TOWARDS AN ECONOMIC APPRAISAL METHODOLOGY TO BETTER CAPTURE POSITIVE URBAN ECONOMIC EXTERNALITIES ARISING FROM AGGLOMERATION - FOR PARTICULAR APPLICATION TO URBAN TRANSPORT INVESTMENTS

A MARSAY

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ABSTRACT

Conventional cost benefit appraisal (CBA) consistently yields higher benefit cost ratios (BCRs) for road projects than for most public transport investments. This affects the ability to motivate the levels of investment needed to realise the intent of national transport policy that prioritises public transport, especially in metropolitan areas.

While modern CBA methods make provision for negative externalities such as accidents and environment, positive externalities like supply chain efficiencies in the freight sector and urban economic functionality efficiencies in the public transport sector, are not well catered for. Under-representation of positive externalities may yield misleading CBA results and hence over or under investment in different transport infrastructure sectors.

Based on evidence of urban agglomeration economies, that are most pronounced in cities that have a wide range of transport modes, a simple appraisal method is proposed that imputes long-term GDP growth uplift to investments in an appropriate programme of transport systems in Gauteng Province in South Africa.

A range of collateral institutional and economic policies, designed to enhance theoretically demonstrated economies of agglomeration, are noted. Further research is proposed to confirm the nature and scale of the linkages between an 'urban economic efficiency' focused programme of transport investments, and enhanced GDP growth.

1. BACKGROUND

In 2005 when final decisions were being made as to whether the Gautrain Rapid Rail project should go ahead, many concerns were expressed. Objections included:

- That the project was diverting resources away from lower income users of existing public transport services to the allegedly mainly higher income Gautrain users;

- That the approximately 3:1 benefit to costs ratio (BCR) yielded by the CBA was based on overly optimistic assumptions, and even double counting of benefits;

- That the project cost, at nearly R30bn, was unrealistically high.

In a letter to the press at the time, the present writer responded to some of these concerns by noting firstly that, on a unit cost basis (cost/km), the R30bn cost was well within range of similar rail projects procured elsewhere in the world. The main point made in the letter, however, was that in contrast to investments in existing public transport infrastructure, the Gautrain project represented a new approach to urban transport planning, predicated on the progressive replacement of inherited low density development by an urban form based on well connected, high value economic nodes. The letter spoke of *'the increasingly high costs of providing basic services in a low-density megalopolis and, the forgone benefits of effective urban agglomerations'* and that it was Gautrain's potential to redress this situation that should be viewed as its main economic rationale (Marsay, 2005).

This argument was further developed in ex-ante (Gauteng, 2006) and ex-post (Gauteng, 2010) studies of the impact of the project on the rest of the Gauteng transport system. In the 2010 report, under the heading, 'From historic disintegration to contemporary [spatial] integration', the following transformative impacts were ascribed to the project:

- Gautrain as a catalyst to the dynamics of urban transformation

- Gautrain as a catalyst to higher regional economic growth

- Gautrain as a catalyst to transformation of the wider public transport sector

The report referred to research that had been undertaken in the context of the Eddington Transport Study (Department for Transport, UK, 2006) that found, given appropriate enabling conditions, significant economic productivity increases could be measured when major transport investments took place in growing metropolitan areas. Eddington showed that economic benefits could be up to 50% on top of direct the vehicle operating cost (VOC) and value of travel time (VOT) benefits normally captured in transport CBA studies.

The implication was that the BCR of 3:1 obtained in the Gautrain CBA study was more likely to have been a significant *underestimate* than an *overestimate* as implied by critics; and that conventional CBA methods were not accounting adequately, if at all, for positive economic externalities associated with enhanced urban economic efficiency.

The purpose of this paper, therefore, is to explore the nature and potential scale of urban economic efficiency gains and whether, and under what conditions, they may be a basis for motivating increased investments in public transport infrastructure in future.

