Draft Report

The Treatment of Value Uplift in Cost-Benefit Analysis

with Special Reference to Transport Infrastructure

Prepared for

Infrastructure Australia

Applied Economics

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Contents

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Executive Summary

This paper responds to the following brief for Infrastructure Australia (IA):

> "To provide a summary of the appropriate treatment of *value uplift* in Cost-Benefit Analyses (CBAs). In particular, it requires the presentation of cogent arguments supported by appropriate micro-economic theory as to why *value uplift* should or should not be incorporated into conventional CBAs. Specifically, IA is looking for explicit commentary in the paper on whether the incorporation of *value uplift* into CBAs would constitute double counting of benefits."

In this paper, value uplift refers to the capitalisation of a stream of benefits into increased land values.

The main findings are as follows.

1. Value uplift is a legitimate part of the benefit of some projects, especially infrastructure projects. As such, it may properly be included in some CBAs.

2. However, where it exists, value uplift is a derived or flow-on benefit from other primary benefits. Therefore, as a general principle, it is always preferable to identify and estimate the primary benefits rather than attempt to estimate and include value uplift in a CBA.

3. Wherever benefits are estimated directly, and this is the preferred evaluation method, inclusion of value uplift would be double counting.

4. The main potential argument for using value uplift in CBAs would be that economic or residential development benefits may be underestimated, or possibly not estimated at all, in some CBAs. This may sometimes occur.

5. However, most CBA evaluations are made **before** the transport infrastructure is created and with the aim of evaluating the proposal for it. In this case, the extent and timing of the uplift would have to be estimated **before** transport infrastructure is created.

6. Moreover, in so far as significant uplift would occur, it would essentially be a function of the core user benefits and economic development benefits (where these are applicable). Thus, forecasts of value uplift would depend on the forecasts of these benefits and not be independent of them.

7. Value uplift valuations would be independent of these forecasts only if the valuations were transferred in from some external research study. However, there is a wide variance in estimates of value uplift from infrastructure developments. Thus, the CBA analyst should verify that the user and economic development benefits in the project case were similar to those in the external case, which would require an assessment of the basic list of benefits in the project case.

8. The paper also briefly considers the role that value uplift might have for CBAs of urban renewal, housing developments and a major sporting stadium or cultural building. In the first two cases, increases in property values may be a significant part of the evaluation.

9. However, this does not imply that increases in land values (value uplift) should be an input to the economic evaluation. First, the value uplift is a function of changes in property values less any inputs of the property owner. Second, value uplift has no independent standing. To count value uplift in addition to the value of the housing produced would be double counting.

10. Finally, the paper reviews briefly the role of value capture, specifically capture by government of part of the increases in private land or property values. It is stressed that this is a financial issue, not an issue of economic evaluation.

11. There are two types of value capture: user charges and taxes. User charges recover the costs of public infrastructure and reduce value uplift and so may be viewed as a form of value capture. Indeed, this is often the most appropriate form of value capture.

12. Value capture taxes include transaction taxes, land tax and a value uplift (betterment) tax. The paper notes that transaction taxes are inefficient and unfair. A land tax is practical but captures very little of land value uplift.

13. If designed efficiently, a value uplift tax would be efficient and fair. However, the caveat is efficient design. Both the beneficiaries and the extent of the value uplift would need to be accurately defined and estimated.

1 Introduction

1.1 Objectives of Paper

As per the initial Brief, the consultant is to provide

> "A summary of the appropriate treatment of *value capture* into CBAs. In particular, it requires the presentation of cogent arguments supported by appropriate micro-economic theory as to why value capture should or should not be incorporated into conventional CBAs. Specifically, IA is looking for explicit commentary in the paper on whether the incorporation of *value capture* into CBAs would constitute double counting of benefits."

Following an early discussion with IA, the paper is re-titled as "the treatment of *value uplift* in cost-benefit analysis". This is because, in the context of economic evaluation, value uplift has a clearer meaning, and is a more relevant term, than value capture.

Value uplift, as defined by the Commonwealth Bureau of Infrastructure, Transport and Regional Economics (BITRE, 2015) is "the process where the value flows on the transport network are capitalised into land values". Value flows are described as the economic values of trips on the transport network. Note that value uplift may refer to residential or commercial property, but the former is the more common use.

This re-titling to "value uplift" is also consistent with the Brief which notes that the key issue is "whether changes in land values …should be part of CBAs."

On the other hand, value capture can mean either (i) the capture of benefits in property values or (ii) the capture of increases in property values by government or some other party. Meaning (i) may be viewed as an economic concept and meaning (ii) as a financial concept (see discussion below).

For the purposes of cost-benefit evaluations, we want to know whether the whole, or part, of value uplift should be included in CBA instead of, or in addition to, standard measures of benefits especially for transport infrastructure.

Value capture in sense (ii) above is relevant to financial analysis. But, in this sense, it is not relevant to CBA. Thus, in this paper, the term "value capture" is used to refer to the financial capture by government of any changes in property values.

In addition to this overall brief, the paper is designed to report the following outputs:

1. A brief discussion on the differences between economic and financial assessments (and thus between value uplift and value capture as defined above).

2. An outline of the benefits of transport infrastructure and how these benefits are usually valued in CBAs. In some cases, there is no agreed standard assessment method.

3. The treatment of value uplift in CBAs for transport infrastructure, including economic and residential development impacts.

4. References to CBA Guidelines for major transport infrastructure in selected Australian and international jurisdictions.

5. Whether similar findings would apply to value uplift in other major urban projects, such as urban regeneration or investment in major sporting or cultural facilities. This is a supplementary note. A full analysis of the inclusion and role of possible uplift in non-transport projects is outside the scope of this paper.

6. A brief discussion of methods of value capture and whether different methods would affect the conclusions on value uplift. Given the distinction in this paper between value uplift and value capture, there is little reason to expect that value capture would affect the CBA.

These issues are discussed in this and the following chapters respectively.

1.2 Economic and Financial Evaluations

There are several kinds of "economic" evaluation. These include cost-benefit analysis (CBA), cost-effective analysis, gross output analysis focussing on the impacts on gross domestic product (or sometimes gross state product) and income analysis (which is closely related to output analysis).

