Appendix 3: Wider economic impacts in the transport sector

A conventional cost-benefit analysis (CBA) of transport projects invariably focuses on items such as savings in travel time and fuel costs, as well as on changes in externalities, like negative environmental outcomes. The 1990s, however, saw a growth in calls by Australian transport infrastructure proponents for the inclusion of 'additional' benefits of road and rail projects. Interest centred on logistic improvements, such as reduced trip times and just-in-time delivery, which were claimed to reduce warehousing and inventory costs (e.g. Rockliffe, 1996).

More recently, proponents of transport infrastructure projects have sought to broaden the conventional analytical perspective to encompass the effects of large projects on the economy as a whole, rather than limiting the estimation of benefits to particular routes alone. Initially referred to as wider economic benefits (WEBs) (e.g. Department for Transport, 2005), the literature has more recently adopted the term wider economic impacts (WEIs), which reflects the fact that many of the posited impacts relate to changes in GDP and employment, rather than to the social welfare measures used in CBA.

Various authors recognise that a number of the effects initially categorised as WEBs may be better treated separately as complementary outcomes of transport projects (e.g. Department for Transport, 2014; Laird & Mackie, 2010; Worsley, 2011; Abelson, 2011). This recognition is based on the lack of definitive evidence in posited WEBs of the direction of causality (e.g. higher wages in large cities), onerous data requirements for modelling, confounding effects (e.g. the effect on productivity or competition of the internet), limitations of many transport models (e.g. fixed-trip matrices and lack of responsiveness to changes in land use), double counting, and potential ambiguity (transport projects may result in dispersion of economic activity as well as agglomeration).

A3.1 Categories of wider economic impacts for transport

A generally accepted taxonomy of WEIs includes the three major categories, which are examined below. A fourth category — increased competition as a result of improved transport links between different markets — was identified in the Department for Transport's (DfT) 2005 *Transport, Wider Economic Benefits and Impacts on GDP*, but was abandoned in the updated, 2014 version (p. 1, fn. 3) because it was not considered to be relevant in the United Kingdom, where transport links were already well developed and existing transport networks were 'unlikely to be a significant constraint on competition'.

A3.1.1 Agglomeration economies

As the generalised cost of transport (travel time, fuel, externalities) falls, firms and workers in their existing locations will effectively be brought closer to each other. In other words, the 'effective density' of the area where production occurs will increase because workers can more easily reach it, even if they live elsewhere.

Although simple distance (e.g. kilometres) or travel time (e.g. minutes) are sometimes used as proxies, DfT (2005, annex 1, para 153) defines the effective density of a location more realistically as 'the employment in and surrounding the area, weighted by their proximity (in generalised cost of transport) to the location'. It is recognised, however, that reduced generalised costs of transport may also result in some countervailing reduction of effective density if workers or firms relocate further away from the central business district.

Increased 'effective' proximity of firms and workers to each other as a result of better transport links is seen as raising productivity due to positive spillovers. Firms are considered to learn more from other firms and about innovations generally if they are 'clustered' physically close to each other, especially because of face-to-face interaction between employees.

O'Flaherty (2005, ch. 2) argues that workers in cities can more easily change jobs, bringing new knowledge to their destination firms when they move. Jaffe et al. (1993) show that new patent applications are five to 10 times more likely to cite patents from the same metropolitan area compared to patents from outside it. Proximate firms are more likely to have available a greater variety of inputs from local suppliers, and can therefore choose those that best suit their production processes. They can also benefit from lower transport costs, search costs and sharing of costly infrastructure. Firms that can draw on a larger pool of workers benefit from greater opportunities for matching available specialised skills with their particular needs. Workers on the other hand, can more easily move to the jobs they prefer.

A3.1.2 Increased output in imperfectly competitive product markets

Conventional transport CBAs implicitly assume a situation of perfect competition throughout the economy, including in sectors that use transport services to obtain inputs and deliver outputs. In a perfectly competitive situation, users of transport services for commuting and for freight pay a price that matches the value to them of the services. Conventionally estimated consumer surplus provides a satisfactory measure of social surplus.

