ASSESSING THE EQUITY IMPACTS OF BUS RAPID TRANSIT: EMERGING FRAMEWORKS AND EVIDENCE

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ABSTRACT

There is an emerging interest internationally in defining, measuring, and analysing the equity impacts of urban transportation projects. Equity and social justice constitute the less studied aspect of the three elements that constitute social justice: economic growth, environmental impact and social justice. The interest is driven in part by the strong social equity focus of BRT projects during the planning and funding stages of their implementation. The paper offers a meta-analysis of empirical evidence on the equity impacts of operational BRT systems, with specific emphasis on poverty impacts in developing countries. We also offer two new case studies on the distributional impacts of BRT systems in Johannesburg, South Africa, and Mexico City, Mexico. We highlight emerging methodological approaches and identify issues that need further attention to ensure the intended social benefits of BRT investments are properly evaluated and, ultimately, achieved.

Keywords: Bus Rapid Transit, equity, poverty, social impacts assessment

INTRODUCTION

Since the Brundtland (1987) report was published, sustainability has been conceptualized as a problem of guaranteeing that any unit of work (project, city, region, building, organization, country, the planet) can exist without using the resources of future generations. More precisely this has been conceptualized three-fold: units should be economically sustainable; environmentally friendly; and socially just. The first two aspects of sustainability have been widely discussed and measured. However, it is only very recently that attention has come to the social justice aspect of sustainability. This paper is broadly concerned with the question of how infrastructure projects in cities can contribute to sustainability from a social justice point of view.

Indeed, social justice is increasingly being looked at in transportation projects in general, and more specifically in urban settings. Given that urbanization is a solid trend, it makes sense to understand how transportation projects can make cities more socially just at a point in history where human beings living in cities increasingly outnumber those living in rural areas. More concretely, we will analyse how Bus Rapid Transit (BRT) performs in terms of equity. BRT systems are becoming very popular internationally as a way of improving urban mobility through a package of interventions, including busway improvements, efficient operations, and general upgrading of the urban environment. BRT is also becoming an important strategy in the climate change arsenal: the International Energy Agency is promoting a massive advance in BRT deployment – to the extent of 25,000 km of new BRT lines worldwide – to help limit global temperature rises to 2 degrees while meeting the mobility needs of cities at a reasonable cost (IEA, 2013). A recent count indicated that BRT-type systems were operational in about 151 cities around the world, of which about 120 were built in the last 12 years (Hidalgo and Gutiérrez, 2013; brtdata.org). A significant number of these are in the developing world, where issues of equity and social sustainability remain most visibly on the public agenda.

An increasing number of studies have been published lately focusing on the equity impacts of BRT systems in developing countries. These studies start to provide evidence on the specific opportunities offered by BRT to address social sustainability in cities characterised by high levels of inequality, informality, and low spatial quality (Jaramillo et al., 2012). This paper reviews the accumulated evidence, in an attempt to develop an understanding of these opportunities, and also of ways in which the planning and deployment of BRT systems might be improved to achieve maximum social impact. A secondary focus is on the methodological approaches used to assess equity and poverty impacts; we identify measurement and evaluation issues that need further research. We also describe two new case studies on the distributional impacts of BRT systems in Johannesburg, South Africa, and Mexico City, Mexico, both of which make methodological advances.

Apart from the popularity of BRT worldwide, our interest in the equity impacts of this set of technologies is driven by three further factors. Firstly, BRT projects in developing countries are often explicitly positioned as being pro-poor, and their political acceptability is often premised on their position within a larger equity agenda. Perhaps the strongest exemplar of this approach is former Bogotá mayor Enrique Peñalosa, who noted that Bogotá's TransMilenio was "[t]he single project that we implemented that most contributed to improve quality of life and gave citizens confidence in a better future (Center for Latin American Studies, 2002). The World Bank, too, uses social equity as a motivation for financing BRT in many developing cities (Gilbert, 2008).

A second reason is that BRT consumes public funds (as do almost all urban transport projects). The construction of BRT infrastructure is typically highly subsidised, while even operational subsidies (either direct or hidden) are usually provided on an ongoing basis. The distributional impacts of this use of tax money are important. Thirdly, the characteristics of BRT as a concept inherently give it the potential to serve traditionally underserved populations better than most other mass transit modes. These characteristics include: (i) by focusing on speed improvement it can improve access for the spatially excluded; (ii) by being deliverable at a lower cost than for instance rail-based solutions, it stands a better chance of offering an affordable fare to users; and (iii) as a surface mode it can be better integrated with urban space and non-motorised transport (NMT) facilities, which particularly benefit the poor. In short, if BRT can't deliver pro-poor outcomes in cities of the developing world, it is hard to imagine what can. The key question is, though, do these outcomes actually materialise, and if not, why?

The paper is divided in the following sections: first, we sketch the background in terms of an emerging scholarly interest in equity and transport. We then provide a brief overview of empirical studies of the equity impacts of BRT internationally, focusing on both methodological and substantive findings. We add to this findings of two recent studies on the distributional impacts of BRT in South Africa and Mexico. Lastly, we draw conclusions and suggest topics for further research, both methodological and substantive.

