Cities that Work

IGC
International Growth Centre

Accessing opportunities

Policy decisions for enhancing urban mobility

Paul Collier
Edward Glaeser
Tony Venables
Priya Manwaring
Michael Blake

January 2018

DIRECTED BY
LSE
UNIVERSITY OF OXFORD

FUNDED BY
UKaid
from the British people

IGC International Growth Centre — Cities that Work

Accessing opportunities: policy decisions for enhancing urban mobility

Table of Contents

List of case studies

With thanks to Jitendra Bajpai, Gilles Duranton, Daniel Graham, Erick Guerra, Jeffrey Gutman, Astrid Haas, Biodun Otunola and Matthew Turner for their significant contributions.

Executive Summary

Cities drive growth because of their ability to bring together firms and workers in an environment that promotes scale and specialisation. Urban mobility is at the centre of this process, enabling firms and workers to access the large and specialised markets for goods and labour that underpin productivity. However, in many developed and developing cities, nonexistent walkways, crippling traffic jams and high costs of transport services limit both the liveability and the productivity of the city. Improvements in urban mobility systems yield significant benefits to transport users, and to a city at large. In order for policymakers to improve urban mobility, they face difficult trade-offs when deciding how best to address **growing demands for private transport in cities,** and when choosing to **regulate and invest in public transport links** such as minibuses and bus rapid transport systems.

Investments in the construction, maintenance and management of infrastructure such as roads and pavements can yield substantial benefits in improving access for users. However, evidence from developed cities suggests that a **fundamental law of highway traffic** exists whereby expanding roads, though allowing for greater ease and access of transport for many citizens, **will not solve a city's congestion problem**. As incomes and populations rise, vehicle use will rise to fill these new roads. As a result, complementary **regulation of private vehicle use** is also needed, to allow private vehicle drivers to internalise the costs of their behaviour on the wider urban environment. Regulation of private means of transport can be a **win-win** for policymakers, if the proceeds from such regulation is used to finance public transport systems. The revenues from private vehicle permit auctioning in Shanghai, for example, at approximately USD$700 million in 2011, were estimated to be high enough to cover the cost of all public subsidies for transport systems in 2012[1].

Accompanying investments in **public transport options** are key to tackling environmentally unsustainable and congested forms of mobility in rapidly developing cities. **Urban population density** is a key factor in determining whether to invest in higher capacity public transport systems to meet mobility demand in a city. Higher capacity systems such as Bus Rapid Transit (BRT) systems and metros can form the backbone for high density activity and **complement** lower capacity feeder route systems from the outskirts of a city. The BRT system launched in Lagos in 2008, for example, served over 200,000 passengers daily in its first year of operation and cut average in-vehicle journey times by 40 percent[2].

Policies to improve mobility in cities are, however, only one piece of the puzzle. People's access to job opportunities and urban services can also be expanded by **increasing their proximity to each other**. This highlights a key role for **urban land use policy** to complement investments in mobility in improving access in cities.

This paper first considers the challenges of urban mobility faced by developing cities, before exploring the role for policy in improving connectivity. In Section 2, this paper looks at options for policymakers in meeting growing demand for private transport in cities through the management of supply and demand. Section 3 considers the trade-offs associated with regulation of, and investments in, different public transport systems.

---

[1] Jun Yang et al., "A Review of Beijing's Vehicle Registration Lottery: Short-Term Effects on Vehicle Growth and Fuel Consumption," *Energy Policy* 75 (2014): 157–66, https://doi.org/10.1016/j.enpol.2014.05.055.
[2] Dayo Mobereola, "Lagos Bus Rapid Transit: Africa's First BRT Scheme," Urban Transport Series (IBRD/World Bank, 2009).

1. Disconnected and congested cities

The importance of accessible, affordable, and uncongested transport

Cities drive growth because of their ability to bring together large numbers of firms and workers with a wide variety of skills, allowing for efficient scale and specialisation of production. With a large pool of connected individuals, people with a wide variety of skills can be matched to jobs that are most suited to them, and firms can specialise to meet the specific demands of consumers.