The situation is different in the case of business users operating in imperfectly competitive markets. Where business users of transport services have monopoly power in their various markets, a reduction in transport costs is likely to have two separate effects. One effect, already captured in conventional CBA, is an increase in consumer surplus accruing to users of transport services from additional (generated or induced) trips. The other, additional, effect is an increase in social welfare because lower costs may induce transport-using monopoly industries to increase their output and, hence, the quantity of goods and services available to society.[1] The literature (e.g. Vickerman, 2007a, p. 603; Kernohan & Rognlien, 2011, pp. 116–21) generally illustrates

1 To induce customers to buy the extra output, the monopolist must reduce its price. Consumers benefit from the lower price. But society also benefits from the larger number of units of output made available compared to a monopoly output. The monopolist also benefits from the additional output. Although the price reduction cuts into monopoly revenues, the additional units sold increase overall receipts.

this situation by presenting a standard monopoly-type diagram and then deriving an 'uprate factor' based on the Ramsey (1927) pricing model (Brown & Sibley, 1986). The 'uprate factor' is intended for scaling up benefits that have been calculated for business-related trips in a conventional CBA.

A monopoly-style diagram is also relevant to the Cournot solution for a duopoly, which is an approach adopted by Kernohan and Rognlien (2011), among others. Two perfectly cooperating duopolists can jointly achieve a monopoly price and output by sharing market output equally. Each effectively maintains a monopoly over their own share of the market. In the case of a homogenous product, an attempt by either duopolist to reduce price or increase output will need to be followed by their competitor, taking both away from the monopoly position towards the perfect competition equilibrium. There is no single, determinate position, however, especially once the assumptions of a homogenous product and identical cost of production are discarded.

By adding more firms, the Cournot solution can be extended to represent an oligopoly. But a larger number of firms will reduce the likelihood of a durable collusive agreement on price or output, while increasing the likelihood of product differentiation (e.g. through branding). As Leftwich (1970, p. 239) points out:

> As a practical matter, sellers in most oligopolistic industries sell differentiated products … Industries approaching pure oligopoly include cement, basic steel and most other basic metal-producing industries. Even here there are elements of differentiation among the products sold in a particular industry. Locational factors, service, and even personal friendships may differentiate the products of the various sellers in an industry.

And reactions of oligopolists in claiming market share are less likely to be based on the assumption that the other firms will not react in turn and will keep their output and prices fixed. However elegant, it is at least arguable that a Cournot solution is an unrealistic portrayal of the real world.

An oligopolistic market may, therefore, be better portrayed in terms of the classic 'kinked demand curve' case, where products are differentiated, and individual firms find it unrewarding to alter prices because of the potential reactions of their competitor oligopolists. The discontinuous, vertical marginal revenue curve below the kink suggests a degree of price and output rigidity for the industry whether marginal costs increase or decrease. If the kinked demand curve interpretation of an oligopolistic industry's structure and conduct is preferred to the Cournot approach, then it would be less convincing to argue that reductions in the generalised cost of transport will result in welfare improvements in imperfect markets. In such situations, any automatic application of 'uprate factors' based on a Cournot model would be decidedly misguided.

In practice, price wars do occur between oligopolists. On the other hand, non-price competition in various forms is also feasible, obviating the need for price and output adjustments, and hence retaliatory price wars. Advertising, changes in quality and design, use of technology to reduce barriers to entry, and issue of loyalty cards to customers, are some forms of this competition. Price wars, product differentiation, and other potential real-world oligopolistic practices mean that there is no single approach to modelling oligopoly. Serious doubt must again be cast on the wisdom of the automatic application of 'uprate factors' to increase estimated benefits of transport services used by oligopolistic industries.

A simple analysis of monopolistically competitive markets is also tricky. Products may be highly differentiated, with a large number of independent sellers who tend to equate marginal costs with marginal revenues. According to Leftwich (1970, p. 275), 'some slight restriction of output and increase in prices may occur under monopolistic competition, as compared with pure competition', so that there may be some welfare gain from increased output following a reduction in costs. The degree of ease of entry into the industry and the extent of advertising and other forms of non-price competition that are used will, however, influence actual outcomes. No unique modelling approach is available.