EQUITY ON THE AGENDA

A common understanding of sustainability as a social goal states that it has three aspects: economic, environmental and social (Martens, 2006). Traditionally, the success of investments in urban infrastructure has been measured mainly in terms of economic performance. In other words, assessment of how well a piece of infrastructure performs refers only to established and measurable economic indicators such as times savings for the users of a given infrastructure unit. This narrow understanding of performance has been criticized in terms of sustainability because it does not account for environmental impacts and other externalities. In terms of social justice, it often serves a policy of predict-and-provide. An added difficulty is that the mathematical models and design tools to support the development of infrastructure projects might have in-built properties that have a negative impact in terms of social justice by valuing more positively the time-savings of mobile-wealthy citizens at the cost of the poor (Martens, 2006).

During the 1990s in the United States, a strong environmental justice agenda developed. However, environmental justice is a narrower concept than equity; it refers only to the distribution of positive and negative impacts among populations defined in terms of demographic characteristics such as race or income. Environmental justice is also a policy mandate. According to Executive Order 12898 from 1994, all federal investment decisions should benefit all social groups equally. Negative impacts should also be equally distributed (Pfeffer et al. 2002; Agyeman & Evans, 2003; Chakraborty, 2006).

In the United Kingdom, discussions have focused more on the promotion of accessibility in order to lessen social exclusion (Lucas, 2006). That is, rather than focusing on improving physical mobility, planners should aim to provide citizens with access to employment, health and other services, family and friends, and leisure activities.

More recently, there has been increasing interest in developing the discussion about how social justice can be considered when building infrastructure projects. There is no common agreement on what this means, nor how to measure it. Many authors define equity in terms of three dimensions (Litman, 2010). Horizontal equity refers to an egalitarian understanding and states that no one individual or social group should be favoured more than others. Vertical equality with respect to social class and income refers to the idea of differentiating resources according to purchasing capacity. Thus an individual or social group, which is at a disadvantage, should receive more opportunities and resources in a progressive system, but will be overburdened in a regressive system. A third dimension is to consider vertical equality with regards to transportation ability and need, which focuses more on individuals' physical ability and access to transportation modes, rather than on their socio-economic conditions.

Conceptually, perhaps the most sophisticated discussion has been developed by Karel Martens (2009). Martens proposes that transportation should be a separate distributional sphere, just like education and health in many countries. This means that transportation should not be considered as a normal economic activity subject to free market regulation. On the contrary, direct intervention from the state should be promoted in order to guarantee that transportation is also a sphere of activity where the worst off (the poor, the handicapped, the young, the elderly) are allocated more resources in order to level out their disadvantages in society, just as in many countries the education and the health systems have such a distributional role. More work, however, is needed to devise ways to measure how infrastructure and transportation projects could have a positive impact along these lines.

In parallel to conceptual development, there has been a growing interest in empirical measurement of the distributional impacts of transport across groups. In developing countries, some of this has been driven by the need to justify rail investments in terms of their positive impacts on the poor. For example, Barone and Rebelo (2003) examined how the construction of a 12,8 km long metro line in Sao Paulo promised to have a positive impact on 79% of the poor population in the city, by extending their access to jobs in the business areas of the city.

Similar work has been undertaken in other places, including Mumbai (Baker et al., 2005), Karachi (Soheil et al., 2000), Bogotá (Cervero, 2005), and Kenya and Tanzania (Howe, 2000). This work is typically a mixture of socio-economic analysis, travel demand analysis, and spatial-economic mapping. Ahmed et al. (2008) used data on demographic growth, land use, motorization, modal split development and investment in road development and public transport to trace how transportation projects and investment in infrastructure has impacted on the general socio-economic indicators of a city over a period of time. Focusing on Karachi in Pakistan and Beijing in China, they show how the bulk of public investment has favoured infrastructure for private motorized users and has made public transportation less affordable for the poor, creating cities with less equity now than 30 years ago. Additionally, they suggest that the infrastructure development in these cities has worsened the poor's accessibility to job opportunities, public services and even their relatives.

Despite these attempts at putting equity on the transport agenda in developing countries, Keeling (2008) noted that 'there is little empirical evidence to demonstrate the relationship between the provision of public transport and social transport needs.' The relationships between transport, accessibility, and poverty outcomes are as yet poorly understood. For this reason the small number of recent studies on the equity impacts of Bus Rapid Transit systems, triggered by the worldwide interest in BRT, has been particularly welcome. The next section summarises what has been learnt so far.

THE EQUITY IMPACTS OF BRT: RECENT APPROACHES AND FINDINGS

A rising number of empirical studies have started to analyse the equity impacts of operational Bus Rapid Transit systems in developing countries. This section provides a brief overview, both with a view to developing an understanding of the emerging evidence around the role of BRT as part of a strategy to improve the quality of life of the urban poor, and to investigating the frameworks and metrics used for analysis. Our focus is largely on vertical equity, i.e. the distribution of benefits and costs across socio-economic groups, with a particular focus on poor populations.

Travel time savings

Travel time savings can be a significant benefit to the poor, given that they typically face very long travel times due to a combination of poor location and limited access to high-speed modes. There is by now significant evidence that BRTs have the capacity to significantly reduce *average* passenger travel times through its combination of exclusive infrastructure and speed-enhancing technology (Deng and Nelson, 2013; Hidalgo and Gutiérrez, 2013). However one needs to assess travel time *by user segment* to determine the equity distribution of this benefit. Hidalgo and Yepes (2005) did this for Bogotá's TransMilenio Phase 1, and found higher travel time savings for poor people (18 minutes per trip) than for middle income users (10 minutes). Tiwari and Jain (2012) compared travel time savings on the Delhi BRT by mode, and found that cyclists save more time than bus users – both in the order of 33%. Although they did not focus specifically on income levels, they point out that in Delhi low income households are predominant users of NMT.