Transport networks are at the heart of making a successful city. By improving access and ease of mobility across a city, the effective area across which cities can connect workers, firms and markets is extended. People across a city can benefit from potential **growth of economic clusters and increases in productivity**. This in turn can act to attract greater levels of foreign investment, urban job creation and wage growth. Evidence from developed cities suggests that this output effect of transport investments is strongest for road construction and has the greatest impact on primary, manufacturing and construction industries[3]. In Bogota, neighbourhoods located less than 500 meters from *TransMilenio* bus rapid transit stations that opened in 2000 have 7% higher wage increases than those located more than a kilometre away as a result of greater connectivity and job-matching – with even stronger effects in peripheral areas[4].

But in many developed and developing cities, citizens lack the ability to access jobs and opportunities, due in part to a lack of proximity to these opportunities, but also because of **limited means of mobility** to move between locations. Nonexistent walkways, crippling traffic jams as well as high costs of transport services limit the quality of life of individuals and restrict the productive potential of cities.

Traffic in Delhi, India
(Photo: Flickr, Lingaraj GJ)

[3] Patricia C. Melo, Daniel J. Graham, and Ruben Brage-Ardao, "The Productivity of Transport Infrastructure Investment: A Meta-Analysis of Empirical Evidence," *Regional Science and Urban Economics* 43, no. 5 (September 2013): 695–706,
[4] Nick Tsivanidis, "Commuting Technologies, City Structure and Urban Inequality: Evidence from Bogotá's TransMilenio" (IGC Cities Conference, London, 2016)

Without adequate means of mobility across a city, firms are **unable to access large input and output markets** that can allow for firms to grow to an efficient scale and specialize in production of particular goods, and that in turn enhances productivity in urban areas. At the same time, citizens are deterred from working far away from their homes. In Mumbai, more than 60% of commuters walk to their jobs - the figure is even higher at up to 70% in Kampala[5]. Without affordable means of transport that can connect workers to jobs in more distant locations, poorer individuals are often forced to move to overcrowded central slums so that they can more easily access jobs.

Improving people's access to opportunities in rapidly developing cities requires:

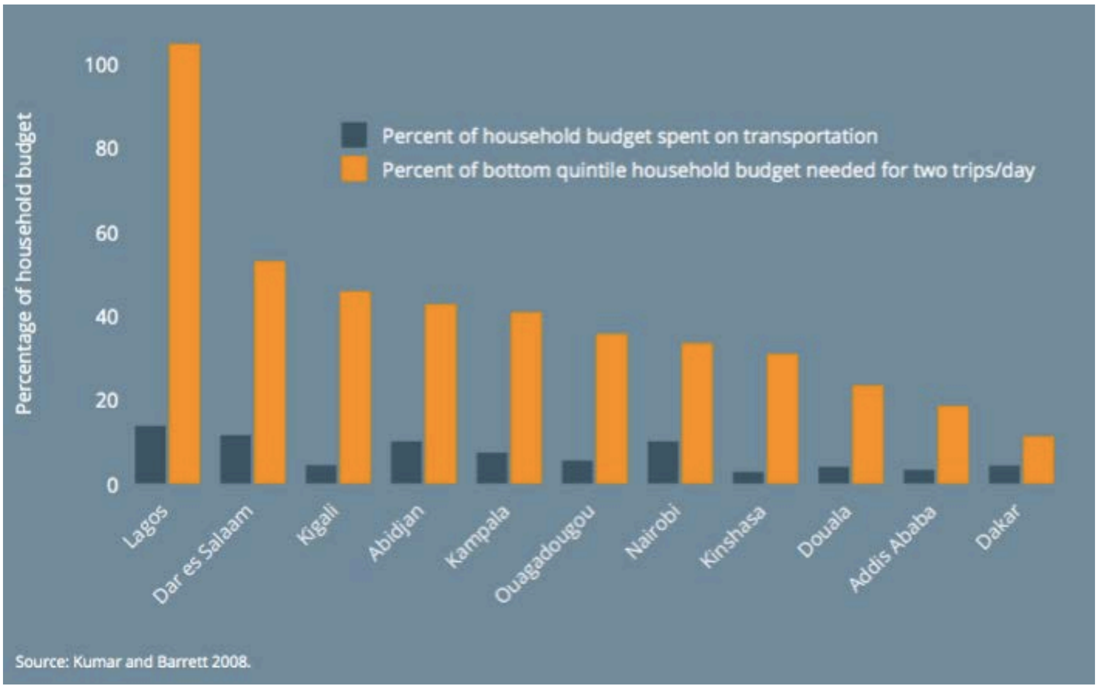
1) **Increasing means of mobility in a city.** This means increasing the supply of infrastructure and services for both private and public means of transportation in a city. Emerging cities have very little land allocated to roadways and other infrastructure, and road networks that do exist are largely clustered near the centre of cities. Evidence from 14 African cities reveals that pavements are missing on around 65% of all roads, and where they do exist, they are poorly maintained[6].