2. WHAT ARE POSITIVE URBAN ECONOMIC EXTERNALITIES?

Urban geographers often write generally of economies of agglomeration to explain long-term historic trends of urbanisation. They observe that individuals and companies gain economically from conducting their varied activities in closer proximity to one another; that is, at higher physical density. Superficially, this economic advantage would appear to be accounted for by purely geographic features such as proximity to a port, a river, or more modern transport infrastructure features such as highway interchanges or intermodal facilities. In addition to this, the lower unit cost of providing utility services such as water, telecommunications and electricity to higher density developments is well acknowledged.

Notwithstanding the reality of the above considerations, more recent research into the agglomeration economies (Rosenthal and Strange, 2001; Quigley, 2008; Combes et al in Glaeser, (ed), 2010; Combes et al, 2012), shows that businesses enjoy additional advantages in terms of their own economic efficiency simply as a result of the presence of multiple types of skills and production resources in observable, experienced proximity.

New techniques of producing goods; new, potentially more profitable ways of deploying ones individual skills; access by firms to a larger, more varied labour pool; all contribute to measurably higher economic productivity. Together these factors contribute to a more efficiently functioning regional or urban economy, with labour market productivity gains thought to be the main contributor.

In pure economic terms the advantage constitutes an *'economic externality'*. This means that, for the majority of players in the economy, certain gains are being enjoyed that they are not paying for individually; hence, the characterisation of the phenomenon as a *positive* economic externality. Moreover, the aggregate of benefits thus enjoyed exceeds the aggregate of business costs incurred individually, showing that the economic externalities manifest themselves through higher net productivity of most economic actors.

While negative economic externalities such as the congestion, safety, noise and air pollution impacts of transport use on non-users of transport, are better understood and catered for in CBA studies, the measurement of positive economic externalities is a far more recent, and less well appreciated entrant to the field of economic appraisal.

Negative economic externalities sometimes require regulatory intervention in order to ensure that actual users of a transport system pay for costs being imposed on third parties.

Examples of such interventions may include:

- the application of higher safety or / and emissions standards for road vehicles;

- congestion charging in urban areas to pay for the impact that intensive individual road use by private cars may have aggregate travel time and also air pollution.

Regulatory interventions deliberately designed to capture, or optimise, positive economic externalities are less known although, when public transport is subsidised, there is always an implicit recognition that some social or economic value is being 'purchased' with the subsidy. What is less clear, however, is what the scale and nature of such value is and what actions, if any, could be taken to ensure that transport investment is taking place in a way that is likely to realise positive economic externalities as opposed to consolidating urban / metropolitan forms that may well be sub-optimal in terms of economic efficiency.

This is a particularly relevant question in the context of South Africa where urban economic structures have been historically influenced by the need to support segregated residential patterns and within which, transport efficiency has consisted in making transport serve that socio-political objective. As already noted, the case for Gautrain was built in part upon a deliberate intent to avoid consolidating existing urban form and to give support for a different, hopefully more efficient, urban form.

An appraisal rationale could therefore be viewed as emerging that is *temporally dynamic*, in the sense that it was looking ahead to a differently structured future metropolitan environment as the basis for its validation; and not simply relying on making the present urban structure and transport system more efficient.

It is with perspective in mind that this paper proposes a 'temporally dynamic' approach to urban transport investment appraisal, seeking to capture longer-term urban economic functionality associated with differently, more efficiently structured, urban forms. In what follows, the relationship between transport, especially public transport, investments and urban economic efficiency is explored. The aim is to discover the extent to which investments in transport systems may be related to the realisation of these productivity gains and, if so, how this can be better incorporated into CBA appraisal methods and thus provide a sound basis for increased investment in urban transport infrastructure and services.

In addition, the conditions under which additional benefits are most likely to occur are also explored so that not only is theoretical justification improved, but also the likelihood of such benefits actually being realised is increased by ensuring that projects do not go ahead only on the basis of appraisal results but also on the basis of explicit commitments designed to bring about the institutional conditions necessary to their realisation.

