastructure and public amenity (Western Australian Planning Commission 2007).

Transaction taxes

Transaction taxes are levied on property transfers in Australia and with the rapid increase in property values since 1997, have become an increasingly important source of revenue for both state and federal governments. Capital Gains Tax is levied on non-owner occupied dwellings by the Commonwealth and Stamp Duty levied by state and territory governments currently makes up around a quarter of their tax revenue (Treasury 2015:143). If the value of property increases due to publicly funded infrastructure provision then some of the investment will be recovered by these transaction taxes. The lack of publicly available information makes it difficult to assess whether a consideration of this revenue source is used systematically in funding considerations for Australian projects.

Joint development

Joint development is a form of value uplift capture when a private agency provides a service, usually infrastructure provision, in return for a right to on sell the surrounding land. The system was used throughout the world in the nineteenth century to fund railway development. Recent examples in Australia are Chatswood station in Sydney and Melbourne Central where air rights were sold to a developer in return for an upgrading of the station precincts (Infrastructure Australia 2012). Currently, it is mainly used for heavy rail development in Asia (Miller and Hale 2011).

[2] Tomalty (2007) identified 15 value uplift funding models being used in North America

What is the evidence for value uplift?

There are a more than a hundred papers on value uplift (Smith et al 2015, Ozdilek 2011). A number of studies have summarised the findings. (Mohammad et al 2013, McIntosh et al 2014, Stokenberga 2015). The usable observations for commercial and residential properties from these meta studies are summarised in Table 1.

Table 1: Average value uplift per transit mode

Mode	Average value uplift (%)	Range (%)	Number of observations
Heavy rail	6.9	-42 to +40	18
Light rail	9.5	-19 to +30	32
Bus rapid transit	9.7	-5 to +32	14

Note: There were insufficient observations for ferries and road infrastructure. The reasons for the lack of road studies are discussed below.

What are the challenges to assessing value uplift?

The significant variations in the reported value uplift for projects would suggest that it would be unwise to plan for an average without an understanding of some of the fundamental principles causing these variations. There are many projects that appear to have little or no effect on the value for surrounding properties and in a number of cases values have actually fallen. A range of factors appear to affect whether there will be value growth, when it will occur and where it will occur.

Land value measurement

In principle, measuring value uplift is quite simple. The value of land is estimated without the project and then values are estimated with the project. The difference is the value uplift. Unfortunately, there are problems with both before and after measurements.

Estimating the value of land without the development is particularly problematic. Land values are essentially the measurement of the economic, social and amenity values of a location. Thus, they change independently of the local transport infrastructure. A recent examination of property values in English speaking countries (BITRE 2015a, b,) showed that shifting trade flows were increasing relative values in those parts of cities exposed to international trade. Others have shown a link between density and productivity which is being capitalised into land values (Liddle 2013). One consequence of this is that values are increasing more quickly in the inner parts of cities than the outer parts. Since most recent mass transit projects are located in places where there is rapid population and/or economic growth in a confined area, it is particularly difficult in these situations to assess land values in the absence of a transport infrastructure project.

Estimating the value of land with the project is also not without its problems. The technique that is mostly used is called hedonic pricing. This method tries to separate a property's value into the component parts contributed by many different aspects such as its aesthetics, access, neighbourhood quality etc. The problem is that these factors are seldom independent of one another but go up and down together. This is called collinearity in statistics. Although a number of recent studies have addressed the problem (Diao 2015), the more usual solution is to just accept it. As Bouchard observed, 'Multi collinearity is God's will and not a problem with OLS or statistical techniques in general… (it) is likely to prevent the data from speaking loudly on some issues' (1987).

Another approach to the problem of collinearity is to use a technique called Geographically Weighted Regressions (Du and Mulley 2012). This uses the actual location of individual properties and a number of its characteristics such as dwelling form (house or unit), number of bedrooms, transport accessibility, socio – economic profiles etc. The great advantage of this method is that it improves the ability to separate out the factors that cause value uplift. The downside is that it is a relatively complex and data intensive system not well suited to quick estimates.