The evidence thus suggests that poor users may benefit significantly from travel time savings, either on BRT or on BRT-related NMT infrastructure. This would be particularly true for poor households in peripheral locations (thus with long travel times), especially if they live close to the trunk line. However Hook and Howe (2005) warn that BRT systems with closed trunk and feeder lines may raise travel times especially if they replace formerly direct bus services and require passengers to make lengthy transfers. Lleras (2003) found evidence of this in Bogotá: travel time savings came primarily from drops in in-vehicle travel time, while passengers who require one or more transfers actually experienced a two minute per trip *rise* in travel time due to increased waiting and transfer times.

Travel costs

Affordability is acknowledged as a key constraint to mobility among the urban poor, many of whom spend 20 to 30% of their household income on travel (Howe, 2000). It is often argued that, by improving efficiencies, BRT systems could bring public transport operating costs down and thus offer more affordable fares to users (Hook and Howe, 2005). There is indeed evidence of lower fares offered on BRT: in Jakarta, for instance, about half of users reported saving money when using Transjakarta (Hook and Howe, 2005). In Lagos, the fact that fares were formalised and not subject to hour-by-hour variation (as in the former unregulated bus system) brought cost savings to many passengers of the BRT 'Lite' (ITP, 2009).

Two practices associated with BRT systems allow them, at least theoretically, to target cost savings specifically at poor users. Firstly, many BRT systems charge according to a flat fare; overlaid with a spatial pattern in which many poor households are located on city peripheries, more well-off short-distance travellers end up cross-subsidising poorer longer-distance ones. Secondly, some systems like TransMilenio provide free (or reduced fare) feeder trips, again benefiting those located further away. Hidalgo and Yepes (2005) report total daily savings for passengers who would have paid two fares on the traditional system, in the order of 8%-12% of the average daily income of low income households in Bogotá.

However not all potential poor passengers benefit in this way. When compared to a *single* fare trip on the traditional bus system, Gilbert (2008) reports that the TransMilenio fare is still higher, disbenefiting those passengers who could previously take a single bus directly to their destination. This appears, anecdotally, to be the case in many BRT systems: the BRT is priced slightly higher than the old transport service, in line with its higher service standards.

Interestingly, the formal nature of the BRT could also cause a cost increase for some passengers. Kash and Hidalgo (2012) report that, in Bogotá's informal bus system, poor passengers often negotiate discount fares with drivers; this option is no longer available under TransMilenio's integrated (and automated) fare system.

Accessibility changes

Accessibility measurement goes beyond the measurement of direct travel time and cost savings to an acknowledgement that 'it is the *accessibility* that a transport system provides which is of fundamental importance to the extremely poor' (Howe, 2000:12). There has been a growing scholarly interest in devising measures to assess the accessibility impacts of transport interventions, and some of this has been applied to the assessment of BRT systems.

Earlier attempts consisted of mapping average travel time savings from origin to destination, against the location of job opportunities in the city. Hidalgo and Yepes (2005) used this technique to show that Transmilenio's (Phase 1) influence area is such that (i) some poor households on periphery benefit from travel time savings, and (ii) it enhances accessibility to high employment areas, including the Central Business District and Industrial Corridor of Bogotá.

More recently, Jaramillo et al. (2012) linked the impacts of BRT more directly to the concept of social exclusion, arguing that exclusion from public transport services has a direct link to poverty. They adapted a technique originally developed in Australia (Currie, 2004) to measure the extent of transport deprivation of a community, taking its locational, demographic, income characteristics as well as its access to public transport services into account. Applying this measure to the *Masivo Integrado de Occidente* (MIO) BRT system of Santiago de Cali (Colombia), they found that the BRT fails to improve access for many of the city's isolated and peripheral districts, which are also districts with higher levels of illiteracy, unemployment, and higher numbers of households from low socio-economic strata. The central districts, by contrast, show absolute overprovision, with public transport services of greater capacity and regularity. MIO is still under development; its initial phase covers only 9% of city districts.

Where Jaramillo et al. (2012) thought only in terms of access *to* the BRT, Delmelle and Casas (2012) added the dimension of the spatial access to potential destinations across the city, and also applied this to Cali, Colombia. Both dimensions are needed for households to experience significant accessibility benefits of a system enhancement. Access to the BRT was measured by counting the population (by socio-economic stratum) living within certain walking time bands of BRT stations, and access to activities using a gravity-type index that incorporated both door-to-door travel time, and the locations of activities. Their findings mirrored those of Jaramillo et al. (2012). While MIO significantly enhances accessibility in the city -- an estimated 83% of the population is within a 15 minute walk of a MIO station – this is skewed in favour of the middle and upper-middle strata, as these neighbourhoods are most centrally located where transit access is better. Poorest neighbourhoods face the second lowest percentage of population covered at approximately 75%, due in large part to their poor location on hillsides where buses cannot operate. However, lower strata populations have equally good access to some types of amenities (such as recreation sites), due to an even spread of these sites across the city, leading the authors to conclude that 'the location of facilities seems to be a greater driver of access patterns than transport alone'.

