Cities that Work

IGC International Growth Centre

POLICY BRIEF

Urban mobility: policy decisions for connecting the city

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This brief explores key trade-offs policymakers face in improving systems of urban mobility. Drawing on cross-city experience, it looks at addressing rising demands for private transport, options for formalising existing transport systems, and trade-offs policymakers face in investing in high capacity public transit.

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Connecting the city

Cities drive growth because of their ability to bring people together in a way that allows for large scale and specialised production. With a large pool of connected individuals, workers can develop expertise in particular tasks and be matched to jobs that are most suited to them over time. At the same time, firms can specialise to meet the specific demands of consumers. **Urban mobility is at the heart of this dynamic process, determining a city's potential for productivity and liveability.**

In many developing cities, connectivity is undermined by limited infrastructure and weak public transport systems. Road space, for example, makes up only 10 percent of land use in African cities – roughly a third of international recommendations. The result is limited access to jobs and services, particularly from suburbs, and crippling congestion. If people and goods are unable to move easily across a city, firms get locked into small-scale unproductive activities, and people cannot access basic goods and services. In Mumbai, for example, more than 60% of commuters walk to their jobs.

Policymakers face difficult trade-offs in improving systems of mobility, both in addressing growing demands for private transport, and in investing in public transport links in a city. Learning from the experiences of cities across the world facing these challenges offers some key lessons for effective infrastructure investment and smart regulation to meet growing demands for transport.

1 **Building roads is not enough.**
Maintenance is key to meeting mobility needs in a city. At the same time, infrastructure investment alone is unlikely to solve severe problems of congestion in developing cities. Evidence from US cities suggests that as incomes and populations rise, vehicle use will rise to fill new roads. Putting a price on road use – particularly on new roads – can help to raise funds whilst managing demand for cars.

2 **Existing informal transport is a complement, not a substitute, for higher capacity systems.**
Even as governments invest in higher capacity transport modes, investment in existing systems will allow them to continue to provide essential feeder services from low density areas.

3 **Bus rapid transit systems can alleviate congestion problems at a fraction of the cost of rail based systems.**
Rail based systems have significant advantages in terms of their relative limited land use and environmental sustainability - but it is only at very high levels of urban density that investing in rail makes sense in terms of cost effectiveness.

4 **Link transport investments with land use in a city.**
Urban density is a crucial determinant both of the desirability and financial sustainability of transport systems.

How can policymakers address growing demands for private transport?

Paved roads and pavements in Kigali, Rwanda. Photo credit: Dylan Walters/flickr..

Making the most of infrastructure investment

In many developing cities, commuting is largely by foot, bicycle, motorbike and car. Meeting growing demand for these private means of transport requires further investment in infrastructure, which includes:

— **Investment in roads.** This allows for the movement of cars and buses over long distances and at high speeds, crucial for urban connectivity. The density of paved roads in countries in sub-Saharan Africa is less than a quarter of that in other low-income countries[i]; without addressing these deficits, access to opportunities across a city are limited. Initial results from a study of 154 cities in India suggest that around 70% of differences in car speeds in a city are the result of the extent and quality of infrastructure, not of traffic congestion[ii].

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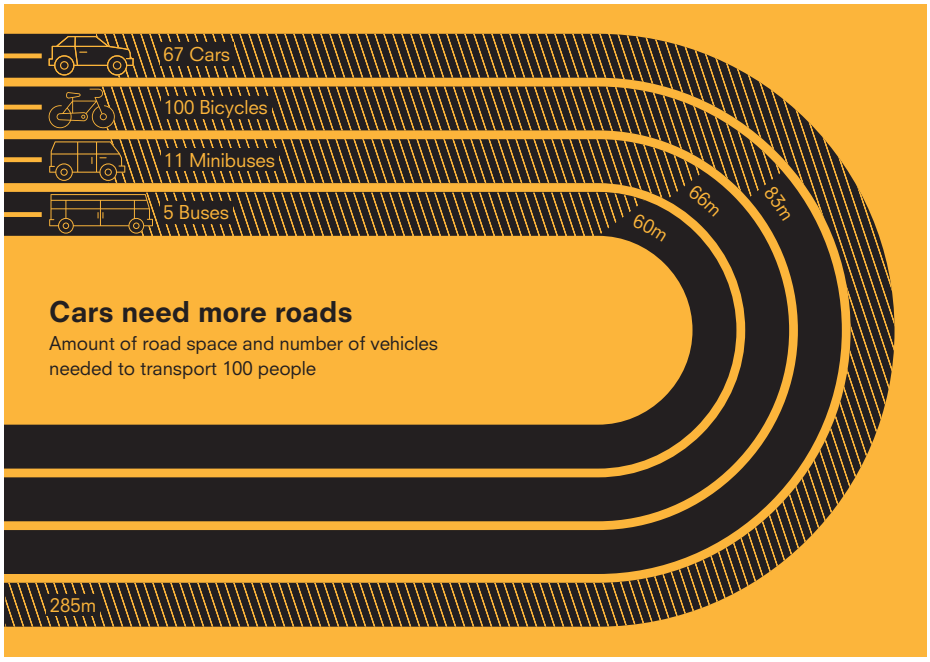
— **Complementary infrastructure for non-motorised forms of transport.** This offers low-emission, low cost access across shorter distances that is safer for pedestrians and cyclists. Non-motorised infrastructure also comes at relatively low costs; estimates suggest that a pedestrian walkway that can accommodate 4,500 people/hour/direction costs approximately USD$100,000/kilometer. This is up to 50 times less costly than an urban road with a fifth of this capacity[iii].