For the purpose of evaluating projects or policies, CBA is the widely recommended method of evaluation at national (Australian Department of Finance and Administration, 2006; OBPR, 2010) and state level (NSW Treasury 2007; Victorian Department of Treasury and Finance, 2013). CBA includes and values all impacts on all individuals, including market and non-market-goods and including social and environmental impacts, in so far as these can reasonably be estimated, within a given community (such as a country or state). A cost-effectiveness analysis is limited in that it examines only the costs of achieving a given physical outcome without valuing the outcome and does not include non-market effects. An output or income analysis is limited because it includes only market outcomes and excludes non-market effects.

Thus, in this paper the terms CBA and economic evaluation are used interchangeably.

By contrast, a financial evaluation assesses the cash payment flows out from and into a specified entity. This may be a public or private entity. Within the public sector, it may be a publicly owned corporation, a government department or the whole of government.

2 Benefits of Transport Infrastructure: Concepts and Estimation

2.1 Benefits of Transport Infrastructure

In this section we briefly outline the major benefits of improved transport infrastructure in three categories relevant to potential value uplift: user travel benefits, third party benefits and other possible benefits including benefits from changes in land uses. These benefits do not include savings in recurrent operating costs or in infrastructure maintenance, or possible profits of private transport operators, which are not relevant to value uplift. It should also be noted that, while the list of benefits is extensive, it may not include all possible benefits.

User travel benefits

- Travel time savings (business) on new infrastructure
- Travel time savings (leisure) on new infrastructure
- Travel comfort
- Travel time reliability
- Service frequency
- Vehicle operating cost savings on new infrastructure
- Reductions in accidents costs on new infrastructure

- Travel time savings (business) on rest of network
- Travel time savings (leisure) on rest of network
- Vehicle operating cost savings on rest of network
- Reductions in accidents costs on rest of network

- Benefits of generated (induced) trips

Third party benefits

- Amenity benefits (noise, air quality, visual benefits etc.) on network
- Savings in carbon emissions
- Biodiversity benefits

Other possible benefits including changes in land uses

- Social cohesion - more social interactions (also reduced social exclusion)
- Health benefits – usually attributed to extra walking

- Increased producer surpluses in *existing* related businesses arising from additional travel, e.g. producer surpluses in accommodation, food outlets etc., without changes in land uses where prices exceed marginal costs.
- Economic development (producer surpluses) associated with new products or services or existing businesses exploiting non-marginal economies of scale in production.
- Economic development: productivity benefits associated with agglomeration economies as a function of increased actual or effective density, which may increase producer surpluses (the return on capital) or wages.
- Higher density land uses, usually residential. Cost savings and/or economies of scale in development of residential housing.

The economic development benefits noted above are sometimes described as wider economic benefits (WEBs). But WEBs is a somewhat generic (not well-defined) term applied generally to economic developments that are alleged to be not captured by standard CBA practice. In this paper, we work with the more precise possible economic development benefits noted above.

It may also be noted that CBAs sometimes include second round multipliers to all or some benefits. However, this is not generally supported for various reasons. One reason is that if costs (C) are greater than benefits (B), i.e. C > B, it would be wrong to apply a multiplier (M) to B and conclude that C < MB, because M would also apply to C. Assuming a similar M, if C > B, then MC > MB.

2.2 Estimating the Benefits of Transport Infrastructure

This section briefly outlines how benefits of transport infrastructure are estimated. For more detailed explanations, see Transport for NSW (2013) or UK Department of Transport (2014, see various Web Tag Units referenced in Section 4 below). As will be seen, there are well established methods for estimating user travel and third party benefits. The most disputed issues relate to the assessment of economic development and agglomeration economies.

User travel benefits

Travel time savings on both new infrastructure and the existing network form the majority of benefits for most CBAs and are estimated simply as a product of the hours of travel time savings and an average value per hour for business and leisure travel respectively. Sometimes, various categories of business and leisure trips are estimated separately. This is straightforward for a given forecast of trips by origin and destination with and without the project.

Valuing travel time reliability, travel comfort and service frequency is more difficult. Again benefits are a function of the change in quantity and the unit value of the change. The unit values are generally derived from stated preference surveys. These values need to be complemented by estimates of changes in travel time reliability, comfort and service frequency as a result of any given project.

Savings in vehicle operating cost are a function of changes in stop-start driving and average speeds and associated vehicle operating costs. Reductions in accidents costs are a function of changes in accident rates of various kinds (e.g. minor, major and fatal) and the average cost of these kinds of accidents. This has been the subject of considerable modelling and research work over many years.

The most problematic and contentious valuation occurs with respect to generated (induced) trips. It should be noted that generated trips include new trips and trips diverted from other modes or routes. The standard approach is “the rule of a half”. This is given by the following simple equation:

$$B(GT) = 0.5(Q_2 — Q_1)\ (C_1 - C_2) \qquad (1)$$

Where *B(GT)* = the total benefit of generated trips
Q is the quantity of trips on any given mode / route
C is the cost of a trip on any given mode / route
Subscripts 1 and 2 represent the position before and after the new infrastructure

This approach is illustrated more precisely in Figure 1 below. In this figure, the demand for trips is shown as a function of generalised trip costs (*GC*), which are all costs including time costs experienced by trip makers. This includes excise and toll costs, which are transfer payments and not resource costs. The quantity of trips is determined by the intersection of the demand schedule and the relevant *GC*. The figure also shows resource cost schedules without, and with, the new infrastructure (RC_1 and RC_2 respectively). For ease of illustration, all cost schedules are drawn horizontal. The *social benefits* for existing trip makers are the savings in resource costs = Q_1 ($RC_1 - RC_2$). The benefits of generated trips are given by area *ABCD,* i.e. the area between what people are willing to pay for trips (the demand schedule), which is a function of *GC*, and the resource costs of the trips with the new transport infrastructure (RC_2).[1]