Bocarejo and Oviedo (2012) took a similar approach to measuring accessibility, but incorporated both travel time and travel cost into their gravity-type index. This reflects an understanding of *affordability* as a key dimension of access. Applying the measure to Bogotá's TransMilenio Phase 3, the authors found that passengers from poor areas would, naturally, be negatively affected by a planned 15% fare increase, but that the increase in speed would more than offset the accessibility loss from higher fares.

Tiwari and Jain (2012) took a simpler approach to measuring the accessibility benefits of the Delhi BRT, by calculating the number of destinations (by type) that are within reach of different types of road users, and the number and type of users for whom this metric has increased (compared to the pre-BRT situation). They show that, if the entire stretch of the corridor is used, accessibility to opportunities increases by 120% for bicycle users and 730% for people who walk to and from the bus on the BRT corridor. Interestingly, people using only cycles benefited most from using the corridor in terms of increased number of opportunities in reach, as cyclists save more time than bus users on the corridor. Tiwari and Jain's (2012) contribution was specifically to focus the attention on the fact that it is not just bus users, but also low-income NMT users who may experience significant accessibility benefits from a BRT project.

While encouraging, these results suffer from a common problem of accessibility studies, namely a failure to demonstrate the *outcome* of enhanced accessibility for households. *Can* the poor actually make use of this enhanced access; *do* they find better or higher-paying jobs, or access better health care, education opportunities, or social networks? There is a need for further research using purposely designed before-after studies, to better understand these impacts.

Property impacts

A few hedonic price studies have been undertaken to assess the effect of BRT trunk line development on property prices in Bogotá (Rodriguez and Targa, 2004; Muñoz-Raskin, 2010). The results show positive trends in land prices in areas that are within walking distance of TransMilenio stations. There are however variations in the results depending on socioeconomic class: impacts are positive for middle-class owners and renters, but negative for lower income and upper-class categories. There is thus evidence pointing to lower-income households being priced out of accessible housing located close to BRT stations and routes.

However the programmatic nature of BRT deployment also creates new opportunities for leveraging low income housing development linked to future BRT services. An example is Bogotá's Metrovivienda land banking initiative, in terms of which the municipality buys land located close to future TransMilenio trunk routes before their values start rising, and then regulate the development and reselling of these properties to be affordable to the poor (Cervero, 2005). Price reductions of 25% below market rates have been reported (Hook & Howe, 2005).

Job creation

Despite Howe's contention that, as a basic need of the urban poor, 'employment is so crucial that there is an argument for regarding it as a *direct* rather than indirect approach to poverty alleviation,' (Howe, 2000:10), surprisingly little research has been conducted on this the job creation impacts of BRT projects. Hidalgo et al. (2013) report that the employment balance due to the implementation of TransMilenio is positive despite the elimination of traditional buses: a net figure of between 1900 and 2900 permanent jobs in operations, plus 1400 to 1800 jobs per month in construction. However they point out that the precise number is highly uncertainty, as it depends on assumptions on the employment in the informal transport and construction industries.

Wright and Montezuma (2004) also reported positive job impacts associated with informal vending during Bogotá's weekly street closures, named *Ciclovia*.

Job creation is more likely to be achieved where overt policies exist to that effect, as in the case of Johannesburg, South Africa, where government adopted a specific objective during the formalisation of informal minibus operations into a BRT operating company, that no legitimate jobs would be lost in the process (Venter, 2013).

Road user safety

BRT is widely held to improve road safety on and around trunk corridors. Estimates of road safety improvements associated with BRT deployments of around an 88% reduction in traffic fatalities has been reported in the Transmilenio corridor (Hidalgo and Yepes, 2005; Hidalgo et al. 2012; Echeverry et al., 2005). A large part of the decline was in pedestrian deaths. Although no socio-economic breakdown is offered, most pedestrian and cyclist victims of traffic accidents are poor.

Tiwari and Jain (2012) argued for the need, when analysing BRT impacts, to use indicators that capture the risks of accidents to different types of users, not only vehicles. They estimated the impacts of the Delhi BRT on accident risk for cyclists and pedestrians, showing that risk has been reduced to near-zero for cyclists and bus users, but that pedestrians are still at risk from motor vehicles. Once again, given the high usage of NMT modes among poor travellers, the equity benefits are likely substantial.

Health impacts

The re-organisation of a chaotic informal bus or paratransit industry into a more efficient BRT scheme, including the scrapping of old vehicles and replacement by modern low-emission ones, has often been associated with significant improvements in air quality. Hidalgo et al. (2013) report savings in health costs due to reductions in emissions from TransMilenio's first two phases in the order of $114 million over a twenty-year period. Unfortunately no particular analysis is offered of the distribution of these benefits across socio-economic strata.

However there are questions as to the overall equity impacts of air quality benefits associated with BRT, especially during early stages of its deployment when the BRT is but a small fraction of a city's transport. In Bogotá, for instance, Hidalgo and Yepes reported that in 2005 the Phase 1 Transmilenio had an as-yet negligible effect on overall pollutant levels in the city, 5 years after it opened. More worryingly, Echeverry et al. (2005) found that air pollution levels rose in other parts of Bogotá, which they partly blamed on the displacement of old buses from the BRT corridors to unserved areas. The possibility exists that air pollution costs might be displaced towards poorer parts of cities, if the rest of the transport system is poorly regulated.

Ridership – benefits for whom?