In discussing imperfect competition generally, Vickerman (2007a, p. 602) cautions that:

> In order to be able to apply CBA in these circumstances, we need first to assess the way in which any transport improvement will affect different activities, then assess the competitive structure of those activities in order to be aware both of the markup and the likely competitive response of firms or other agents, and only then can we hope to evaluate the benefits accurately.

DfT (2005, para 101) is equally explicit about the need for evidence and the facts of a situation before estimating benefits associated with imperfect competition:

> Two steps are required to estimate the impact of these additional effects on welfare. First we need to know how firms respond to transport cost savings, specifically what the impacts are on output. Then we need to know the size of the additional benefits delivered by the additional output.

A3.1.3 Changes in the labour market

Lower transport costs may induce more workers to travel in order to enter employment, or seek more remunerative employment. This is a benefit to travellers that is captured in conventional CBA in the 'generated demand' triangle. Worker-travellers take their decision to increase travel (or not) on the basis of after-tax earnings. The wage paid to the worker by the employer, however, includes payroll and income taxes, because it is the total before-tax wage that reflects the worker's contribution to the value of their output for the employer.

Although the tax component is not captured in conventional CBA analysis of transport projects, it reflects part of the additional value of production attributable to new commuting trips of workers, or to those now earning higher wages in different jobs. Additional tax revenues can be used to fund other socially desirable projects that would otherwise not have been funded, or they can be used to reduce taxes imposed elsewhere in the economy. They therefore constitute an additional social benefit, an impact that is not captured in the conventional analysis.

Rather puzzlingly, the other side of the taxation coin is ignored in the literature on WEIs and by proponents of increased spending on transport infrastructure. Infrastructure projects that raise significant amounts of additional taxation receipts because of the postulated increase in labour supply, would arguably also be significant enough to require substantial financial resources.

Whether the funding for infrastructure construction and operation is raised by general taxation, printing money, or by loans, there will be some consequential opportunity cost to the economy. Government borrowing will reduce consumption and divert resources away from the private sector. Inflation generated by excessive printing of money will distort resource use. Taxes distort markets and may reduce the supply of labour. Whether the deadweight loss of these effects outweighs the additional tax raised from an increased labour supply — or indeed all WEI effects — depends on the particular circumstances of each project. Failure to include both the positive and negative effects of an infrastructure project can only result in a less than impartial analytical approach.

A3.2 Some empirical issues

Estimation of posited WEIs is largely an empirical issue. A preference for harmonisation of the parameters or variables employed, therefore, needs to take into account issues that are relevant to empirical analysis.

A3.2.1 Agglomeration economies

Conceptually, agglomeration benefits are measured as the increase in output (GDP) due to the implementation of the transport project. A key variable that requires estimation is, therefore, the elasticity of total productivity with respect to the effective density of employment for industry i in area j. Evidence of causality is thus required to establish that changes in productivity or output are due to an increase in effective density generated by a specific transport project, but this is rarely, if ever, provided in the transport literature or CBAs. Paucity of data and the effort that is required to estimate agglomeration benefits, however, encourages use of 'uplift'; factors derived from large cities, whether they are appropriate or not. Mare and Graham (2009, p. 4) add that confounding effects in correlations may also bias estimated productivity impacts upwards.

Effective density is estimated as a gravity model, with agglomeration factors falling away exponentially with generalised travel cost. Definition of zones used by transport models is therefore critical: many models include only origin–destination data for trips between zones, so that larger zones will exclude more within-zone trips. Some models also rely on physical distances between zone centroids rather than on generalised costs of travel.

A further concern is that changes in productivity may be attributed solely to transport projects, potentially risking a form of confirmation bias. Supporting infrastructure, such as the availability of high speed internet, may not be as conspicuous as a major highway or rail upgrade, but may play a key role in increasing urban productivity. Some, (e.g. Florida, 2003) might similarly argue that entertainment, high level educational facilities and life-style ambience are also essential to attracting the 'creative class' of high-productivity individuals to jobs in cities.