2) **Reducing congestion that negatively impacts these means.** As cities grow, more pressure will be put on existing transport systems, resulting in higher congestion. This is not necessarily a bad thing – it can signal greater economic activity in a growing city. However, measures to reduce congestion can allow for greater access to opportunities, reduce costs of transporting goods, and limit CO_2 emissions. Estimates of the costs of congestion in Britain, France, Germany and the US suggest that congestion costs - including the cost of wasted time, inflated transport costs and the cost of carbon fume - cost these economies $200 billion (0.8% of their GDP) in 2013[7].

3) **Enhancing affordability of transport systems.** In many developing cities, effective means of mobility across a city are prohibitively expensive for the majority of citizens. Though determining what exactly an 'affordable' fare is is difficult and will depend on the city, distances travelled, and the income group being targeted, in many cities the cost of public transport is out of reach for a large percentage of households. The full price fare of a travelling 10km to work by public transport each day in many cities comprises over 30% of incomes of the poorest quintile, deterring long distance travel[8]. As a result, we see low ridership on many public transport systems, whilst low-income households are often forced to live in low quality informal settlements in central areas of cities to avoid the cost of commuting from areas further from the city centre

---

5 Somik V. Lall, "Planning, Connecting, and Financing Cities - Now : Priorities for City Leaders" (The World Bank, 2013),
6 Ajay Kumar and Fanny Barrett, "Stuck in Traffic: Urban Transport in Africa," Africa Infrastructure Country Diagnostic (2008).
7 Centre for Economics and Business Research/INRIX, "The Future Economic and Environmental Costs of Gridlock in 2030: An Assessment of the Direct and Indirect Economic and Environmental Costs of Idling in Road Traffic Congestion to Households in the UK, France, Germany and the USA," 2014.
8 Robin Carruthers, Malise Dick, and Anuja Saurkar, "Affordability of Public Transport in Developing Countries" (Washington, DC: World Bank, 2005).



Share of household budget spent on transport (for all households with positive transport expenditure) and share of household budget needed for two public transport trips/day for the poorest quintile
(Source: Lall et al., 2017)

In Bogota, for example, though a large proportion of the population can access between 76.3 - 97.9% of all employment within an hour using public transport, when taking into account the affordability of fares charged, *effective* access to employment in the city is reduced by up to 54%[9]. Evidence from Addis Ababa suggests that improving the affordability of public transport services for users through transport subsidies, for example, can have a significant positive effect on the employment prospects of unemployed youth living in the outskirts of the city. In one study, transport subsidies for higher-skilled unemployed workers at vacancy boards resulted in a 7% increase in likelihood of higher quality, permanent work[10].

For more on subsidies for transport fares, and pro-poor subsidies in particular, see Cities that Work Policy Brief on Institutions and incentives for infrastructure and service delivery.

It is important to note, however, that the price of transport, both in terms of monetary cost and in the costs of congestion, plays an important role in rationing its use in a city. As such, enhancing affordability of transport systems without increasing means of low congestion mobility (and incentivizing individuals to switch to these) is simply likely to increase congestion in a city.