The question of whether the benefits of time and cost savings, accessibility and safety enhancements accrue to lower socio-economic groups can partly be answered by examining the characteristics of BRT users. As can be expected, the number of poor users will vary from system to system according to local income distributions. Deng & Nelson (2013) report that almost 80% of passengers on Beijing's BRT Line 1 are from low income and lower middle groups; yet, in Cape Town, South Africa, the first BRT route is being criticised for carrying mostly middle to higher income passengers through whose backyards the trunk line runs (Molefe, 2012).

A more pertinent question might be whether poor users who have the opportunity to use the BRT, choose to use it. Several studies have compared the share of poor passengers on BRTs with the share of poor residents in the area, and found them to be underrepresented. Hidalgo and Yepes (2005) reported that for TransMilenio in 2003, 37% of passengers came from the two poorest strata of the city, but these strata represented 44% of all citizens. Furthermore, 24% of travel time savings accrued to the lowest two income levels. Since their share of passengers was 37%, the average saving per passenger was lower than for middle income users. In Lagos, Nigeria – a city with high poverty -- the BRT 'Lite' system carries overwhelmingly more passengers in blue collar, clerical, and self-employed job categories than in unemployed or informal sector categories (ITP, 2009).

It is incorrect to interpret such findings as necessarily a failure of the BRT to serve poor passengers. Poor households tend to travel less overall, due to opportunity and resource constraints, and so would be underrepresented on all motorised transport modes.

However, Alan Gilbert, in a wide-ranging assessment of the extent to which TransMilenio, as a governance intervention, has brought benefits to the poor of Bogotá, concludes that '[w]hat is less certain is how much Transmilenio has so far helped the poor' (Gilbert, 2008:458). The reasons he gives for this are that, while the poor make up the bulk of passengers, it is used most intensively by middle income users, due to a combination of route coverage (Phase 1 missed most of the poor areas) and fares being more expensive than in the traditional system.

Overall socio-economic impacts

Several authors have undertaken social cost-benefit analyses in an attempt to comprehensively account for the socio-economic impacts of BRT system implementation. Most recently, Hidalgo et al. (2013) reported on an assessment of TransMilenio's Phase 1 and 2, taking travel time benefits, reduced vehicle operating costs, reduced accident costs, health benefits due to air pollution improvements, and all system costs into account. They found an overall benefit/cost ratio of 2.5, and a social internal rate of return of 24.2%. The authors also tested the sensitivity of the results to variations in the underlying assumptions, and found the overall findings to be robust. Unfortunately no breakdown by socio-economic group is provided to assess the distribution of these net benefits.

These findings are in contrast to those of an earlier study by Echeverry et al. (2005), who found (using different data sources and assumptions) the citywide net effect of TransMilenio (Phase 1) to be negative, mainly due to the displacement of congestion and air pollution costs away from the trunk corridor into other areas of the city. This is a serious finding from an equity point of view: it implies that the BRT reform was regressive, as those who benefited included a higher proportion of wealthy people than those who lost (users of the traditional system). However, this evaluation has been criticized due to methodological errors and faulty information sources (Hidalgo et al., 2013).

What these conflicting findings indicate, perhaps more than anything else, is that the distributional impacts of BRT are contested, and that a careful accounting of all costs and benefits are needed across the entire influence area to arrive at a full picture of equity.

NEW CASE STUDIES: JOHANNESBURG AND MEXICO CITY

This section offers two case studies of recent analyses of the distributional impacts of new BRT deployments. They offer further insights into the effects of BRT on the poor, while extending current methodologies in two directions. The first study, from Johannesburg, South Africa, demonstrates the application of a retrospective household survey to control for the effects of differential trip rates on BRT usage. The second, from Mexico City, extends benefit/cost analysis to look at the distributional impacts on individual strata of the population.

Distributional Impacts of BRT in Johannesburg, South Africa

Johannesburg's first 26km-long BRT line extends from the CBD south-westwards to the large residential area of Soweto. Named 'Rea Vaya' (We are Going), it consists of a trunk line served by feeder and complementary routes extending into neighbourhoods. The income profile of the served areas is mixed, ranging from upper-middle income households to very low income people living in shacks.

A small-scale assessment of the passenger impacts of the BRT was undertaken in 2011 to assess its distributional impacts (Vaz and Venter, 2012), with a specific focus on impacts on lower income household. The study also added perception/satisfaction questions to add an urban identity dimension to the study.

Travel time and cost changes

Travel time and cost benefits of the BRT were determined while controlling for the origins and destinations served, to ensure benefits are correctly ascribed to the BRT rather than to different travel distances on different modes. Rea Vaya users save on average between 10% and 20% of their travel time, compared to their previous mode to the same destination.

Travel cost savings are less impressive. Rea Vaya passengers pay on average 13% less for their trips than users of other public transport services, but this is partly due to the longer travel distances of BRT users (the flat fare structure promotes longer distance trips). Controlling for destination, the fare saving by BRT is an insignificant 2% per trip.

Accessibility changes

Regarding changes in accessibility, key findings are that:

- Rea Vaya does not significantly alter the spatial access profile of low-income households in Soweto, either within the neighbourhood or to jobs in the larger city. The BRT trunk follows a major corridor also served by other public transport modes (including minibus-taxi and commuter rail), and the single line is yet to be extended to other non-central areas in the city.

- By offering higher off-peak and weekend frequencies, Rea Vaya has significantly improved temporal access to opportunities. This is an aspect often overlooked in studies of BRT benefits. Whereas conventional modes typically serve profitable peak-hour trips to work, the BRT provides all-day service to a variety of destinations. This is evidenced by the variety of trip purposes served, including education (28% of trips), shopping (16%), and even small amounts of trips to look for employment.