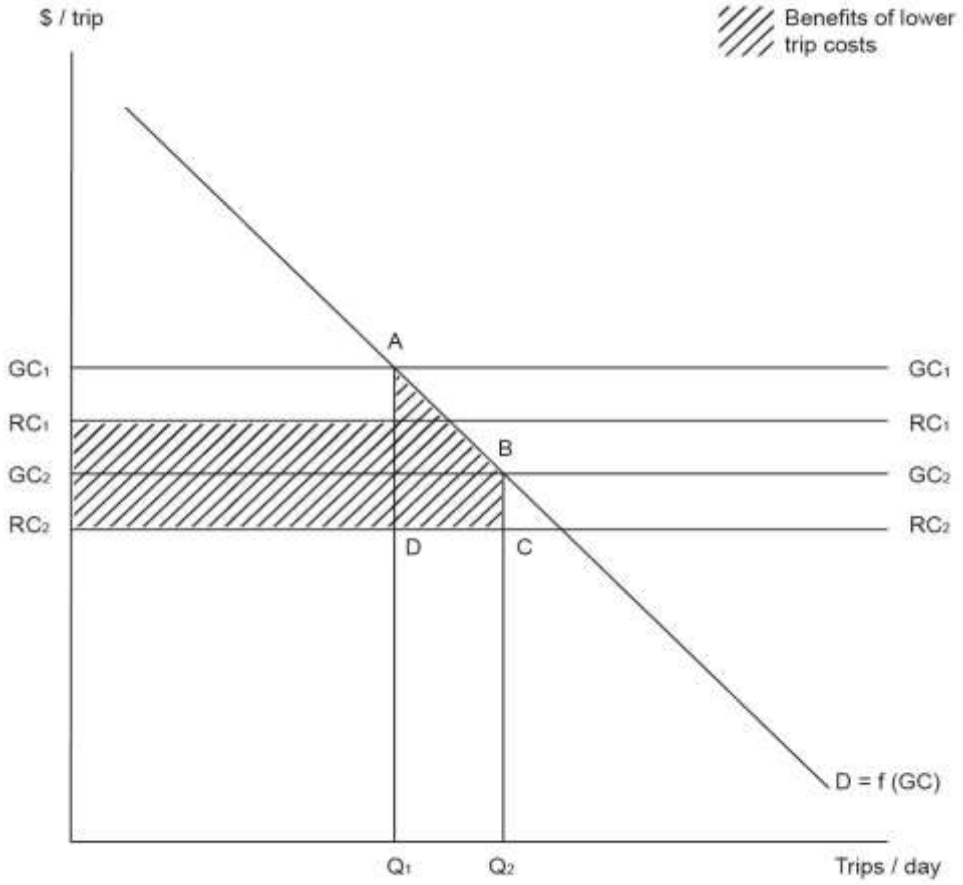

Figure 1 Travel benefits with generated (induced) trips

[1] This is sometimes described as the sum of private benefits and resource cost correction. See Abelson and Hensher (2001) for a more detailed discussion of the valuation of generated trips.

Critically, in principle the demand schedule allows for both more trips under given land uses **and** additional trips with changes in lands uses. This may be illustrated by example. Suppose that the generalised commuting cost from location *B* to the CBD falls from $15 per trip to $10. With say 400 commuting trips per year, for trips from *B* to the CBD, this would equate to a saving of $2000 per annum or an approximate capital value of $50,000 (with a private time preference rate of 4% and a long time frame). Some people may now choose to relocate from *A* to *B,* although *B* represents a longer commute than *A* and indeed they may not save any travel time as a result. Nevertheless, these people who relocate get a personal benefit per trip that can be represented on average as = 0.5 ($GC_1 - GC_2$) and there is an additional social benefit = ($GC_2 - RC_2$). The rationale is that if a household has a higher value for living in location *B*, it would have chosen that location initially. Rather, they chose location *A* and the move to *B* is a result of the fall in trip costs (i.e. the fall in GC). The benefits of generated trips by existing local individuals is a function of the difference between GC_1 and RC_2, as explained above.

Of course, in the short-term, land use induced traffic is likely to represent a small component of all induced traffic effects (e.g. relative to mode switch, trip retiming etc.). In the longer term, land use induced trips may become more important.

This means, as various authors such as Metz (2008) have pointed out new infrastructure may not result in travel time being saved to allow other activities to be carried out; rather, travel time is conserved, allowing more distant destinations to be reached within the time available for travel. Coleman (2010) also observes that people often move from high density to lower density areas as a result of the transport change.

This means that the long-run impacts of transport investment may be a change in land use rather than a savings in travel time. However, the decision to relocate is a function of the change in travel time, Therefore, the value attached to the decision to relocate can be estimated, as described above, as a function of the change in generalised costs of travel.

Third party benefits

In so far as amenity benefits can be quantified, they would usually be a product of a quantity change (in noise, air quality or carbon emissions, etc.) due to the new transport infrastructure and a unit valuation parameter. The latter would be derived from revealed preference behaviour or stated preference surveys. In the case of revealed preference, a common valuation technique is hedonic property analysis which shows how property values vary with environmental (amenity) attributes along with many other attributes. Thus in this particular case, value uplift (or decrement) is an indirect input into CBA.

Other possible benefits including changes in land uses

Transport infrastructure can promote access and reduce social exclusion. It can also sever communities. We have not reviewed valuation literature on this topic for this paper. In so far as the evaluation includes generated trips as discussed above, there would be a risk of double counting to include an additional benefit for social inclusion.

Some studies include a health benefit for extra walking to and from public transport, as compared with door-to-door travel in private motor vehicles (see NSW Department of Transport, 2013).

Producer surpluses in existing complementary businesses may arise where prices exceed marginal cost due to imperfect competition or under-utilisation of assets, without any changes in land uses. For example, this could occur with under-utilised accommodation or with food and refreshment businesses around new in infrastructure.

However, such potential surpluses should be treated critically. First, if the prices in related markets reflect marginal social cost, shifts in demand schedules in these markets do not produce additional welfare gains (there is no economic surplus above normal return on capital). Secondly, where prices do exceed marginal costs, expenditure around the new infrastructure may simply reallocate expenditure and associated surpluses. For example, suppose that the Pacific Highway is upgraded and that traffic transfers from the New England Highway. Businesses around the Pacific Highway may gain and those around the New England Highway may lose. Thus a special case would need to be made that the gains in producer surpluses along the Pacific Highway exceeded the losses around the New England Highway.

Economic development and related producer surpluses may also occur as a result of *new products or services* due to non-marginal economies of scale in production. New transport infrastructure may allow firms to enter new markets and thus exploit economies of scale. The economic trade literature has shown that 'dynamic efficiency' gains from trade liberalisation can yield significantly larger net benefits than would be obtained using static 'Harberger triangle' analyses (Romer 1994, Nordås et al., 2006). These additional long-run gains relate to new markets, products and processes that would not have arisen had the earlier intervention not occurred.

When this occurs, neither travel time savings nor the generated trip benefit model described above (essentially the Harberger triangle) may capture the full economic development benefits. Where such benefits are claimed, the most direct way to estimate them is by estimating the resulting producer surplus (the excess of revenues over all resource costs employed) that would arise with the new output.