Investing in infrastructure isn't just about construction – by making smart investments in **maintenance**, governments can prevent costly capital investments from going to waste, and reduce costs of vehicle maintenance to users[iv]. Evidence from infrastructure projects by multilateral institutions suggests that rates of return on road maintenance investments are significantly above – in some cases almost double – those on construction projects[1,v].

A kilometer of pedestrian walkway can accommodate 4,500 people/hour/direction at USD$100,000 - up to 50 times less costly than an urban road with a fifth of this capacity

1 Maintenance of roads may also be higher when roads are delivered through public-private partnerships, as private firms are likely to be better incentivised to maintain infrastructure so that they can maintain revenues (either through user fees and/or government transfers conditional on road quality).

The more cars, the more road needed: amount of road space and number of vehicles needed to carry 100 people



Note: Figures calculated assuming 1.5 passengers/car, 65% occupancy for 14-seater buses, and 40% occupancy for 50 seater buses (based on global urban estimates of average occupancy for these vehicle types)

However, though investing in roads is necessary for high speed connectivity across a city, it is not sufficient:

— Construction of roads take time and come at a significant cost (approximately $1.5 million per kilometre for two-lane concrete highways[2]). Given this high cost and limited land space for roads in many cities, policies aimed instead at encouraging **shared transport modes** that use less road space may be a more cost effective way of improving mobility.

— At the same time, as incomes rise, evidence from US cities suggests that there may be a **fundamental law of highway traffic**. Even if roads can be expanded, allowing for a higher *volume* of travel, this won't fix a city's congestion problem. More roads induce more people to travel by car, eventually leading to the same level of traffic[v].

As such, further policy is needed to manage demand for private transport in favour of higher capacity transport systems.

2 Figure based on data from the World Bank, 'Road Cost Knowledge System' (World Bank, 2006). The average cost of producing a two-lane concrete highway measured in 2000US$ is $1.02 million. This has been adjusted for inflation to 2017 using average consumer price inflation rates from Brazil, Chile, Uganda, India, Thailand, Philippines and Bangladesh.

Prices or quotas? What kind of regulations are best suited to reduce congestion?

There are two ways in which policymakers can incentivise citizens to switch to public transport use:

1. Putting an additional price on private transport. This can be done by imposing a quota on car ownership and allowing users to bid over user-rights. This can also be done through congestion charges and parking fees that impose an additional cost on driving on urban roads.

2. Quantity restrictions on vehicle ownership or usage. This can include vehicle license restrictions, high occupancy vehicle restrictions that regulate the number of people in a car, and 'odd-even' policies that only permit certain vehicles on particular days.

Though both types of restrictions have proved effective at limiting congestion across cities, financial restrictions have significant advantages. By allowing people to pay to use their vehicles, user-rights are efficiently allocated to those who are most willing to pay. Additional fees on cars also raise revenues for governments, enabling a win-win situation where restrictions on private use can be used to fund maintenance of existing infrastructure and public transportation systems. Revenues from private vehicle auctioning in Shanghai, for example, were approximately USD$700 million in 2011 - roughly enough to cover the cost of all public subsidies for public transport systems in 2012[vi].