Distribution of benefits

The distribution of benefits was examined by comparing the income distribution of BRT-using households with that of all households (Figure 1). Clearly persons living in households earning less than R2500 per month are under-represented on Rea Vaya. By far the majority of BRT users are in the mid-income range of R2500 to R8000 per month, skewing the distribution of benefits in favour of medium-income rather than lower-income users.

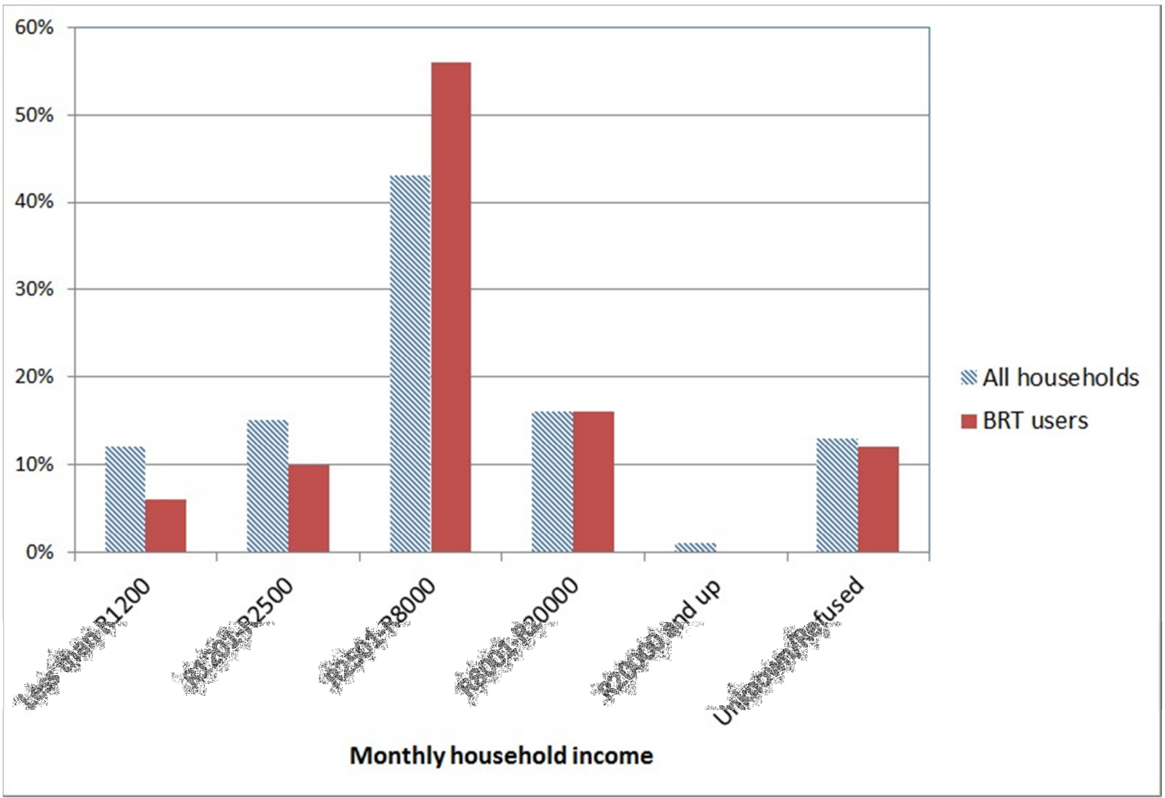


Figure 1 – Income distribution of BRT-using versus all households, Johannesburg

(Source: Vaz and Venter, 2012)

One explanation that can account for this is that lower-income persons are simply less mobile – including more unemployed or retired persons, for instance – and are therefore less likely to travel at all; they would thus be underrepresented on all transport modes. To test for this, the above calculation was repeated but only for mobile households – households with either workers or scholars using public transport on a daily basis. The results were substantially the same: even among mobile households, Rea Vaya is relatively less popular among lower income groups. Since the sample was taken among households within one residential area, this result cannot be attributable (as was partially the case with the TransMilenio results discussed above) to the fact that the BRT route is more accessible to medium-income households in the sample.

A more likely explanation is that the pricing of BRT is not progressive enough to attract the poorest travellers. Rea Vaya fares are higher than those of the highly subsidised commuter rail (when using a weekly or monthly pass), while serving many of the same destinations as the rail. It seems that the lowest income users are not willing to pay for the faster and more reliable service offered by the BRT.

Community perceptions

To examine the impact of the BRT-related upgrading of the urban environment on the community's quality of life and general satisfaction, people were asked for their general satisfaction with living in the area. Table 1 shows the results are markedly different for different socio-economic groups. Households living in formal housing are generally satisfied, and this is regardless of whether they benefit directly from the BRT or not. Households in informal housing (shacks and backyard structures) are overwhelmingly unsatisfied – a reflection perhaps of the hardships of living in poor housing conditions – but markedly less so if they use Rea Vaya. This points towards larger spin-off effects of BRT investment, in terms of community perceptions.