Economic development may also occur as a result of productivity benefits associated with agglomeration economies. The agglomeration literature suggests credibly with evidence that productivity (and wage rates) are a function of the density of employment. Density reduces the costs of inputs, increases the flow of technical information and makes markets more attractive.

As described by TfNSW (2013), the degree of agglomeration is measured by employment density, defined as the number of persons employed per area, such as square kilometre. This is sometimes extended to effective employment density defined as total employment in the locality plus employment in surrounding areas weighted by their proximity. The proximity is a function of the generalised travel cost. The effective employment density increases if a transport project reduces the generalised travel cost between areas even if the total employment in each different zone remains unchanged.

The calculation of agglomeration economies requires the productivity elasticity with respect to effective employment density by industry sectors by spatial travel zones. The agglomeration elasticity measures the percentage changes in output productivity as a result of a percentage change in employment effective density. Hensher et al (2012) estimated the agglomeration elasticity for Sydney in their studies of the wider economic impacts of transport infrastructure investment.

However, the relationship between transport infrastructure and agglomeration (and hence productivity) is not settled and may vary with circumstances. First, if trip times fall, effective density rises even if the number of trips between the two centres is unchanged. It is not clear why this should increase productivity. Secondly, transport infrastructure often results in more decentralised residential living and sometimes decentralised employment.

If agglomeration economies are expected to occur, they are usually estimated either as a function of wage increases in relation to changes in density or as a simple add-on percentage of user benefits based on research studies elsewhere. Given the uncertainty about density impacts and agglomeration benefits, this paper would strongly discourage the latter approach.

Transport infrastructure may also enable higher density land uses, especially residential development (sometimes described as intensification benefit). This could produce economies of scale in development of residential housing or cost savings from the use of established utility infrastructure or social services. In this case, the net benefit would be the gross value of the property developed less all internal and external costs associated with the development.

This is an alternative to the “rule of the half” for valuation of new trips arising from changes in household locations. It would be based on the assumptions that the changes are non-marginal and that some costs are not internalised. A further critical assumption would be that the increase in density is due wholly to the transport infrastructure and not to relaxation of planning regulations which could have occurred wholly, or in part, without the transport infrastructure. Another way of expressing this is that it is critical to identify the true base case.

Given that the base case and the role of transport infrastructure are accurately identified, the net benefit could be estimated as suggested above. In this case, the benefits of relevant generated trips should not also be included.

3 Value Uplift from Transport Infrastructure and Cost-Benefit Analysis

3.1 Value Uplift from Transport Infrastructure: Theory, Evidence and Issues

Theory

The basic theory of real estate prices is that prices are determined by both structural and locational attributes. Transport infrastructure reduces travel time. Households close to transport infrastructure enjoy this benefit. This proximity is capitalised (as a present value) into property prices and hence into land values. House prices also pick up both positive and negative externalities.

It should be noted that property (and land) values capitalise changes in private benefits and costs, not changes in public costs. They therefore reflect private generalised costs, which include indirect taxes, rather than social resource costs.

Also some of the benefits of increased productivity may be captured in higher taxes. In these cases, property prices would not capture all these benefits. In any case, firms are likely to appropriate some benefits of improved transport as increased profits rather than pay all the increased profits out in higher rents.

In a substantial review of the capitalisation thesis, Albouy (2009) found a high degree of support for the view that amenity and transport values are capitalised into property prices and hence into land values. However, he also reported that one-quarter of the value of amenities are reflected in lower wages and three-quarters in higher house prices.

In another review of the literature on house price capitalisation, Hilber (2011) concluded that house prices do capitalise local public goods and amenities (including transport infrastructure) but that the degree to which capitalisation occurs depends on the extent to which property supply is constrained (inelastic). Lower trip times shift the demand curve for any given housing stock. But if this leads to additional supply, the time savings are less strongly capitalised (or perhaps more accurately reflect the preference valuation of the marginal purchaser). High capitalisation also depends on costless transactions and high mobility.

Figure 2 illustrates the effect of a shift in housing supply. In this figure, lower trip times shift the demand curve for housing in any given location from D_1 to D_2. If the housing stock were inelastic, the price of housing would mirror the trip time savings and rise from P_1 to P_2. However, with the increase in the supply of housing, the actual price increase is from P_1 to P_3.

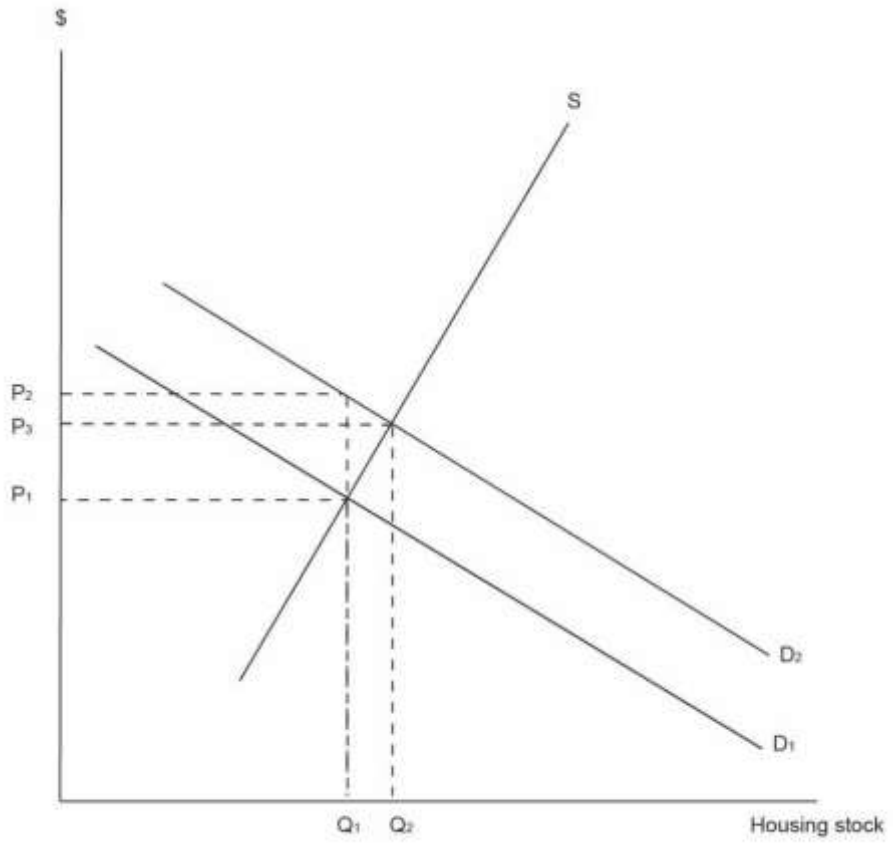

Figure 2 House prices with lower trip costs

The evidence for value uplift

Smith et al (2015) report on over a hundred studies on value uplift around mass transit nodes. BITRE (2015) provides summary statistics for 64 studies ("the usable observations") shown in Table 1. As shown, although on average land values increased by between 6.9% and 9.5%, there are large variations. Many projects appear to have little effect on the value of surrounding properties and in some cases values have apparently fallen. Presumably these variations relate to the different circumstances in the various cases, although possibly also to variance in study methods.