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At the same time, the impact of quantity restrictions that limit vehicle use at particular times or on particular days (rather than limiting the quantity of vehicles directly) is less clear. While evidence from a number of cities suggests that these policies can reduce congestion and increase public transport use in the short run[vii], evidence on their long run impact is mixed. Whilst in cities such as Quito these restrictions have been able to effectively reduce vehicle flows at peak hours over the long run, in many cases, permanent vehicle use restrictions have had limited impact in reducing vehicle use or air pollution[viii]. In some cities, evidence suggests that these types of quantity restrictions on vehicle use are circumvented by drivers buying additional (often higher polluting) vehicles[ix].

While congestion pricing systems in London or Stockholm involve costly and complex technology to track and fine car usage, this doesn't have to be the case. In Singapore in 1975, a low-cost paper license system was introduced to restrict car usage in the downtown area during rush hour. Colour coded tickets made enforcement of this system easy to implement. Now digitalised, this system is able to variably price roads depending on traffic levels to manage transport flows. In this way, restrictions on private cars can be implemented even where enforcement capacity is low and upgraded over time. Putting a price on the use of roads as soon as they are constructed can help to establish these fees as the legitimate price for road use.

In Oslo, resistance to the introduction of a toll charge in 1990 was overcome by use 20% of revenues from toll charges for public transport investment

Key to successful reforms to restrict private transport is public consultation to highlight benefits of these policies and address concerns, and investment in public transport alternatives to ensure continued mobility in a city. In Oslo, resistance to the introduction of a toll charge in 1990 was overcome by use 20% of revenues from toll charges for public transport investment.

Working with informal transport

In many developing cities, informal, low-medium capacity vehicles such as minibuses, taxis and motorbikes form the dominant means of public transport. These systems provide an essential means of mobility, offering in many cases better and more reliable services than existing formal transport systems – as well as a significant source of employment in many cities.

WHY ARE INFORMAL, LOW CAPACITY VEHICLES SO COMMON IN DEVELOPING CITIES?

Because of their relatively smaller size when compared to high capacity buses, minibuses, taxis and motorbikes are relatively cheap to invest in; a 14-seater minibus in Nairobi, for example, costs almost 4 times less than a 35-seater bus[x]. These lower costs mean private operators can profitably supply these services in greater quantity and at lower fares. These vehicles can also travel almost anywhere where (even low quality) roads exist, and as such, are likely to be able to get commuters closer to their destinations.

In turn, the dominance of low capacity minibuses and cars on roads increases congestion and reduces profitability of higher capacity buses. Limited government investment in higher capacity transport to capture the public benefits of reduced congestion means that the quantity and quality of these services remains low – and so does ridership.

At the same time, regulations to control public transport vehicle licenses and route operations often limit profitability of formal provision. As such, these transport services often lack some of the necessary permits for operating legally.

Despite their importance, informal low capacity services present significant challenges for long term mobility in a city. In an effort to cut costs and improve profitability in highly competitive markets, informal vehicles are often **poorly maintained, overcrowded and unsafe**. Reckless driving means that in cities such as Douala, two-thirds of moto-taxi drivers have been victims of traffic accidents[xi]. At the same time, as these vehicles are at best medium-capacity, large numbers of vehicles are required to provide mass transport. This, combined with their irregular stops, mean that these vehicles contribute significantly to **traffic congestion** in city centres.

Replacement or improvement: what is the role of policy?

In many developing cities, policymakers have attempted to overcome the challenges of informal transport services by banning their operations and replacing them with formal transport services. This has had limited success, given the difficult of enforcing regulation on politically influential operators. Instead, these transport systems can offer complementary services to higher

capacity transport, serving low density areas where congestion is lower and demand is too low to cover enough of the costs of high capacity transport. As such, policy can improve existing informal systems by:

Regulation to improve the quality of vehicles and services such as health and safety regulations and regulations on bus stops can be beneficial to consumers if suppliers are able and willing to comply with these. Effective regulation to improve safety of semi-formal transport has yielded significant benefits in a number of cities.

As passenger volumes rise above around 5,000 in each direction per hour, high capacity buses can become more cost effective when accounting for commuters' time otherwise wasted in waiting for transport

CASE STUDY: REGULATION, FORMALISATION AND INTEGRATION OF MINIBUSES IN ISTANBUL

In Istanbul, legal status was granted to *dolmus* seven-seaters in 1954, allowing these vehicles to become increasingly organised and integrated into the formal transport network through regulation of routes, schedules, fares and vehicles. Larger capacity minibuses have been added to the fleet and by the 1970s these paratransit services accounted for almost 50 percent of public transport in the city. The city now has plans to include *dolmus* minibuses in the existing contactless smart card payment system that applies to other forms of public transport including high capacity buses and the Istanbul light rail system.