Box 1: Value uplift around heavy rail: Central Station, Sydney

Value uplift around major rail stations has become an intense focus of study since the publication of *Taken for a ride: taxpayers, trains and HM Treasury* which concluded that the owners of the land surrounding the stations on London's new Jubilee Line benefited by £13.5bn for the £3.5bn spent by taxpayers on the line (Riley 2001). Central Station is located at the southern end of Sydney's CBD. It is the terminus for much of New South Wales country passenger rail network and the principal node in the urban passenger rail network. It is also the terminus for the Inner West Light Rail to Dulwich Hill. Central Station was one of the potential sites for major stations investigated for the proposed High Speed Rail network linking the east coast capitals. Part of this investigation was perhaps the most detailed assessment of the potential for value uplift publicly available in Australia (AECOM 2013).

The investigation began with the limitations of the site including Prince Alfred Park adjacent the station, the extensive station yards and heritage buildings and highly fragmented land ownership over much of the surrounding area. The study concluded that with a business as usual scenario, the restraints of the site meant that value uplift would be relatively modest. However, if the airspace above the rail yards was redeveloped for passive recreation (a larger New Prince Alfred Park) in a similar way to Millennium Park in Chicago and development occurred on the existing Prince Alfred Park site and the surrounding area, value uplift would be substantial, possibly more than $30bn.

This case highlights the importance of the characteristics of the surrounding area for value uplift, particularly its potential for supplying more land.

Sampling

Most value uplift estimates have assumed that the value of properties sold before and after the development is a representative sample of the entire transport catchment. This may be so but the assumption does not appear to have been tested empirically. Using a combination of unpublished tables from RP Data and ABS Census data, it can be calculated that around five percent of Sydney's houses and seven percent of units turned over in 2011[3]. Whether a sample of this size is enough for a reliable assessment of values will depend on the context but nevertheless caution would appear warranted as there is some indication that sampling bias leads to an overestimation of value uplift (Gatzlaff and Haurin 1997, Hwang and Quigley 2004).

Origins and destination

Almost all studies are concerned with value uplift at journey origin. Indeed, of the hundred or more studies on value uplift there may only be one (Blaimey 2010) that explicitly considered journey destination. This is a problem because intuitively a train station catchment with quick access to a large CBD will be worth more than one that accesses a suburban centre (Bowes and Ihlandfeldt 2001). Similarly, the value of land at the destination of new infrastructure would rise with new infrastructure provision.

Time

Another issue with measuring value uplift is time. Very few of the more than 100 value uplift studies have measured the change from a project's announcement to a decade or so after it was operational. There is some evidence that much of the uplift occurs when the project is announced with uplift slowing or even reversing once the project is built (Urbis 2014, Iacona 2009).

Calculating the catchment area

It has been a rule of thumb among planners for decades that people will walk half a mile (800 metres) to a train and a quarter of a mile (400 metres) to a bus. Accordingly, most studies of value uplift for mass transit have used these distances for their catchment areas. Unfortunately, like many rules of thumb, the empirical evidence for using these distances is not strong. The shape of the catchment can also be changed by the infrastructure project. Heavy rail in particular can consume significant amounts of land and change the shape

[3] There is no comparable data base for commercial properties to allow turnover to be calculated. However, turnover is likely to be lower than that for houses and units because there are less commercial properties than residential properties. This would make calculating land value uplift for commercial properties more prone to sampling errors than residential property.

of the catchment (Darroch 2014). Thus, delineating a heavy rail catchment area, for example, by simply drawing an 800 metre radius around a station can be problematic.

A study of almost 2,000 walking trips to bus stops and train stations in the Sydney, the Illawarra and Hunter areas showed the catchment area affected by a number of factors including trip purpose, transport mode, socio-demographic profile, time of day and day of week amongst others (Daniels and Mulley 2013) . When the fluidity of the catchment area interacts with people's willingness to pay for transport access, it can be appreciated why there is so much variation in value uplift studies. This is especially the case in a situation like the newer sections of Perth rail system where station access can be mainly by bus feeder services or park and ride.

There is also an element of design to the shape of a catchment. Just because development occurs next to a new transit link does not mean it is a Transit Orientated Development. Design and planning that connects the catchment development to transport infrastructure is critical to mode choice and consequently the value of transport infrastructure (Irvine 2009, Hale 2014). Those developments that fail to integrate transport and its surrounding land use will have a lower uplift than those that do.

Network architecture

Perhaps the most critical element of value uplift for new transport infrastructure is the architecture of the surrounding transport network. Network architecture has three main elements; hierarchy, connections and density. All affect value uplift.