Nor does the WEI agglomeration literature typically feature in its modelling the constraint of travel time budgets (TTB). Based on detailed analysis of historical data, Zahavi (1979), Marchetti (1994) and others have argued that people will only travel a daily total of about an hour from home to work and return. Unless a transport project improvement captures a significant additional number of workers who can now reduce their daily travel time to an hour or so, the number of additional workers may not increase enough to change productivity levels. Improved transport modes may also result in increased fares, thus dissuading some workers from travelling.

Mean travel times of between 60 to 90 minutes per day are considered to be historically stable, but Milthorpe (2007, Table 1) found that they had increased in Sydney from about 73 minutes in 1981 to 81 minutes in 2005. As Milthorpe (2007, s. 2.2) notes, increased TTBs may involve use of mobile phones and laptops, either for recreation or work. The ready availability of technology in urban areas, as well as transport improvements, may therefore also play a role in determining effective densities and agglomeration economies.

On a broader level, use of GDP or its sub-national equivalents is not compatible with the welfare approach adopted in CBA. But even the fundamental issue of standing appears to have been neglected in the literature. Reporting on studies of transport projects in Germany and China (Laird & Mackie, 2010, para 2.2.4) that do not address the issue explicitly, Laird and Mackie (2010, para 2.1.5) comment more generally that:

> An improvement in transport supply in one region will make that region more accessible to other regions and potentially result in the displacement of economic activity to the 'other' regions. This is known

as the two-way road effect. Thus an improvement in transport supply in one region may increase the size of the economy at the national level but reduce it at a sub-national level.

In sum, empirical analysis of WEIs can be problematic due to deficiencies in available transport models and the paucity of data relevant to specific projects. Detailed critiques are provided by DfT (2014); Worsley (2011); Laird and Mackie (2010); Graham et al. (2009) and Byett et al. (2015), among others.

A3.2.2 Output change in imperfectly competitive product markets

It is not clear why the WEI literature has focused so strongly on the aspect of imperfectly competitive markets. The implication is that it is ignored in conventional CBA. However, standard texts, such as Boardman et al. (2011, ch. 5), inform readers in some detail of the need to examine secondary markets that are distorted by taxes or other government interventions, externalities, or imperfect competition. The outcome differs for factor markets, primary markets and secondary markets, and depends on the efficiency of each. Further, Rouwendal (2012) examines different forms for demand functions (not just the straight line) for a number of different models of imperfect competition, finding that the indirect effects 'may have the same order of magnitudes as the conventionally measured direct effects, may be much smaller, or may exceed them substantially'.

DfT (2005, para 204) derives an expression that it recommends should be used as an 'imperfect competition uprate factor' that is the product of the elasticity of demand of the imperfectly competitive firm and the percentage mark-up of the price in excess of the marginal cost. The uprate factor is used to scale up travel time savings and any transport reliability gains to businesses (but not commuters).

Drawing on a number of price-cost studies for UK manufacturing industries and economy-wide elasticities, DfT (2005) recommended an uprate factor of 0.1, based on a price-cost margin of about 0.2 and a price elasticity of demand of 0.5. That is, for imperfectly competitive firms, any welfare gain due to business travel time savings, as well as transport reliability gains, should be increased by 10 per cent above values estimated using the conventional analysis in CBA. Although it refers to an 'uplift factor', rather than an 'uprate factor', DfT (2014) confirms this recommendation.

Abelson (2011) notes that improved transport infrastructure may also result in economies of scale that reduce costs and hence increase welfare gains. He points out, however, that 'because the gains from economies of scale are particular to each situation, these economies cannot be incorporated simply into a standard appraisal. They must be justified and estimated on a case-by-case basis'.

Tyers (2014) examined the economy-wide effects of oligopolistic service industries in Australia. In particular, his analysis explored the effect of government price-cap regulation and price surveillance of the sectors that had been privatised or made more competitive since the 1980s: telecommunications services, transport, health, education, utilities and finance. According to Tyers (2014, p. 6), the privatised services (electricity, gas, water, finance, transport and telecommunications) account for at least 20 per cent of Australia's GDP, but 'the precise extent of imperfect competition in Australia's service industries is difficult to quantify'.