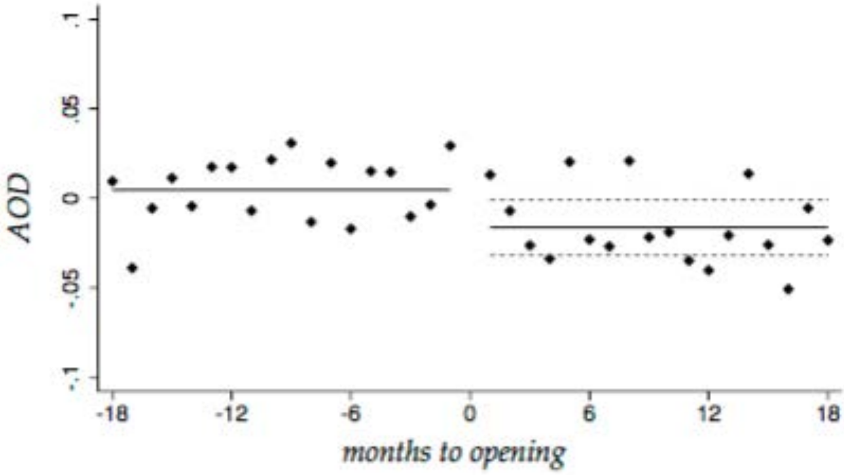
[9] Camila Rodriguez, “Bogota’s Bus Reform Process: Accessibility & Affordability Effects, Lessons Learnt & Alternatives to Tackle Informal Services” (World Bank, 2016).
[10] Simon Franklin, “Location, Search Costs and Youth Unemployment: A Randomized Trial of Transport Subsidies in Ethiopia,” CSAE Working Paper Series (2015). Transport subsidies were randomly allocated to higher skilled workers as part of this study

Improvements in urban mobility systems are particularly beneficial for low-income households, as affordable and efficient transport links allowing households to access larger labour markets whilst still living on less costly land further from the centre of the city.

Additional benefits of improving urban mobility

In addition to improving the quality of life for commuters and extending the effective area across which cities can connect workers, firms and markets, investing in more affordable, accessible and uncongested means of mobility also have a number of additional benefits:

1) **Increased sustainability.** Investing in shared urban transport systems to reduce traffic and improve accessibility in a city can tackle negative environmental externalities associated with private vehicle use. Cross-country evidence suggests that the opening of subway systems worldwide between 2000 and 2014 have been associated with a 5% reduction in urban air pollution through reduced automobile use[11].



Aerosol Optical Depth (AOD) measure of particulates relative to subway openings
(Source: Gendron-Carrier et al., 2017)

2) **Social cohesion.** Investing in public transport systems to improve their quality can also serve to enhance cohesion across different social groups by encouraging a diversity of groups sharing transport services. In Mexico City, for example one of the key aims in expanding the urban railway system has been to encourage social cohesion, whilst in Barcelona targeted subsidies for transport are used to improve economic and social integration of less affluent groups[12].

3) **Coordination of expectations.** Investments in transport links such as roads, bus lanes and light rail stations can also act to anchor expectations and therefore investment across a city by increasing connectedness and desirability of surrounding property and therefore land values in the area, whilst providing a credible signal of planned future investments in surrounding areas. Before the Light Rail Transit system opened in Addis Ababa in 2015, for example, private investments in surrounding areas were already

[11] Nicholas Gendron-Carrier et al., "Subways and Urban Air Pollution," 2017,.
[12] "Mobility and Social Cohesion," Background Paper in Preparation of the Metropolis Conference in Toronto (Metropolis, 2006).

taking place in expectation of future economic activity. Without the government's intervention, potential profitable clustering of investment may not have occured as no one is willing to make the first risky investment without assurance others will do the same.

Construction along new roads in Addis Ababa

(Source: Bird and Franklin, 2015)

The role of urban policy in improving urban mobility

The significant benefits of addressing constraints to transport systems in cities mean that governments have a key role to play in improving urban mobility. Policy plays a crucial role both in enhancing and managing the supply of transport infrastructure and services, and in managing demand for public and private transportation services**.**

Public transportation refers to shared passenger-transport services which are available to the public. These can be privately provided.