Hierarchy refers to the organising structure of the network. This can be very different between countries, cities and times (Levinson 2012, Parthasarati 2014). Since most value uplift studies come from the United States (Smith et al 2015), an understanding of their network hierarchy is particularly important. In post Second World War United States, the urban freeway system mainly built by federal agencies in the fifties and sixties became the organising principle of their cities. Australia started building its freeway system two decades later and they were mainly retrofitted into existing development. Consequently, the transport networks in the post War sections of Australian cities generally have weaker hierarchical structures than their US counterparts (Landis 2007). Because the network architecture can be very different, caution needs to be exercised when drawing lessons from other places and just as importantly, from other times (Hesse 2013).

Evaluating the location of the beneficiaries of a new piece in the transport network without a consideration of network hierarchies is inherently difficult. This is why there are more than a hundred studies of value uplift in relatively simple hierarchies like rail and perhaps less than five recent studies on value uplift from investment the road network with its complex hierarchies. The few studies on the urban freeway network have value uplift estimates ranging from negative to 1,100 per cent (McIntosh et al 2014, Batt 2001).

Box 2: Value uplift around light rail: Gold Coast

The City of the Gold Coast occupies a narrow strip of land between the Pacific Ocean in the east and a mountain range to the west. It stretches for around 100km south of Brisbane to the Tweed River. Being the product of post-World War Two 'sun-belt' growth, its architecture is shaped by highways. The old Pacific Highway (now the Gold Coast Highway) hugs the coastline and joins the older suburbs like beads on a string. Because of congestion on the old road, a new freeway, the Pacific Motorway, was built to the west. A heavy rail line next to the Motorway will eventually reach the Gold Coast Airport at Coolangatta. These two parallel roads running north-south and their interconnecting roads running east-west are the organising principle of the Gold Coast. This type of urban form is typical of tourism based cities (Dedekorkut-Howes 2013)

The Gold Coast Light Rail is a single track 13 kilometre line system with 16 stations between Griffith University and University Hospital and the Pacific Fair shopping centre at Broadbeach i.e. the central Gold Coast. Much of its route is adjacent to the Gold Coast Highway. First proposed in 1996, construction commenced in 2010 and the line opened in July 2014. Extensions north to join the heavy rail line near Parkwood and south to the Gold Coast Airport are planned.

An examination of Gold Coast house prices supplied by RP Data for the 2000-2013 period at the ABS Statistical Area 2 (SA2) geography shows there has been no observable differences in price movements in the SA2s surrounding the project compared to other SA2s on the Gold Coast. In other words,

measured at this geography, there has been no discernible value uplift. It may be that measured at a finer level e.g. 400 metres from a rail station, there may be some but nevertheless for a city shaping project such as this one it would be expected that uplift would be visible at a broader level bearing in mind that the betterment charge discussed earlier is levied on the whole of the city.

It may be that the Gold Coast Light Rail's position in the network architecture and the value of the traffic may provide an explanation. For much of its current route, the light rail line replaces bus services on the existing Gold Coast Highway and so largely functions to provide more capacity on an existing network link.

In addition, given that value uplift is the process of value flows along the network being capitalised into land prices, the largely low value of discretionary journeys for shopping and entertainment on the light rail may also be functioning to reduce value uplift.

The lack of visible uplift so far may not be the end of the story. It can take years or sometimes decades for the benefit of city shaping infrastructure to become apparent. The completion of the light rail link to the north and south could significantly change the value of the existing middle section.

Connections refer to the number of connections each node in the network has. This is sometimes referred to as network complexity or entropy. The number and *value* of connections determine how much a node, for example a railway station, is worth. One of the major problems with value uplift is that while it is possible to calculate the number of connections to a node, their value is often opaque in the largely non marketised transport network. There are indications that value in the network may be concentrated in a small proportion of nodes. A study of the US freight network showed that just one per cent of the network was carrying 40 per cent of the value while 90 per cent of the network carried 10 per cent of the value (Tomer and Kane 2014). This may explain why value uplift has been relatively high around railway stations close to and connected to the CBD and often quite low in those located further away (Bowes and Ihlandfeldt 2001).