3. RELATIONSHIP BETWEEN TRANSPORT AND URBAN ECONOMIC EFFICIENCY

The above studies, and in particular the 2010 work led by Pierre-Phillipe Combes on the estimation of agglomeration economies (Combes et al in Glaeser, (ed), 2010) have attempted to measure the scale of positive economic externalities associated with higher density. A consensus value is that geographical proximity, or physical density, (entailing population density) generates an elasticity with respect to agglomeration of about 0.05. This means that if urban density goes up by 100% (i.e. doubles) an economic productivity gain of the order of 5% can be expected. By extension, at a density ten times higher than the average in a region, economic productivity in a dense urban economic node could be as much as 50% higher as elsewhere in a region.

The observation that real economic value, in the form of urban economic efficiencies, is indeed a benefit ascribable to urban density raises the question of how people may be enabled to benefit from the phenomenon. Supporters of increased public transport investment in cities have long held that without effective public transport systems, the high densities understood to be expressive of economic value can become a liability instead.

At a very general level, for example, it is difficult to conceive of major cities such as New York, London or Paris being able to sustain their role as vibrant economic and social hubs without their transit systems. The following examples illustrate that the concept of urban economic efficiency is well appreciated in general terms at least by those responsible for either maintaining a city's transport systems; the case of New York below; or for making major commercial location decisions; the case of Paris vs. London.

After these general illustrations, the history of attempts by transport economists to bring the concept of urban economic efficiency into economic appraisal tools is reviewed.

3.1 New York's perennial transport funding crisis

New York City officials in the mid 1950s realised that without a mix of effective road-based transport and high capacity public transport systems economic decline was inevitable. At the time railway and metro services in the city were close to bankruptcy, with little prospect of finding the funding to recapitalise and modernise. Yet, private sector operated roads, bridges and ferry companies were highly profitable. The city authorities realised that unless an alignment of commercial interest between private road-based and public transit based systems could be brokered, the city would die commercially.

Following a ten year political and funding battle the Metropolitan Transportation Authority was found in 1965 in an alliance which allowed the revenues of the road, bridge and ferry services to support bond financing of public transport investment.

In the mid 1980s, a further crisis arose as a result of a growing misalignment between city rates revenues and a population progressively migrating into the adjacent states of New Jersey, New York State and Connecticut. Funding agreements with contributions from national, state and city governments enabled substantial recapitalisation to take place.

New York continues to experience a public transport-funding crisis (amNewYork, 2016; wsws, 2015) resulting, in part, from the city borrowing large sums of money to sustain the reinvestment programme of the 1980s and 1990s. In part also it reflects the continued inability to raise sufficient from fares to service debt and cover operating costs, with fares being kept relatively low out of concern for low income New Yorkers also affecting decisions about fare levels.

Despite the ongoing difficulty to motivate the necessary funding to increase the capacity and quality of transit systems, a broad social consensus remains that the economic value of 'New York Inc.' requires that solutions continue to be found.

3.2 Transport and labour productivity in Paris and London

In the early 2000s, a London-based management consultancy, wishing to compare Paris and London as office locations, discovered that labour productivity in Paris as a whole was higher than in London as a whole. But, in inner London, labour productivity was higher still. A report (Marsay, 2002) informally titled 'A Tale of Two Cities' was produced in which the reasons for these differences were explored.

It was noted that Paris had invested in a much wider range of radial and orbital transport infrastructure, both roads and public transport, including transport corridors that traverse the city in several directions. The result was that, for an average (+/- 1 hour) commute time, employers had access to the full labour pool in the greater Paris area and, equally, individual workers from all parts of the city could access jobs in any part of the city.

In contrast, London's transport corridors were mainly radial routes terminating at the perimeter of the central area. While access within its central area is excellent, London's transport infrastructure did not readily permit orbital transport or complete traversing of the city, whether by road or rail. The result was that employers had access to less than half of greater London area's considerably larger labour force; and workers, similarly, had access to a smaller total number of jobs, within the same travel time, than their Paris counterparts.