Transport investments are costly, and can shape the form and function of cities for decades. As such, policymakers face a number of important trade-offs when considering how best to improve transport links in a city that address the needs of urban mobility in the long run:

Improving connectivity by…	Capital and operating costs	Effect on congestion	Effect on emissions	Resistance from public transport operators	Resistance from transport users
Investing in roads	Medium	Reductions minimal	Can increase emissions or have minimal impact	Low	Low
Road management	Low- medium	Medium reductions	Minimal reduction	Low	Low
Investing in pavements and cycle lanes	Low	Medium reduction effects	Medium reduction	Low	Low
Regulating private vehicle use	Low	Minimal – high reductions (depending on type and enforcement)	High reduction	Low	High
Formalising minibuses	Low	Minimal reductions	Mimimal – medium reduction	Low	Low
Investing in bus rapid transit systems	Medium – high (depending on type)	Medium – high reductions (depending on type)	Medium reduction	High	Low
Investing in rail based urban systems	High – very high	Medium – high reductions	High reduction	Low	Low

2. How can policymakers address growing demands for private transport in cities?

Private travel encompasses journeys made by car, motorbike, bicycle and by foot. In many developing cities, these form the predominant means of travel in a city. They therefore provide important means of connectivity where there is limited municipal revenue for public transport services.

Increasing infrastructure supply for private transportation

Infrastructure for private transport include roads, flyovers, cycle superhighways, and pedestrian over- and underground walkways. Investing in this infrastructure can play a crucial role in improving accessibility in cities - initial results from a study of 154 Indian cities show that 70% of the variation in car travel speeds comes from differences in the speed of travel at 2am, largely determined by the extent and organisation of road infrastructure[13].

To meet growing demand for private transport use in many cities, policymakers can invest in increasing the effective supply of infrastructure for private (and some forms of public) transport by:

1) **Building new infrastructure.** The density of paved roads in countries in sub-Saharan Africa is **less than a quarter** of that in other low-income countries[14]. Even in urban areas, only 16% of developed land across 7 major cities in sub-Saharan Africa between 1990 and 2014 was allocated to roads[15]. A lack of investment in urban road space is in many cases indicative of limited access to opportunities and services across a city and can result in high levels of congestion. In Kampala, for example, a road network built in the 1960s to accommodate 100,000 vehicles – of which currently only 20% is in adequate condition - is unable to accommodate the free flow of approximately 400,000 vehicles today[16]. In Douala, only 0.5% of residents in peripheral settlements have direct access to a paved road[17]. As such, building new roads is a key part of urban policy to improve mobility.
2) **Maintaining existing infrastructure.** At the same time, maintenance of existing infrastructure is crucial in improving urban mobility. In many cities, potholes in roads are a source of delays for high capacity buses, whilst uncovered manholes on pathways are a threat to accessibility by pedestrians.

3) **Spatial planning and regulation to use existing space more effectively through 'traffic management' solutions.** In Lagos, for example, infrastructural investment and planning has significantly reduced congestion by improving road capacity and alignment at junctions, as well as constructing laybys and bus shelters to reduce congestions on main roads. Accompanying investments such as traffic lights and

[13] Prottoy Akbar et al., "Accessibility and Mobility in Urban India," 2017.
[14] Vivien Foster and Cecilia Briceño-Garmendia, "Africa's Infrastructure: A Time for Transformation" (2010),
[15] Patrick Lamson-Hall et al., "A New Plan for African Cities: The Ethiopia Urban Expansion Initiative" (NYU Stern Urbanization Project, 2015).
[16] KCCA, "Stategic Plan 2014/15-2018/19: Laying the Foundation for Kampala City Transformation"; Astrid Haas, "From Moving Vehicles to Moving People: Designing a Mass Public Transportation System for Kampala," *IGC*, 2017
[17] Ajay Kumar, "Understanding the Emerging Role of Motorcycles in African Cities: A Political Economy Perspective" (Sub-Saharan Africa Transport Policy Program, 2011).

signalling to control traffic flows on particular roads can also be used to improve use of existing road capacity.