Table 1 – Satisfaction with area (n=150 households)

Housing type	Percentage of households satisfied with living in this area	
	BRT-using households	Non-BRT-using households
Formal house	78%	80%
Informal house	20%	8%

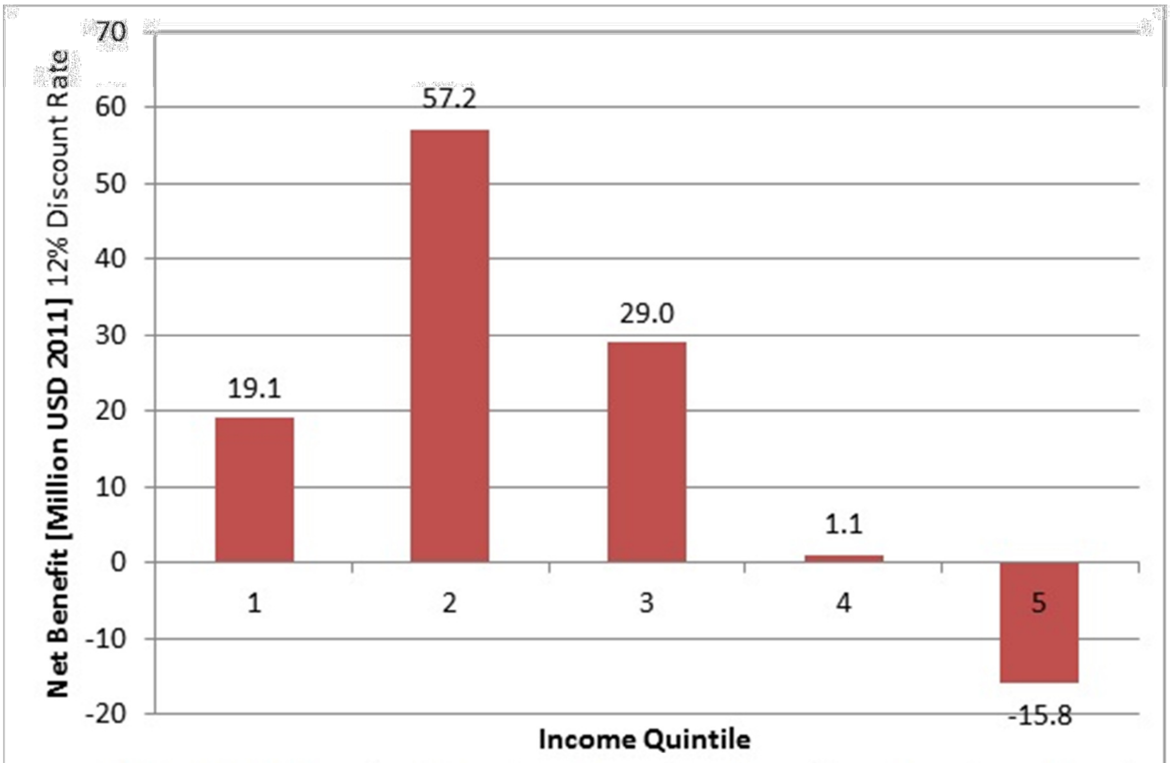
Distributional Impacts of BRT in Mexico City

BRT is a recent addition to the mass transit options in México City, and has seen a rapid expansion. The first Metrobús BRT line started operation in June 2005 on Insurgentes Avenue (16 km). Between 2005 and 2012, the city implemented 4 lines with a total length of 95km serving 800,000 passengers per workday (Metrobus, 2013). An evaluation by the National Institute of Ecology (INE, 2008) indicated that the initial corridor in Insurgentes Avenue was beneficial to society as a whole using standard cost-benefit analysis. The initial 16km yielded a net present value of $12.3 million U.S. dollars, using a discount rate of 7%, with robust results to changes in underlying assumptions. In this evaluation the biggest benefits result from reductions in air pollution, travel costs and travel times.

With an interest in exploring the distributional impacts of BRT in the Mexico City context, Delgado and Uniman (2011) developed a new methodology which they applied to Metrobus Line 3 – a 17km BRT corridor moving 140,000 passengers per day, implemented in February 2011 (Metrobus, 2013). The methodology is an extension of standard cost-benefit analysis, measuring impacts to different income quintiles. It requires careful assignment of costs and benefits to each income group using the actual usage of the BRT corridor and the burden of taxation for different income groups, among other factors.

The standard cost-benefit analysis indicates that the Metrobus Line 3 BRT corridor is beneficial to society as a whole – net present value was estimated at 90.6 USD million using a 12% discount rate, with a benefit/cost ratio of 1.54. The distributional analysis indicates that the BRT corridor is progressive: 42% costs are concentrated in quintiles 4-5 and 78% of the benefits are perceived by quintiles 1-3. The benefit/cost ratio is greater than one for quintiles 1-4, but less than one for quintile 5 (Figure 2). This result – progressive distribution – holds for variations in the mechanism to assign costs and benefits.

In this analysis it is important to indicate that the lowest quintile receives less net benefits than the second and third quintiles. This may be caused by price exclusion – fares for very low income populations represent a very large proportion of their income – or by lack of coverage – the BRT corridor does not serve very low income areas.