Paris' apparent 'over-investment' in transport infrastructure and services was yielding economic benefits that were measurable in terms of higher labour productivity as firms could draw from a larger effective labour pool and so employ, on average, better quality employees; and individuals could offer their services to a larger number of possible employers and, on average, command higher wages.

In central London, in an area bounded by the Circle Line, where transport accessibility was found to be even better than in Paris, labour productivity was also higher than in Paris.

4 MEASURING ECONOMIC PRODUCTIVITY GAINS FROM TRANSPORT

From the very beginnings of formal transport cost benefit appraisal, and seemingly quite independently of urban geographers' research work on the quantification of agglomeration

gains, the question has been raised whether public transport investments yield benefits additional to direct and indirect efficiency savings in the transport systems themselves.

Conventional transport cost benefit analysis of transport as developed by Michael Beesley in the 1960s in the planning of London's new Victoria Line, states that economic benefits attributable to the project comprise the travel time and cost savings of users of the new system, plus any benefits to non-users that arise as a result of congestion reduction.

French transport planners in the 1970s, motivating for the construction of the first TGV high speed railway lines between Paris and Lyon, argued that urban productivity benefits in addition to direct and indirect transport benefits, could be substantial. Although not demonstrated in any *ex ante* quantitative analysis, *ex post* studies revealed that the TGV had effectively brought parts of Lyon to within functional economic proximity of the Paris economy, with businesses able to locate in Lyon at much lower cost than in Paris, and yet participate in the Parisian economy as though a Paris suburb. Lyon was benefitting from the labour productivity transmitted, agglomeration effects of Paris.

A general policy conclusion that may be drawn from this is that good public transport systems are 'purchasing' urban economic efficiency, not just transport efficiency.

In the UK, on the other hand, the position of HM Treasury from the mid 1970s to mid 1990s was that any such urban efficiency gains were just another way of expressing the impact of transport efficiency improvement and so should not be counted twice. In the later 1990s and early 2000s, for various reasons, Government began to review its position.

Firstly, public disquiet at the programme of highway construction led the incoming Labour Government of 1997 to call a moratorium on the programme and to commit instead, to a series of Regional Multi-Modal Studies (MMSs) aimed at redressing the perceived imbalance between roads and public transport investment.

Secondly, in 1999, a government sponsored policy review of the relationship between transport investment and economic activity concluded that, while conventional cost benefit analysis may capture most economic benefits, 'it may not account for market efficiency (or inefficiency) adjustments and these should be investigated' (SACTRA, 1999).

With this finding in mind, consultants undertaking the studies were encouraged to develop appraisal methods that would 'level the playing field' and permit rail and other public transport projects to be tested fairly against road projects.

In 2001, a setback was experienced when the independent Commission for Integrated Transport commissioned research (Faber Maunsell and NERA, 2002) to review the conclusions of those MMSs that had reported up to this time. This is what was found:

- the policy objective of increasing rail investment was indeed being achieved with 50% of proposed investments being in rail and other public transport, but

- benefit to cost ratios (BCRs) for non-road solutions were typically very low and did not meet the Treasury's benchmark BCR even with softer, social benefits added.
- highway projects were found to score consistently much higher on the same broad-based BCRs, sometimes having double figure benefit to cost ratios.

A further, more comprehensive review (UK Department for Transport, 2003) also noted that where apparently satisfactory BCRs had been achieved for public transport schemes, demand forecasts were often predicated on assumptions about other, collateral conditions in support of public transport, over which proponents of the projects had little control.

Notwithstanding the setback, Government remained encouraged by the intriguing finding of the 1999 SACTRA report and in 2004 commissioned the most comprehensive review of the role of transport in the national economy ever undertaken in the UK: the Eddington Transport Study (UK Department for Transport /HM Treasury, 2006), named for its chairman, Sir Rod Eddington, a former CEO of British Airways.

Eddington reviewed, first the history of the relationship between transport and economic development, noting the step changes in economic progress that have occurred in response to new transport technologies such as canals, then railways and, in the twentieth century, the combination of internal combustion engines and paved roads. Secondly, the study assessed the economic benefits of a large, generic packages of different types of transport infrastructure intervention, with the aim of establishing, and accounting for, any differences in economic impact by type of project.