Oligopolistic vehicle manufacturing in Australia is being wound down under the Australian Government's Automotive Transformation Scheme. Increasingly sophisticated use of the internet by producers and distributors (*The Economist*, 2 May 2015) is likely to increase the degree of competition in a range of other industries. Companies like Uber and Lyft, for example, are pressuring governments to allow individuals to offer passenger transport services in competition with taxis. Napster and Spotify (music sharing), PayPal (electronic payments), Prosper and Lending Club (peer-to-peer lending), and multiple online sites for rating restaurants, toilets, and performances, are just some of the growing number of suppliers and information providers. Even where entry of competitors has not yet occurred, the mere threat of the possibility is likely to constrain less than competitive behaviour.

Another relevant issue that has not been addressed directly in modelling WEIs is the effect of government regulation, rather than market structure, in limiting competition. Australian examples of legislated rigidities and imperfect competition include chemists, newsagents, taxis, centralised wage determination mechanisms, some postal services, trade union and professional association restrictions, after-hours penalty rates, occupational health standards (such as truck driver hours and maximum weights of bags that may be lifted manually). Institutional rigidities preclude significant increase in production or fall in prices, even if a producer's transport costs are reduced.

While not denying that reduced transport costs in imperfectly competitive industries can generate benefits additional to those estimated in conventional CBAs, there is an arguable case for considerable caution in automatically applying multipliers like the DfT (2005) 'uprate factor' in an analysis. Given the diversity of firms within an industry, and differences between industries and countries, mechanistic application of standardised WEI factors is unlikely to produce a robust, defensible analysis.

A3.2.3 Changes in the labour market

DfT (2005, paras 109, 118) summarises the effect of improved labour supply as follows:

> If a transport improvement facilitates increased GDP, there will be tax consequences, whether the additional work involves more people in employment, additional hours, or moving to more productive jobs. The welfare effects of small changes in time savings will be marginal for individuals, but the GDP effects can be more substantial for the minority of people affected … in some cases, relatively small welfare benefits from time or cost savings can lead to significant GDP effects. There is no theoretical reason to be certain whether the welfare effect of such savings will be smaller or larger than the GDP effect … [It is] likely to be significant only where a transport scheme relieves a significant transport constraint, and then only for a minority of individuals (insofar as transport cost changes lead to a change in employment or in employment patterns).

A transport intervention that reduces the generalised cost of transport to a commuter can be thought of as an increase in the effective wage. It is therefore possible to estimate an elasticity of labour supply with respect to effective wages, and to use it to estimate a change in the level of employment. The product of the change in employment and GDP per worker (average labour productivity) yields the overall change in GDP. Studies relevant to the United Kingdom find that the labour supply elasticity with respect to wages ranges from 0.5 to 0.15, so DfT (2005, para 241) proposes 0.1 as 'best estimate'. In a UK study, Venables (2007, p. 186) concluded that increased incomes due to workers moving to higher productivity jobs 'typically yield[s] total gains several times larger than those that would be derived from a standard cost-benefit analysis'.

DfT (2005, paras 245–47) refers to evidence that time savings on commuting journeys tend to result in longer commuting distances, and that 'workers are not very responsive to changes in wages when choosing how much to work'. It therefore recommends that the GDP effect should be assumed to be zero. DfT (2014, para 4.1.25) states, however, that 40 per cent of the change in GDP is due to the labour supply impact, and 30 per cent of the change in GDP is due to moves to jobs of different productivity levels.

A3.3 Wider economic impacts in the Australian and New Zealand jurisdictions

A report to the Council of Australian Governments Reform Council by SGS (2012a) reviewed the literature on agglomeration economies and provided estimates of projected changes to metropolitan GDP. The report was based on case studies of proposed transport projects in Melbourne and Adelaide, and greenfield housing development in urban fringe areas of Sydney.

The SGS (2012a) report adopts an approach similar to overseas studies by estimating changes in state gross value added (GVA) based on correlation between effective job density (EJD) and labour productivity by statistical local area (SLA). EJD is derived using travel time rather than generalised cost of travel.