Income Quintile	1	2	3	4	5
[USD/month]	0-362	362-603	603-1205	1205-2410	2410+
B/C	1,62	2,76	1,88	1,03	0,6

Figure 2 – Results of Distributional Analysis for Metrobus BRT Line 3 in Mexico City
(Source: Delgado and Uniman (2011))

CONCLUSIONS

Bus Rapid Transit systems are growing very fast worldwide, and are particularly suited to deployment in developing countries due to their lower construction costs, shorter times for construction, and lower technological hurdles as compared to other technologies. That fact also positions BRT systems ideally to help promote social justice, poverty reduction, and equity among urban populations. There appears to be a growing interest, both among scholars and funding agencies, in documenting and understanding the equity impacts of BRT (and also other urban transport projects), as evidenced by the growing number of empirical studies on this topic. Nevertheless there is still a large knowledge gap, and a significant need for more attention to be paid to social sustainability and equity in public transport studies.

One of the areas in need of attention is the development of better methodologies for defining, conceptualising, measuring, and comparing equity in a consistent and transferable manner. It seems a lot more work is needed before a common set of equity or distributional indicators can emerge, similar to those that have been adopted for Clean Development Mechanism funding. Methodologies in use in economics and the social sciences, such as properly designed before-after studies and the use of control groups, might prove useful. Accessibility measurement offers promise as a way of capturing the true benefits of access-enhancing projects in terms of enlarging the spatial envelope within which poor households can pursue livelihoods. Yet, despite being around for several decades already, there appears to be little convergence of techniques and approaches. Empirical work is needed on the linkages between theoretical accessibility measures that reflect ‘opportunity’, and the actual outcomes that households experience that improve the quality of their lives. For instance, can we demonstrate that BRT-enhanced accessibility leads to higher trip rates, higher participation in the economy, or higher quality of life? Once such linkages are better understood, BRT systems can be better targeted to achieve the poverty outcomes sought by governments and funders.

When BRT systems are evaluated there is a need for greater disaggregation of user groups, to allow comparison across socio-economic strata (and other groups of interest such as women, children or disabled users). For instance, health and traffic safety benefits are typically reported in the aggregate rather than by group. This recommendation has implications for better data collection and analysis procedures.

Regarding the empirical evidence about how beneficial BRT systems, as they are currently deployed, are to the poorest members of society, the weight of the evidence indicates that BRT systems do offer significant real benefits to lower-income users in many developing countries. Demonstrated benefits include increased accessibility to opportunities, travel time and cost savings, health and safety benefits, and increased community satisfaction. However, the benefits do not seem to go as widely as they might, and are in many cases concentrated among the higher strata of the poor (or the lower strata of the middle-income), bypassing the poorest who arguably suffer most from exclusion-based poverty. Two reasons emerge for this: lack of coverage, and pricing.

Many of the BRT systems reviewed in this paper deployed their first trunk services along central parts of the city, skirting more peripheral areas where the poor tend to live. Where peripheral areas are connected with the trunk route through feeder services, much of the benefit in terms of travel time, directness, and travel cost are often lost. There seems to be a need to extend the coverage of trunk services more directly into peripheral, low-income areas, despite the physical challenges this may entail.

In fact, many BRT systems are currently building further phases aimed at exactly such extensions. This raises the issue of gradual achievement of benefits for the poor: many benefits are due to network effects, which grow significantly only once a network is in place. Another way of looking at this is to acknowledge what Echeverry et al. (2005) call ‘spillover effects’ in the early stages of deployment, due to the simultaneous existence of the BRT with a weakly regulated, poorly operated traditional system. Such a situation can impose substantial negative impacts on the rest of city, much of which may fall on peripherally located poorer communities. This raises the importance of taking a comprehensive approach to the reforming of public transport, and considering mitigation of negative spill-over effects. It also cautions against drawing conclusions around the desirability of BRT too early, before its full benefits can be realised.

Another aspect of the potential ‘coverage mismatch’ of BRT systems with the needs of the poor relates to its inherent logic as a heavily corridor-oriented strategy. The economics of BRT depend on the alignment of a trunk along routes with higher passenger movement, thus tending to be heavily radially oriented. In many developing cities the increasing importance of informal sector activities creates a greater need for irregular or circumferential movements associated with hawking, trading or employment-seeking (Howe, 2000). In many ways the popular ‘closed’ BRT system is not ideally suited to serving the different travel needs of the poor. Further thinking is needed on how the advantages of BRT can be married with flexible, open transport services to serve a variety of travel needs conveniently and affordably.

A second concern is that BRT seems, by and large, to be priced slightly higher than competing lower-quality services (often informal or unregulated). Affordability constraints might put it out of reach of the poorest users, despite pro-poor fare structures and free transfers. Pricing is a difficult matter to resolve, being dependent on the financial capacity, political environment, and cost drivers in individual cities, but it is important that BRT planners are aware of the fact that fare policies have a major influence on the equity impacts of their service.

It is also important to note that not all beneficiaries of BRT are bus users. Bikeway and pedestrian improvements are commonly associated with BRT projects; these are widely considered to serve especially the poor who can access it. More widely, where BRT projects entail precinct upgrading and the provision of urban amenities, the poor may benefit from a reclamation of urban space (Wright and Montezuma, 2004).

Lastly, BRT systems pull together and connect parts of the city in ways which the informal systems don’t, especially at the level of urban identity, level of service and spatial coherence. The most daring BRT designs also allocate more space to public transport at the cost of space for private motorized mobility. We still need to develop conceptual tools and methods to assess the long term impacts of such interventions on rates of motorization and the spatial development path of cities, and whether they become more inclusive and accessible or not.

In summary, we conclude that while Bus Rapid Transit, as a concept, offers significant opportunities for enhancing social justice and poverty alleviation, these outcomes should not be taken for granted: they only occur under specific, well-thought through conditions.

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