Working with citizens to enforce regulations can significantly reduce monitoring costs of enforcement. In Kenya, over 1000 *matatu* minibuses were randomly selected to have stickers placed on them that encouraged passengers to report when drivers were driving dangerously. As a result, insurance claims that involved death or injury from drivers targeted by the scheme fell by over 50[xii].

— **Regulating quantity in particular areas of a city.** As passenger volumes rise above around 5,000 in each direction per hour, high capacity buses can become more cost effective when accounting for commuters' time otherwise wasted in waiting for transport[xiii]. In many cities, attempts to introduce higher capacity systems have failed because these systems are undercut by informal minibuses and motorbikes. Under these circumstances, restrictions on medium-capacity services on particular lanes can have significant public benefits.

Without additional public or private funding, any attempt to improve quality of services is liable to come at the cost of affordability, and any attempt to cap fares is liable to be met with a deterioration in the quantity or quality of services

However, it is important to note that the benefits of imposing safety or other quality regulations are by no means guaranteed. Without additional public or private funding, any attempt to improve quality of services is liable to come at the cost of affordability, and any attempt to cap fares is liable to be met with a deterioration in the quantity or quality of services. At the same time, efforts to regulate the quantity of providers in particular areas often face strong resistance from existing providers.

Successful experiences from a number of cities suggest that in many cases, the best way for governments to overcome both of these challenges is to work

with informal providers to combine regulation with finance, or access to private finance, to maintain and improve vehicles. Expanding access to new vehicles, credit and training to collectives of informal private operators in Dakar, Senegal, has allowed for renovation and route regulation of around a fifth of minibuses in the city between 2005-2008[21]. In Lagos, Nigeria and Accra, Ghana, governments provided the finance or financial guarantees that allowed existing informal vehicle owners to form cooperatives and jointly invest in higher capacity buses. To ensure these high capacity buses were financially sustainable, financial support was combined with regulation to enforce exclusive use of particular routes. Public transport needs were met and congestion was reduced while maintaining crucial political support for the introduction of higher capacity buses. Lower capacity services then complemented formal transport services by providing feeder services from low density areas to higher capacity systems in denser areas.

in many cases, the best way for governments to improve public transport services is to work with informal providers to combine regulation with finance, or access to private finance, to maintain and improve vehicles

Discussion and compromise with existing operators is key to this process. In Johannesburg, South Africa, minibus taxi operators were included in negotiations on the new bus rapid transport (BRT) from the start, allowing them to become drivers and shareholders in the new system and limiting resistance[22].

Investing in higher capacity transport

In high density areas of city, investing in high capacity transport models can play an important role in reducing congestion and enhancing mobility. Broadly speaking, there are four types of higher capacity transport system:

— High-capacity buses

— Bus Rapid Transit (BRT) systems where buses have priority or sole use on dedicated lanes

— Light Rail Transit (LRT) systems where trains run over-ground on an exclusive-dedicated line. This is distinct from tram systems which operate on roads.

— Metro or mass rapid transit (MRT) systems where high-capacity trains travel either above or underneath the ground

An effective transport strategy for a city involves investing in these complementary transport modes in a way that allows commuters to move easily between modes.

BRT vs LRT

In many cities, high levels of congestion mean that high capacity buses cannot serve enough customers to cover their costs. As such, policymakers often face a choice between investing in BRT or LRT systems in higher density corridors.

Left: Transjakarta BRT system in Jakarta. Right: Addis Ababa's Light Rail system.

These systems have a wide range of carrying capacities and costs across countries. Depending on their level of complexity, BRT systems can range from being able to transport around **2,500 – 20,000 people/hour/lane**[xiv]. LRT systems can have higher capacities but generally fall somewhere in this range.

LRT systems are generally more expensive to construct and operate for a given carrying capacity . The 7.8km LRT system built in Singapore in 1999, for example, cost over USD$36 million/km to construct[xv]. By comparison, most BRT systems cost well under USD$10 million per kilometre to construct[xvi]. BRT systems are likely to be particularly cost effective when compared to more complex transport systems if road lanes can easily be transformed and a bus system is already in place.