Table 1 Average value uplift per transit mode

Mode	Average value uplift (%)	Range (%)	No. 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

Source: BITRE, 2015.

For example, BITRE (2015) notes that there has been little discernible value uplift around the 13km Gold Coast Light Rail. This may be because the light rail largely replaced existing bus services. It is also possible that uplift may have occurred close to the light rail but not further away (although the betterment charge was levied on the whole of the city).

Mulley and Tsai (2013) initially found little overall evidence of value uplift around the Liverpool-Parramatta transitway. But when they disaggregated property types, they found that houses up to about 1200m from the new transitway bus stations rose in relative value with no special price gradient with distance, except for houses within 100m of a bus station which fell in value. But the transitway had little impact on the prices of units.

BITRE (2015) also notes that there are relatively few publicly available studies of property value changes in relation to urban freeways and these have value uplift estimates ranging from negative to 1,100 per cent (McIntosh et al., 2014). So no general conclusions with regard to road infrastructure can be drawn. Some reasons for this are discussed below.

Grimes and Liang (2010) used increases in property prices to estimate the net benefits of a motorway corridor that induced major land use changes. In this paper, using relative land value increases as a measure of the present discounted value of the benefits of the motorway extension, Grimes and Liang calculated a benefit-cost ratio (BCR) for the motorway extensions of at least 6.3, and possibly as high as 21.9. Ex-post estimates of benefits using this method were approximately double the ex-ante estimates of benefits for the project. This suggested that current appraisals may not provide an approach to measuring benefits that includes all of the relevant effects. However, this is a strong generalisation from one study which may not, ex-ante, have predicted all the benefits.

Urbis (2014) reports that three major roads (M7 Sydney, Eastlink Melbourne and M1 Brisbane) had a significant impact on industrial land values in the relevant areas of Sydney, Melbourne and Brisbane respectively, but does not provide quantified estimates (except for Brisbane).

Issues in estimating value uplift

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.

However, there are several problems with estimating value uplift, both before and after changes in transport infrastructure. As noted, there are significant variations in the reported value uplift for projects and the causes and the implications need to be understood.

At the start it should be noted that most observations relate to property values, not to land values. It is generally assumed that there is a close relationship between changes in property prices and land values. But where non-transport inputs contribute to changes in property values, these inputs need to be netted out against the changes in property values to derive the changes in land values.

Multiple factors affect property values, including the economic, social and amenity values of a location. The technique most often used to determine the contributions of different factors to

property prices is hedonic pricing. When these factors are highly correlated, it is hard to identify the true drivers of property prices.

Often prices change independently of the local transport infrastructure. BITRE (2015a, 2015b) showed that shifting trade flows increased relative values in those parts of cities exposed to international trade. Liddle (2013) showed a link between density and productivity which was capitalised into land values. Since mass transit projects are often located in confined areas where there is rapid population and/or economic growth, it is difficult to assess the various contributors to changes in land values.

Separating the effects of new transport infrastructure from other transport infrastructure is also difficult. As BITRE (2015) observes, network architecture has three main elements; hierarchy, connections and density. All affect value uplift. Hierarchy refers to the organising structure of the network. Whereas mass transit systems may have a simple hierarchy, roads often have a complex hierarchy. This complicates assessment of new roads on property prices.

Connections refer to the number of connections each node in the network has. The number and value of connections determine how much a node, for example a railway station, is worth. This may explain why value uplift is relatively high around railway stations close to, and connected to, the CBD and often low in those located further away.

Network density is the number of nodes (road intersections, railway stations tram stops etc.) in a given area. Network density has been found to increase the perceived time of travel and the risk of accidents. Both tend to reduce property prices.

Determining the catchment of beneficiaries of transport investment is also complex. It is commonly assumed that people will walk 800 metres to a train and 400 metres to a bus. Accordingly, most studies of value uplift for mass transit have used these distances for their catchment areas. However, the evidence for using these distances is not strong. 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 reflected 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).

Design and planning that connects the catchment development to transport infrastructure can also be critical to mode choice and consequently the value of transport infrastructure. Developments that fail to integrate transport and its surrounding land use will have lower uplift than those that do.

Time is another issue with measuring value uplift. Few value uplift studies have measured the change from a project's announcement to 10 years or more after it was operational. Urbis (2014) found that significant uplift in industrial land values occurred after the announcement of the M7 in Sydney and during construction of the M1 motorway in Brisbane, but only after the opening of Eastlink in Melbourne. In so far as city shaping changes take time, this should in principle be factored into the CBA.

3.2 Using Value Uplift in Cost-Benefit Analysis

Table 2 provides broad order-of-magnitudes of capitalisation for the main elements of benefits of transport infrastructure identified in Section 2. These are general statements drawing on the theoretical and empirical literature, some sources of which have been identified above.

Table 2 Benefits and Capitalisation in Property Values

Benefit	Capitalisation
User travel benefits	
Travel time savings (business) on new infrastructure	Little capitalisation
Travel time savings (leisure) on new infrastructure	High proportion capitalisation, not full[a]
Travel time reliability	High proportion capitalisation, not full[a]
Travel comfort	High proportion capitalisation, not full[a]
Service frequency	High proportion capitalisation, not full[a]
Vehicle operating cost savings on new infrastructure	High proportion capitalisation, not full
Reductions in accident costs on new infrastructure	Some capitalisation
Travel time savings (business) on rest of network	Some capitalisation
Travel time savings (leisure) on rest of network	Some capitalisation
Vehicle operating cost savings on rest of network	Some capitalisation
Reductions in accident costs on rest of network	Some capitalisation
Benefits of generated (induced) trips	High proportion capitalisation, not full
Third party benefits	
Amenity benefits around new infrastructure	High proportion capitalisation, not full
Amenity benefits around rest of network	Some capitalisation
Savings in carbon emissions	No capitalisation
Biodiversity benefits	No capitalisation
Other possible benefits including land use changes	
Social cohesion	Little capitalisation
Health benefits	Little capitalisation
Producer surpluses in existing complementary businesses	Some capitalisation of surpluses
Economic development: scale savings or new products	Some capitalisation of surpluses
Productivity benefits due to agglomeration economies	Some capitalisation of surpluses
Higher residential density (more efficient) land uses.	High proportion capitalisation, not full

(a) Amount of capitalisation depends on charges for transport services and infrastructure

There is likely to be a high element of capitalisation of private travel benefits (time savings reliability, comfort and service frequency) and of amenity benefits (if any) around new transport infrastructure. Indeed, in so far as private time preference rates are below the social opportunity cost of capital, private property owners may capitalise the benefits more highly than analysts in a CBA study (using the opportunity cost of capital).