However, SGS (2012a) also proposes a different approach to estimating 'uplift' in GVA, based on elasticities of changes in human capital due to changes in EJD. This approach is based on the hypothesis (SGS, 2012a, p. 2) that households are 'knowledge intensive enterprises' in their own right, and that transport projects will open more opportunities to learn and acquire skills. It is not entirely clear from the report whether the acquisition of additional human capital is hypothesised as being due to better access to educational centres or to on-the-job training, but the calculated elasticities are based on the incidence of formal tertiary qualifications in each SLA.

With regard to productivity effects of agglomeration, the points made by SGS (2012a) are similar to those by DfT (2014), Worsley (2011), Laird and Mackie (2010), and Graham et al. (2009), among others. For example, 'rather than firms being more productive because they are in a central location, firms that are more productive can command central locations', so that the direction of causality runs in the opposite direction to the one usually hypothesised. A further problem is that researchers are not able to obtain access to detailed firm-level productivity data in Australia, whereas overseas studies have been able to do so. Indexes of EJD also do not distinguish between 'jobs' and their relevance to a particular sector in terms of their contribution to GVA: for example, a bank teller and an investment banker will be treated as equivalent occupations. SGS (2012a) also acknowledge that the use of cross-sectional data at a particular point in time to estimate elasticities may not be appropriate for projecting changes in future productivity due to a transport intervention or land-use strategy.

Given these uncertainties, it is incongruous that SGS (2007, Table 14) should attribute over $17 million out of a total of $85 million in present value benefits to urban consolidation benefits as a result of replacing a railway level crossing with an underpass in suburban Springvale in Melbourne. Capital Metro Agency (2014, Table 18) attributes a similarly high proportion of about 20 per cent in WEIs to its estimate of the total benefits for a 13-kilometre light rail connection between a suburb that is already served by a rapid bus service and one out of the four existing Canberra town centres.

Some other reports on WEIs commissioned by Australian jurisdictions, but not reviewed here include SGS (2012b), KPMG (2012), and Hensher et al. (2012). At the time of writing, a detailed study of elasticities of productivity with respect to employment density was being undertaken by SGS under the aegis of the Australian Government's Bureau of Infrastructure and Transport Economics on behalf of Austroads.

Studies have also been undertaken in New Zealand. Mare and Graham (2009) used more detailed data than those available to researchers in Australia to estimate agglomeration elasticities. Kernohan and Rognlien (2011, Table 8.2) analysed imperfect competition through the prism of a Cournot model using the price-cost differences of New Zealand firms. They recommend an uplift factor of 10.7 per cent be applied to business-user benefits. Agglomeration impacts or externalities are included in the NZ Transport Agency's (2013, p. 5: 406–411) *Economic Evaluation Manual*. It includes weighted average agglomeration elasticities for New Zealand by industry, as well as the procedure to apply the agglomeration elasticities to estimate productivity changes by location.

Discussions with transport agencies in Australia and New Zealand indicate a general acceptance of the need to include WEIs in evaluations of transport projects. Manuals issued by government agencies in a number of jurisdictions contain sections on WEIs or WEBs. Central agencies are typically more guarded, emphasising the need to avoid the application of elasticity and other values obtained from overseas studies or from other projects, although current methodologies are broadly supported. Most of those interviewed recognised the potential pitfalls of double counting, the need to demonstrate causality, and the limitations imposed by data availability.

Infrastructure projects that are sufficiently large to generate WEIs are, however, also likely to require considerable funding resources. Raising substantial funds is also likely to have a negative effect on economic activity (see Appendix 7 on marginal excess tax burden). Somewhat worryingly, the apparent enthusiasm of government agencies to apply the WEI approach is not matched by a corresponding willingness to adjust costs and benefits for the opportunity costs of increased borrowing or taxation.

Infrastructure Australia (2013, p. 11) notes that WEIs may not always be positive and that 'the availability of Australian specific data needed to calculate WEBs is currently sub-optimal'. It states that it will treat estimates of WEBs 'separately to the traditional CBA', but is nevertheless broadly supportive of their inclusion in proposals for infrastructure spending.