In addition, the study team was specifically briefed to investigate whether there was any empirical basis for labour productivity-transmitted, urban economic efficiency benefits such as those suggested by the French TGV experience. (The present writer is unaware if the team also had access to the less formal, Paris vs. London, work referred to above).

Perhaps the most relevant aspect of the Eddington work, from the perspective of the present paper, is that for the first time in the UK, major effort was given to understanding the economics of agglomeration as they might apply to transport investment appraisal. Drawing on UK research work on agglomeration (Overman, Rice and Venables, 2007; Graham, 2005) as well as additional, bespoke research on agglomeration and the role of transport undertaken in the context of the Eddington study itself (Eddington, 2006 (a)), they developed, first a better understanding, and then quantified estimates, of the additional impacts that transport infrastructure investments appear to have on economic productivity and GDP growth.

Figure 1 summarises Eddington's understanding of economic productivity gains that can arise from transport investment, and Figure 2 gives their estimates of the scale of additional economic benefit, measured as increments in assessed benefit cost ratios.

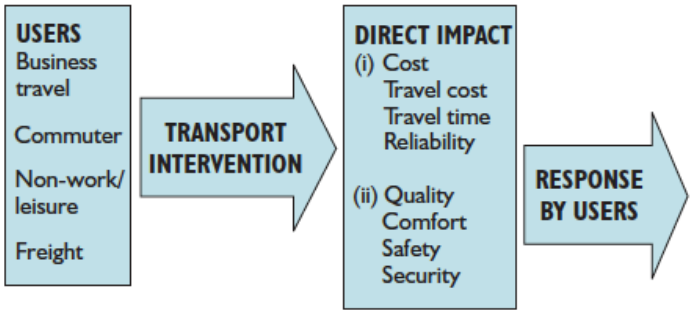

Figure 1 Links between transport and economic performance
Source: (UK Department for Transport /HM Treasury, 2006, Vol 1, Figure 2.3, p24)

In summary, Eddington showed that investment in transport infrastructure, especially when taking place in the context of growing metropolitan centres, can lead to productivity gains which can translate into between 30-50% on top of usual VOC and VOT-based benefits. This reflects the combined influence of all seven sources of 'Wider Impacts' listed in the Figure, with cluster/agglomeration benefits and labour productivity the main contributors.

Drawing on their review of the historic economic impacts of transport, Eddington also noted that the scale of benefits would be largest where new investments make significant changes to pre-existing spatial relationships. In contrast, incremental improvements to the efficiency of transport arrangements within already established spatial structures were less likely to include wider productivity gains, despite yielding otherwise adequate BCRs.

Figure 2 compares BCRs for different types of transport investments with and without gains from agglomeration / urban economic efficiency. Both road and public transport projects show substantially increased rates of return when wider benefits are added. While road projects consistently yield higher BCRs than public transport projects, the public transport projects show much greater increments from urban economic efficiency gains. This latter finding is significant for transport investment planning in metropolitan areas where choices often need to be made between roads and public transport projects.