However, the amount of capitalisation will depend heavily on the extent to which users are charged for use of the new infrastructure. The higher the charges, the lower will be the rate of capitalisation. Also, we saw above, value uplift, which is a function of savings in *GC*, may not be an accurate measure of savings in *RC*. Higher residential density is also likely to be manifest in higher land values, though again private and social valuations may differ.

With regard to user benefits around the rest of the transport network, a lower proportion is likely to be capitalised into property values as these benefits are widely spread.

Turning to producer surpluses or economic development benefits, some capitalisation in land values would be expected. However, in most cases, only some businesses would benefit from economies of scale or productivity gains. This would marginally increase the demand for commercial space in these areas, but we would not expect full capitalisation of economic development benefits.

Conclusions

As shown in Section 2, there are robust methods for estimating most of the benefits of transport infrastructure. On the other hand, value uplift generally does not fully represent these benefits. Most often, value uplift would underestimate the benefits.

The main argument for using value uplift in CBAs would be that some benefits, most often economic development benefits of some kind, are underestimated, or possibly not estimated at all, in some CBAs. This may sometimes occur.

But this essentially reflects hindsight. Most CBA evaluations are made **before** the transport infrastructure is created and with the aim of evaluating the proposal for it. In this case, the extent and timing of the uplift would have to be estimated **before** transport infrastructure is created. And this cannot be done independently of estimating the primary benefits: the core user and economic development benefits, where these are applicable. Thus, forecasts of value uplift would depend on forecasts of these very benefits and would not be independent of them.

The value uplift valuations would be independent only if these value forecasts were transferred in from some external research studies. But even in this case, the CBA analyst should verify that the user benefits and economic development benefits in the project case would be similar to those in the external cases.

As has been seen, there is a wide variance in estimates of value up lift from mass transit infrastructure and few estimates of uplift from major roads in a road network. Thus we return to the need for assessments of the basic list of benefits.

4 Treatment of Value Uplift in Economic Evaluation Guidelines

In this section we briefly review whether various national or state guidelines recommend use of value uplift in CBA of transport infrastructure.

Austroads: Guide to Project Evaluation, 2012

Austroads (2012) has produced a detailed manual on project evaluation. The two most relevant parts are Part 2: *Project Evaluation Methodology* and Part 5: *Impact on National Regional Economies*.

Part 2 provides guidelines "for conducting benefit–cost analysis and multi-criteria analysis on public transport infrastructure projects, policies and programs—any choice in fact that can be characterised in terms of positive and negative economic impacts. Its aim is to foster good practice, consistency and transparency in the evaluation of transport projects."

Part 5 provides a guide to when the use of macro-economic models in project evaluation is appropriate and how they can be applied. The Guidelines note that "major transport infrastructure projects often significantly alter the economies of regions in which they are located and, if large enough, the national economy as well. These effects may not be fully captured by standard benefit-cost analysis evaluations." To respond to this, the Guidelines suggest the use of economy-wide type models known as computable general equilibrium models, not forecasts of value uplift.

Neither Part of the Guidelines suggests using value uplift as a valuation method for estimating benefits.

Transport for NSW: Principles and Guidelines, Economic Appraisal of Transport Investments and Initiatives, 2013

Transport for NSW (TfNSW, 2013) is a detailed, clear and authoritative guidance (308 pages) on economic appraisal of transport investments. The major relevant sections for economic development and land use are Chapter 4, *Land Use Integration in Economic Appraisal*, Section 3.1.7, *Wider Economic Benefits* and Section 5.3 *Evaluation Techniques*.

In Section 2 above we drew on Section 3.1.7 in the TfNSW Guidelines to describe a possible valuation method for wider economic benefits in terms of productivity gains as a function of employment density. To estimate economic development benefits, Section 5.3 of the TfNSW Guidelines recommends using either input-output, or computable general equilibrium, modelling. TfNSW does not refer to value uplift as a possible input to CBA for transport infrastructure.

UK Department for Transport: Transport Analysis Guidance (TAGs)

UK Department for Transport (DfT) has produced an extensive set of Transport Analysis Guidance manuals (Web TAGs) for assessment of transport infrastructure. We report on the manuals that appear most relevant to possible value uplift.

TAG Unit A1.1, Cost-Benefit Analysis, 2014. This makes no reference to value uplift.

TAG Unit A2.1, Wider Impacts, 2014. This manual describes ways to evaluate agglomeration impacts, output change in imperfectly competitive markets and tax revenue changes due to changes in labour supply. This manual makes no reference to value uplift.

TAG Unit A2.2, Regeneration Impacts, 2014. This manual describes how a transport scheme may impact on the economy in regeneration areas. The expectation is that in some cases improved accessibility will increase jobs and output. The manual recommends that data be sought by surveys of local businesses and that the impacts be measured in terms of changes in employment and output. The manual makes no reference to value uplift.

TAG Unit A2.3 Transport Appraisal in the Context of Dependent Development, 2014. This Unit focuses on assessment of the impacts of transport investment on new housing. It notes that similar principles could apply to impacts on commercial development.

The manual finds that, in many cases, land use developments will occur independently of the transport scheme. These developments would be included in the base and project case and the inclusion of trips from the new housing would be dealt with by standard appraisal methods. The new housing benefits are not then additional to the transport benefits

However, housing development will sometimes depend on the transport investment. The manual recommends that, in these cases, the transport scheme and housing development should be considered as a combined project. But it also notes that the net benefit of the housing development will be a function of **all** utility infrastructure and other input costs as well as net external (amenity and congestion) impacts. “It is not appropriate to attribute all of the benefits of the dependent housing to the transport intervention in isolation”.