A3.4 Issues for consideration in harmonising approaches to wider economic impacts

Vickerman (2007b) provides a comprehensive review of the debate regarding the existence of WEBs, distinguishing between macro-level and micro-level approaches, and noting the difficulty of 'knowing whether an elasticity obtained from the macro-study is in any way applicable to a single investment decision'. After reviewing differences in approach in the estimation of elasticities in macro-studies (output, productivity, or employment), the issue of direction of causality, and use of land use transport interaction (LUTI) models versus computable general equilibrium (CGE) models, he points out that most of the empirical evidence relates to ex ante studies. He cites 'one of the relatively few ex post studies' by Hay et al. (2004) to the effect that 'a very significant project, the Channel Tunnel, has not produced significant wider benefits over its first ten years of operation, at least on the regional economies close to the tunnel'.

Reviewing the effects of a number of Train à Grand Vitesse (TGV) projects between pairs of major French cities, Vickerman (2007b) finds that traffic levels generally increased in both directions, but that there was no overall net impact on these major cities, although there was a tendency for increased concentration of economic activity towards them from their regional hinterlands. Vickerman (2007b, p. 16) concludes that 'what is clear is that there is little evidence of there being standard transferable [wider economic benefits] multipliers region to region or project to project' that can be applied to estimated benefits in individual ex ante analyses.

DfT (2014, s. 5.2) reviews a number of data and modelling issues in the United Kingdom that can affect the robustness of estimates of WEIs. Lack of modelling of intra-zonal travel in transport models is likely to produce inaccurate estimates of agglomeration effects. Where transport models do not employ generalised cost matrices, there is likely to be bias in WEI assessments because changes in agglomeration effects depend on costs. Insufficient segmentation of modes in transport models may affect estimates of effective density; for example, if the model does not include a public transport mode. Finally, models may not cover the geographic area under consideration, leading to unreliable results.

Laird and Mackie (2010, pp. 1–2, para 5.1.3) report on British studies where estimates of the growth in GVA attributed to transport investments:

> are significantly in excess of the Present Value of Benefits used in conventional cost benefit appraisal … Clearly these GVA estimates are large and, on the basis that they also exceed welfare benefit estimates, give rise to questions of consistency with the methods used to appraise transport projects … the methods available to estimate the potential GVA impact of a region post a transport investment are still in their infancy and need work to ensure they pass internal consistency and robustness tests.

In a detailed review of using the UK GVA approach, rather than GDP, Byett et al. (2015, p. 94) noted that:

> One issue that was not fully resolved was whether the benefits measured are additional or inclusive of the rule-of-half benefits measured within the standard transport appraisal … Hence at this stage it is recommended that the GVA approach be used alongside the EEM [Economic Evaluation Manual, NZ Transport Agency], rather than as an additive effect.

More particularly from the perspective of this publication, in a summary table of pros and cons of the GVA methodology, Byett et al. (2015, Table 10.1, p. 95) also conclude that:

> The GVA approach is not consistently defined across different studies. Likewise density measures also differ across studies. These inconsistencies reduce the ability to compare model outcomes and calibrate model parameters.

Abelson (2011) concludes that 'searching for wider economic benefits is something of a holy grail in transport economics' and that transport infrastructure:

> often disperses employment rather than concentrates it; correlations of wage and employment density overstate the density effect on wages; attribution of significant agglomeration economies to a small number of generated trips is not very plausible; and the empirical basis for agglomeration economies driven by effective densities is thin and subject to unresolved technical issues. This paper concludes that agglomeration benefits should generally not be included in an appraisal.

Just as there is sometimes unjustified aversion to new ideas, it can sometimes be the case that a new idea or approach is adopted without sufficient critical review. In the case of WEIs, enough caveats have already been expressed by various specialist observers to signal that a thorough review of the approach is desirable before its acceptance and automatic application to transport projects in Australia and New Zealand. Nevertheless, transport agencies appear to be willing to forgo more detailed review.

To ensure consistency and robustness in CBA studies of transport projects, a harmonised approach should be adopted to the following:

- review of the basic methodological principles used in the WEI approach, particularly from the perspective of its application to cost-benefit analysis
- review of the desirability of complementing the WEI approach with a corresponding application of METB estimates to costs and benefits
- peer review by non-transport econometrics experts of estimates of WEI variables and parameters.

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