Network density is the number of nodes (road intersections, railway stations tram stops etc.) in a given area. Time is much more important than distance in deciding when and where to travel (2012 SOAC). There is real time and perceived time. It is perceived time that matters. Navigating dense networks makes time appear to go more slowly and trips in dense networks are perceived to take longer than they actually do (Parthasarati 2013). Consequently, the area of a catchment is smaller in a dense network than one that is sparse. The second effect of network density is on risk. The cost of a journey, as in most things, is price multiplied by risk. As the network density increases, so does the risk and consequently the cost of the journey. For road users, dense networks are associated with higher accident rates because of the number of intersections that need to be negotiated on the journey (Zhang et al 2014). For pedestrians, their risk of crime victimisation goes up as network density increases especially around railway stations (BOCSAR 2015). Thus, the risk component of travel costs goes up with network density. How much will depend on context but it will always be difficult to measure.

Land Tax

A tax on the unimproved capital value of land would solve the many difficulties outlined above particularly that of locating the benefit on a piece of transport infrastructure in a network. This has led some to consider whether a land tax may be the best method of capturing some of the value from public investment in infrastructure (see McLaren 2014 for review of positions).

Although land tax is most associated with US author and politician Henry George, it has a long history in Australia. All levels of government, including the Commonwealth, have levied land tax at some point (Legislative Assembly NSW 2014).

The issues involved in replacing stamp duty with a tax on unimproved capital value of land without exemptions are discussed in *Australia's future tax system* (Henry et al 2010) and the Chalk report to the Brisbane City Council (1989). In outline, the advantages are first, efficiency of collection. Second it is non-distortionary because it applies to everyone, everywhere. Third, because land is immobile the tax is difficult to avoid. Fourth, it discourages land banking. Fifth, it rebalances the tax system away from its current heavy

reliance on taxes on labour (income tax) and enterprise (company tax). Sixth, it encourages the highest use of land.

There are a number of points of opposition to land tax. First, farmers and others that make their living directly from the land may be unfairly disadvantaged because unlike other businesses, their means of livelihood would be directly taxed. Supporters of the tax say that this can easily be addressed by setting a threshold such that low value per hectare properties are not affected. Second, those who hold valuable property but are income poor may struggle to pay the tax. Supporters say that there should be an option to pay the tax on disposal of property and in any case a land tax encourages a property to go to its highest use. Third, the most serious objection to land tax and the reason why it has often been discontinued in the past is the question of which level of government levies it. If all three levels of government are funding transport infrastructure but only one is levying the value uplift then it would seem probable that this arrangement would not long endure. However, this may not be an impossible obstacle (see Day 2005 for a detailed discussion). The Commonwealth currently collects the vast bulk of transport taxes mainly through fuel excise but also provides substantial transport infrastructure funding to state and local governments.

In the context of capturing value uplift from transport infrastructure investment, land tax has a number of advantages. First, it solves the problem of localising benefits from investments in links in complex networks inherent in schemes such as betterment taxes. For example, an investment in a freeway network may reduce freight costs which are capitalised into land in a number of locations. Only a land tax can capture this benefit.

Second, it avoids the risk of hypothecating values inherent in value capture methods such as TIFs because land tax is based on actual rather than expected values. If the project does not deliver value, it does not create additional land tax.

Third, recent discussions of transport funding (Harper et al 2015, Henry et al 2010) recommend replacing existing taxes with a model that would see road users essentially rent the road space they are travelling on. If road use is charged by space and the surrounding land is not then there is potential for significant distortions in both land use and road use.

Fourth, land tax addresses the equity issues inherent in the current Australian mass transit pricing model that sees subsidies predominantly flowing to heavy rail through fare box concessions. Those who can afford to live in the catchment areas of railway stations benefit disproportionately from the billions of dollars that are spent each year on heavy rail (Glazebrook 2009), since although their incomes are higher than those that use other modes (SOAC 2013), more than three quarters of their travel costs are paid for by state and territory tax payers. A land tax would mean that people who live in valuable mass transit catchments are paying for at least some of the access to highly subsided travel.

Conclusion

There are compelling reasons why public funders should capture land value uplift from their investments in transport infrastructure. The models that have been used in Australia are not well suited to investments where the benefits may be spread over the network. A broad based land tax has been suggested to address this. While this tax has many advantages it also has substantial governance challenges.

There is a risk of introducing market distortions if a broad based land tax is not considered as part of changes to transport pricing.

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