Thus the net value of the new housing development is the sum of the private value uplift of land and the various social impacts (including public costs). However, the forecast private value uplift can be assessed only as a function of estimated developed property prices and costs.

DfT also advise that this approach should be used only when neither the transport nor the development can be justified in the absence of the other scheme.

Tag 3.1.3, Land Use / Interaction Models, 2005. Land use / transport interaction models generate trip forecasts as a function of both forecast land uses and changes in land uses as a result of changes in accessibility. However, the guidance notes (p.10) that “it is currently not possible to conduct a CBA in which land-use changes feed through into travel demand changes. The reason is that, at present, the way in which land-use responses and transport responses are represented mathematically in land-use/transport interaction models are not sufficiently

consistent to allow the calculations to be undertaken in a manner which accords with the theory on which transport cost/benefit is currently based".

In essence, where such land use changes are forecast, they are generally estimated as described in Section 3.2 of this paper and in DfT *TAG Unit A2.3* (see above).[2]

Transport Scotland: Scottish Transport Appraisal Guidance, 2008

There is no reference to value uplift in the 74-page Scottish Transport appraisal guideline

New Zealand Transport Agency: Economic Evaluation Manual, 2016

The NZ Transport Agency Manual (2016) is a lengthy and conventional guide to economic evaluation of transport projects. There is little discussion of economic or residential developments as major benefit possibilities. There is no reference to value uplift as an input to evaluations.

OECD/ International Transport Forum, 2014, Major Transport Infrastructure Projects and Economic Development

This volume reports on the London Crossrail Project, two major projects in Paris and an overview of economic assessment methods. The evaluation methods for wider economic benefits and for economic development that are discussed and supported are consistent with the discussions above.

Conclusions

Various major official guidelines make little or no reference to value uplift as an input to economic (CBA) evaluations. Value uplift may be viewed as part of the valuation of housing or commercial development. But even in this case the value uplift is essentially the gross private value of the developments net of private costs and is a derived estimate from these estimates.

[2] TfNSW (2013) describes how transport demand and mode choice can be modelled in logit models based on random utility maximisation and how consumer surpluses can be obtained from this demand modelling. This is known as Logsum method of valuation. NZIER (2013) recommends that a similar approach be applied to estimating and valuing land use changes. However, this method is rarely used. As TfNSW notes, to convert the utility into dollar terms, analysts must estimate the marginal utility of income, which varies between project specific surveys and there is no formal guide how it should be derived.

5 Value Uplift in Other Infrastructure Projects

In this section we briefly review the role that value uplift may have for CBA of other infrastructure projects. Specifically, we consider value uplift in investment in major housing development, urban renewal and a major sporting stadium or cultural building.

For major housing developments, the net benefit is the gross value of the housing produced less all relevant costs. These costs may include land opportunity costs, site development, some external infrastructure costs, construction, sales costs and any external costs such as impacts on traffic congestion and neighbourhood amenity.

Critically the (land) value uplift for the site(s) is a residual of the gross value of the housing produced less any costs borne by the landowner. Various related points follow. First, any value uplift is a derived number; it cannot be estimated independently of the drivers of the uplift. Second, value uplift is a benefit to landowners. In some cases, this may be government. But, in any case, the derived value uplift on the site(s) is just one element in the evaluation. Thus while in principle it could be an element in an evaluation, it would not be a measure of overall project value. Third, value uplift has no independent standing. To count value uplift in addition to the value of the housing produced would be double counting.

Turning to urban renewal projects, these may involve improvements to the public domain, investments in infrastructure as well as in housing and commercial buildings. In this case the major measure of gross benefits would be the sum of the value of buildings created and the increase in the value of existing housing and commercial buildings. The latter may increase as an indirect result of the amenity and cultural improvements. There may also be other benefits, such as social inclusion and/or social diversity, which are usually hard to quantify. The cost elements would be broadly as described above for major housing developments.

Again, most benefits and some costs would accrue in value uplift to landowners, private or public. The value uplift for the site(s) would be function of the gross value of the properties produced, or the increase in value of existing properties, less any costs borne by the landowner.

But the same issues arise for urban renewal projects as for simpler housing developments. Any land value uplift is derived from changes in property values and costs borne by landowners. Value uplift is not a separate additional benefit.

Thirdly, turning to investment in major sporting or cultural venues, these venues may enhance the attractiveness of local neighbourhoods and thus increase local property values due either to access to the new facility or to an increase in local amenity (though there may also be an adverse effect by increased congestion).

If local property values can be shown, demonstrably and reasonably, to change as a result of amenity impact of the new sporting or cultural venue, as distinct from the improved use value, these changes should be included in an evaluation of the project.

This is not an easy task. In particular, it may be difficult to separate out the roles of improved use and improved amenity on property values.

However, if amenity impacts can be identified, land value uplift would generally equate to property value uplift as the landowner would not bear any costs. Thus it could be asserted that land value uplift is being included in the evaluation. But the observable benefit, or at least the estimated benefit, would be the uplift in property values as a result of the improved local amenity.

6 Methods of Value Capture

In this report we take "value capture" to be the recovery of some, or all, of the value that public infrastructure generates for private landowners, usually with the aim of assisting with the financing of the infrastructure. Our reading suggests that this is the most common meaning of value capture.

Sometimes value capture is defined more broadly to include value capture on publicly owned land. This can include sale of development rights on public land or public/ private partnerships in land development. In some cases, this may be an important form of value capture in a broader sense. However, this is outside the scope of this review.

It should also be noted that various public financing methods, essentially charges rather than taxes, effectively reduce value uplift **before** it occurs rather than recover some of the uplift after it occurs. It could be contended that these are not really methods of value capture. However, the impacts are similar. Both methods effectively reduce value uplift. Thus, both sets of financing methods are discussed briefly below.

As has been noted, value uplift is affected by user charges for infrastructure. User charges are a way to recover the costs of public infrastructure. These charges reduce the value that public infrastructure generates for private landowners and so may be viewed as a form of value capture. Indeed, this is often the most appropriate form of value capture.

Developer charges for provision of direct or indirect services, whether levied by state of local governments, also recover part or all of the costs, of designated development works. Given that, in a competitive market, these charges cannot be passed on to consumers, these charges reduce land values or at least reduce the increase in land values (value uplift). Developer charges that reflect the costs of infrastructure provided are efficient charges that do not deter net beneficial development.