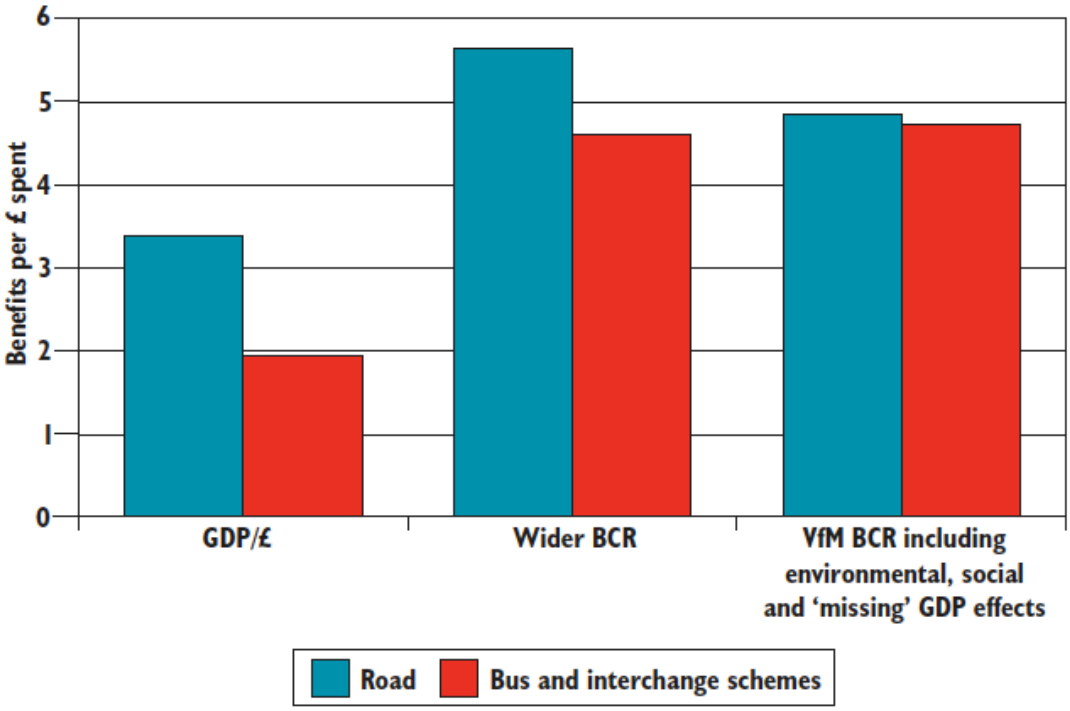

Figure 2 The impacts of a more complete appraisal of transport projects
Source: (UK Department for Transport /HM Treasury, 2006, Executive Summary, Figure 9, p36)

The third set of comparisons in the Figure bring social and environmental costs and benefits into the equation and it is instructive to see that the 'Wider BCRs' remain much higher than the conventionally calculated BCRs even after these costs are taken into account. This shows that the value of the positive economic externalities from urban economic efficiency gains far exceeds negative, social and environmental, externalities.

This finding is significant also for transport planning, where over-emphasis on negative externalities at the expensive of positive externalities may yield misleading CBA results with over investment in roads and under investment in public transport infrastructure.

An example in which the new ability to quantify urban economic efficiency gains has affected a major transport investment decision is the case of London's East-West Crossrail, linking Paddington Station in the west to Liverpool Street in the east of that city. For many years HM Treasury had refused to underwrite the funding of the project because the BCRs from conventional transport cost benefit appraisal were below the benchmark set in the then current edition of the Government's 'Green Book' guide for appraisal (HM Treasury, 2003). Further study of the project, making use of the evidence of productivity-based economic benefits methodology (Buchanan, Volterra, 2007) resulted in a much higher BCR and led to Treasury approval of the project, (which is set to open in 2017).

A study of the North West Rail Link project in Sydney, Australia makes similar findings of enhanced BCRs based on employment agglomeration impacts (Hensher et al, 2012).

5 TOWARDS A SIMPLE MEANS OF MEASURING URBAN ECONOMIC EFFICIENCY

Notwithstanding the above studies, no simple appraisal tool to measure urban economic efficiency exists. Available methods typically require sophisticated research skills together with reliable urban economic statistics. In what follows a proposed approach is offered. It builds on the evidence from agglomeration research that the urban economic productivity associated with higher density urban forms will manifest itself in a higher than otherwise rate of economic growth; and that a significant share of this enhanced growth may be attributable to the transport systems that sustaining the urban structure. The example offered is based around the Gauteng metropolitan city region.