LRT systems are generally more expensive to construct and operate than BRTs for the same carrying capacity

	BRT	Light Rail
Construction time	1-2 years	2-3 years
Maximum capacity (passengers/vehicle unit)	160 – 270	170 – 280
Line capacity (passengers/direction/hour/lane)	2,500-22,500[3]	12,000 – 27,000
Maximum speed (kph)	60 -70	60 – 80
Average capital costs (US$million/km)	8.4	21.5
Average operating costs (US$ / vehicle revenue km)	2.94	7.58

Source: Adapted from Cervero (2013)
Note: Capital and operating costs calculated from US case studies, using 2000 $USD Consumer Price Index average.

Economic analysis suggests that BRTs are likely to be the most cost-effective option for mass public transport when taking into account capital, operating and delay costs[xvii]. This only changes in very high-density areas where hourly passenger volumes are in excess of 30,000, where a bus-based system could result in significant and costly delays. The higher construction and operation

3 Number of lanes (2) and carrying capacity for maximum based on Bogota's TransMillenio, from Venkat Pindiprolu, 'Applicability of Bogotá's TransMilenio BRT System to the United States: Final Report' (NBRTI, 2006).

costs associated with rail-based systems, as well as the likely need for higher public subsidies, may instead be justified on the basis of other benefits, including environmental sustainability and the opportunity costs of land required.

The importance of urban density

One key determinant of what transport investments would be valuable to undertake is urban density. The higher the urban density, the more people can benefit from access to a station – and relatedly, the lower the cost per person of connecting people to the system. This means that the costs of building and operating these transport systems can be more easily recouped from users through user fees. It is estimated that BRT systems, for example, can only remain financially viable if there are at least 10 passengers boarding per kilometer per day per bus[xviii]. This requires both sufficient density and pedestrian access to bus stops.

It is estimated that BRT systems, for example, can only remain financially viable if there are at least 10 passengers boarding per kilometer per day per bus

As they grow, cities can incrementally develop transport systems appropriate to rising density . With very high levels of urban density, it can become necessary to invest in even higher capacity mass rapid metro systems, with trains that run over- or underground in a city. These systems, such as the New York City subway and the Shanghai Metro, have much higher carrying capacities and significantly higher costs

CASE STUDY: LAND USE TO COMPLEMENT TRANSPORT INVESTMENTS IN CURITIBA, BRAZIL

In Curitiba, Brazil, complementary reforms to land use planning alongside transport investments have ensured financial viability and popularity of their BRT system, implemented in 1974. This has been achieved in two main ways:

— Land use regulation to encourage transport orientated development - higher density in areas surrounding BRT lines and major roads. On sites along the planned transport axes, legislation permits buildings with total floor sizes of up to six times the total plot size, with density of development decreasing with distance from public transport links. In this way, the city has been able to ensure linkages between residential and commercial density and the transport requirements that come with such density.

— Land use planning actively encouraged use of public transport by providing pedestrianised access to public transport in the city centre, as well as dedicated land space allocated to exclusive bus lanes.

By complementing land use and mobility investments, the costs charged per passenger have been able to be maintained at affordable rates: citizens pay roughly 10 percent of income on travel[xix]. This is in contrast with cities such as Lagos, where in 2013 it was estimated that the average citizen spent roughly 40% of their income on transport[xx]. As a result of improving convenience, affordability and proximity of this system, by 1991 it was estimated that 28% of commuters had switched from car to BRT travel[xxi].

The importance of urban density in improving the financial sustainability of transport system highlights a key role for active land use planning to encourage density around transport routes and terminals. Evidence from Bogota, Colombia, suggests that worker welfare from the introduction of the TransMillenio BRT could have been enhanced by 23% if zoning regulations had allowed for higher density development in areas that became better connected to jobs and workers[xxii].

As they grow, cities can incrementally develop transport systems appropriate to rising density

It is important to note that because of the significant public benefits of public transport services, governments should not necessarily expect them to recover costs purely through user fees. An important potential source of revenues is the urban land value appreciation created by the transport project. One key reason Hong Kong's MTR Corporation is able to self-sustainably finance the construction, extension and operation of the city's mass rapid transit system is because they are granted exclusive development rights to land above and around stations at the "before-rail" market price. They are then able to partner with private developers to develop and sell property on this land, capturing a portion of the nearby land value appreciation resulting from the railway investment.[xxiii]

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