Of course, if developer charges exceed the costs of the infrastructure provided, they become a tax and further reduce value uplift. This is therefore another, slightly different, form of value capture. Such developer charges would be somewhat arbitrary and may discourage development. They would not be an efficient levy on value uplift.

There are three other major ways to capture value uplift through taxation. These are through transaction taxes, land taxes or value uplift (betterment) taxes.

Transaction taxes are levied on property transfers in Australia and are an important source of revenue for the states via stamp duty on most property transactions and for the Commonwealth government via capital gains tax (CGT) on non-owner occupied dwellings. Where publicly funded infrastructure increases the value of private property, some of the investment will be recovered by these transaction taxes. In principle, it would be possible to identify properties within the catchment of new infrastructure and to levy an additional stamp duty or CGT, subject of course to determining the effective catchment.

However, transaction taxes are inefficient because they significantly deter property transfers and inequitable because they tax people who move more often. And, as has been seen, it is very difficult to identify transport catchment areas. Thus, this report does not support transaction taxes as a way to capture value uplift.

The second taxation approach to value capture is a broad tax on land values. Ideally, this would be a tax on unimproved land values as these values represent economic surplus over and above normal return on capital. A tax on improved land values involves a tax on input costs for land development which is not fully efficient. However, existing land taxes are essentially taxes on improved land values and it is doubtful whether a tax on truly unimproved land values would be practical given valuation difficulties.

A tax on property values would be still less efficient as this would be an indirect tax on production. Actually, there is a tax on new housing (the GST). But this accrues to the Commonwealth and could not be adjusted for special state infrastructure programs.

A general tax on the land value would be practical in that it would not involve locating the benefit on particular properties around new transport infrastructure. The major downside is that land tax is typically only around 1% or less of property values. It would capture only a small amount of the value uplift. The real value capture would be minimal.

It may be noted, however, that Tax Increment Funding (TIFs) is a form of hypothecated value capture used quite widely in the United States especially for urban renewal projects, as well as to some extent in Canada and the United Kingdom (Langley, 2013). As noted by BITRE (2015), typically 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 may work for developments over a wide area and where property taxes are the norm. However, they appear to be essentially a funding mechanism based on hypothecated use of an existing tax system rather than a special attempt at value capture.

Under a value uplift tax, also described sometimes as a betterment tax, land owners deemed to be beneficiaries of infrastructure development pay a levy on changes in unimproved capital value (or, as noted above, actually on changes in improved land values). The tax can be paid annually or on a one-off basis. A value uplift tax has the potential to capture a large amount of the value uplift and to generate substantial revenues. It is potentially highly efficient as it is a tax on economic surplus and is fair.

If designed efficiently, a value uplift tax would work well. However, the caveat is efficient design. Both the beneficiaries and the extent of the value uplift would need to be accurately defined and estimated. Land valuations are typically inferred rather than observed values. This is probably why, according to BITRE (2015), there have been few applications of value uplift taxes in Australia. However, given its high potential benefits, this report would advocate that more consideration should be given to possible applications for value uplift taxation.

7 Conclusions

This paper has focused on CBA for transport infrastructure and any possible role for value uplift in such CBAs. In this paper, value uplift refers to the capitalisation of a stream of benefits into increased land values.

The main beneficiaries of investment in transport infrastructure are generally trip makers on either the new infrastructure or the rest of the network. Benefits may also arise to third parties (for example as amenity benefits) and arise in some form of economic or residential development.

Drawing on authoritative sources such as Austroads (2012), TfNSW (2013) and several UK Department Web Tags (2014), as well as our own experience, the paper provides a brief summary of how each of these sets of benefits would conventionally be evaluated in CBA. These methods are robust and generally well-tested, especially for trip makers.

In all cases, the estimates aim to value the benefits directly rather than indirectly by way of value uplift estimates. This includes economic and residential development benefits where these may apply. This is confirmed by a review of international guidelines on evaluation of transport infrastructure.

The main potential argument for using value uplift in CBAs would be that economic or residential development benefits may be underestimated, or possibly not estimated at all, in some CBAs. This may sometimes occur.

However, most CBA evaluations are made **before** the transport infrastructure is created and with the aim of evaluating the proposal for it. In this case, the extent and timing of the uplift would have to be estimated **before** transport infrastructure is created. In essence, this means estimating the benefits and costs that will in turn determine value uplift.

In so far as significant uplift would occur, this would essentially be a function of the core user and economic development benefits (where these are applicable). Thus, forecasts of value uplift would depend on the forecasts of these very benefits and would not be independent of them.

Value uplift valuations would be independently estimated only if these value forecasts were transferred in from some external research study or studies. However, there is a wide variance in estimates of value up lift from mass transit infrastructure and few estimates of uplift from major roads in a road network.

Thus, the CBA analyst should verify that the user benefits and economic development benefits in the project case were similar to those in the external cases and this would require, in turn, an assessment of the basic list of benefits.

The paper also briefly considers the role that value uplift might have for economic evaluations of investment in major housing developments, urban renewal and a major sporting stadium or

cultural building. In these cases, especially in the first two, increases in property values may be a significant part of the evaluation.

However, this does not imply that value uplift will itself be an input to the economic evaluation. First, the value uplift is a derived number; inputting the basic benefits and costs is the preferred approach. Second, value uplift is a benefit to just one of the parties involved. In some cases, this may be government. In any case, the derived value uplift on the site(s) is just one element in the evaluation. Third, value uplift has no independent standing. To count value uplift in addition to the value of the housing produced, which drives value uplift, would be double counting.

Finally, the paper reviews briefly the role of value capture, specifically in this paper the capture by government of part of the increases in private land or property values. It is stressed that this is a financial issue, not an issue of economic evaluation.

The paper notes that there are two types of value capture: user charges and taxes. User charges recover the costs of public infrastructure and reduce the values that public infrastructure generates for private landowners and so may be viewed as a form of value capture. Indeed, this is often the most appropriate form of value capture. Developer charges for provision of services recover part or all of the costs of designated development works and are also a user change and an indirect form of value capture.

Value capture taxes include transaction taxes, land tax and a value uplift (betterment) tax. The paper notes that transaction taxes are inefficient and unfair. A land tax is practical but captures very little of land value uplift.

If designed efficiently, a value uplift tax would work well. However, the caveat is efficient design. Both the beneficiaries and the extent of the value uplift would need to be accurately defined and estimated. As has been noted, land valuations are typically inferred rather than observed values. However, given its high potential benefits, this report would advocate that more consideration should be given to possible applications for value uplift taxation.

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