5.1 An approximation of the value of urban economic efficiency in Gauteng

To illustrate the potential scale of urban economic efficiency gains to the Gauteng city-region from investment in transport infrastructure and services, consider:

- An 'urban economic efficiency' (UEF) transport spending programme is committed to, involving a higher proportion of rail and other public transport expenditure, and entailing an increase in transport spending from R15bn per year to R25bn per year;

- An 'urban economic efficiency' premium of 20% higher GDP growth than otherwise;

- Thus, if Gauteng's GDP (currently about R1, 500bn p.a.) grew at an average of 2.5% p.a. instead of 2.0% p.a. over a period of 30 years, its UEF-enhanced value becomes R65 trillion over against R60 trillion for a default transport scenario.

Table 1 summarises this scenario. The analysis draws on work undertaken by the author for the Gautrain Management Agency (Marsay, Brits, 2017).

Table 1 Benefits of an urban economic efficiency transport investment programme for the Gauteng economy

Transport investment	**Investment cost**	**GDP growth**	**Value of Gauteng GDP with / without 'UEF' transport**
Annual investment to sustain a basic economic growth trajectory	R15bn	2%	30 year GDP @ 2.0% growth = **R60tn**
Additional transport investment for incremental economic growth	R10bn	0.5%	30 year GDP @ 2.5% growth = **R65tn**
Total annual transport investment	R25bn	2.5%	
Aggregate, 30 year, investment	**R750bn**		Difference = **R5tn**

Based on the assumptions made, the above analysis shows an 'incremental GDP' BCR of **6.6:1** (calculated as R5tn/R750bn). This is the estimated economic value of a package of transport investments that would lead to a higher rate of economic growth than would be sustainable under a 'business as usual' trajectory. In the context of the assumptions made in this scenario, this is a potential measure of an agglomeration premium.

An additional contrast between the UEF and the business as usual scenarios is that the former allows a broader based accessibility for more sections of the population to more parts of the city / city-region. As well as sustaining higher economic growth it should also give a better distribution of the benefits of such growth. In contrast, a business as usual trajectory may yield greater travel efficiencies in the shorter term but with these being distributed in favour of those with access to private car transport. In other words, as well slowing city growth over the long-term, it yields a less equitable sharing of that growth.

6 CONCLUSIONS

The Eddington Transport Study, as well as demonstrating the reality of transport-related agglomeration impacts, also noted that the scale of such effects would be greatest in the context of growing urban areas. It was also stated that the optimisation of agglomeration benefits is likely to require a range of collateral measures aimed at supporting efficiently functioning urban economies. Gauteng Province's 25 Year Integrated Transport Plan (Gauteng, 2013) which seeks to develop a more economically and socially efficient urban future, proposes the following measures to support its transport vision:

- Subsidised housing provision within urban core areas – to improve accessibility to public transport for low income people and mitigate premature take-up of car use;
- Facilitating local economic development outside the urban core – to mitigate the need for long distance commuting, again for low income groups;
- Land use densification in support of public transport –to contain urban sprawl;
- Reinforcing the existing commuter rail network, (but noting that rail can only play its role effectively if a more effective service delivery model for PRASA is found);
- Extending integrated, road-based public transport networks, to provide the better local accessibility and trunk route reliability needed to attract people from cars;
- Capacity building in the transport industry – without good management and operational skills, public transport will remain inefficient and unattractive to users;
- Strengthening intermodal freight hubs – to mitigate road congestion via greater use of rail and efficient freight distribution on the road network.

It is acknowledged that the benefit calculation proposed here is general, notwithstanding the very strong, wide-ranging research evidence for transport-related urban economic efficiency gains. Further research is therefore being developed to confirm both the nature and the scale of the linkages between an 'urban economic efficiency' focused programme of transport investments in South African cities, and enhanced regional GDP growth.

Current methods of transport economic appraisal tend to yield much higher BCRs for road projects aimed at the private motorist. This is largely because short-term value of time, which is the main component of the BCRs achieved, is being captured at the expense of long-term economic growth and social equity effects. A method of economic appraisal, aimed at capturing long-term economic externalities associated with agglomeration, with commitments to all the collateral actions to ensure such growth is actually realised, may be the only way to reverse the trend to very low density, car dominated urban futures.

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