One-way traffic regulations in central business districts, for example, can reduce congestion resulting from vehicles turning off roads across traffic from the opposite direction. One-way traffic systems introduced on main roads in Kampala have helped to reduce congestion and manage traffic flow at junctions[18]. As such, though one-way systems often increase distances travelled, they can cut down travel time for private and public vehicles in busy areas. However, this should be weighed against negative effects of one-way traffic on:

- Safety – studies suggest that speeds are higher on one-way streets, resulting in higher levels of collisions[19].
- Surrounding developments – evidence from Louiseville, Kentucky, suggests that one-way roads tend to reduce surrounding commercial values as compared to two-way roads[20].

In addition, in many cases the extra time spent travelling further distances using a one-way system outweighs the time saved in traffic. For shorter journeys in particular, research suggests that two-way streets can serve more trips per unit of time due to shorter distances that need to be travelled – and that even on longer journeys, the trip serving capacity of two-way streets where cross-traffic turns are banned may be highest[21].

Non- motorised vs motorised transport

Infrastructure for non-motorised forms of transport in particular offer low-emission access to locations unreachable by motorized transport and in dense central areas of cities can offer the quickest form of travel. Investing in this infrastructure can dramatically increase accessibility at relatively low costs.

The capital cost per kilometer of a pedestrian walkway that can accommodate 4,500 people/hour/direction is approximately USD$100,000. This is up to 50 times less costly than an urban road that can carry only 800 people per hour per direction[22].

Separated cycle superhighway in London (Photo: Cmglee, 2014)

---

[18] World Bank, "Bus Rapid Transit for Greater Kampala Final Report" (World Bank, 2014).
[19] William Riggs and John Gilderbloom, "Two-Way Street Conversion: Evidence of Increased Livability in Louisville," *Journal of Planning Education and Research* 36, no. 1 (March 1, 2016): 105–18; Reid Ewing and Eric Dumbaugh, "The Built Environment and Traffic Safety: A Review of Empirical Evidence," *Journal of Planning Literature* 23, no. 4 (May 1, 2009): 347–67
[20] Riggs and Gilderbloom, "Two-Way Street Conversion."
[21] Vikash V. Gayah and Carlos F. Daganzo, "Analytical Capacity Comparison of One-Way and Two-Way Signalized Street Networks," *Transportation Research Record: Journal of the Transportation Research Board*, no. 2301 (2012),
[22] Phillip Rode et al., "Accessibility in Cities: Transport and Urban Form," New Climate Economy Cities (LSE Cities, 2014).

Increasing access to these means of travel is particularly beneficial for low-income groups to whom this is the primary means of travel. Investing in physically separated walkways or separate cycle ways can also improve vehicle flow on roads, though this often comes at the cost of closer proximity to opportunities by foot/bicycle.

However, investing in pavements and pedestrian tunnels also cannot provide a sustainable solution on their own for improving efficient connectivity across an entire city, given the time taken to travel long distances by foot or by bicycle. As such, additional investment in motorised transport can also significantly expand means of mobility in a city.

The limitations of expanding effective road supply

- Though expanding the supply of infrastructure for private cars plays an important role in expanding access to mobility, these investments **take time** and come at a **significant cost.** The average cost of constructing a two-lane concrete highway across developing countries is approximately $1.5 million per kilometre[23].

- At the same time, it is important to note that evidence from US cities has revealed a **fundamental law of highway traffic**, whereby vehicle kilometres travelled increases proportionally with interstate highways[24]. Therefore, expanding roads, though allowing for greater ease and access of transport for many citizens, **will not solve a city's congestion problem**; as incomes and populations rise, vehicle use will rise to fill these new roads. This is a particular problem in central areas of large cities, where congestion significantly affects people's ability to move around the city. In Accra, for example, despite relatively good roads, traffic congestion continues to rise as around 2 million commuters travel to the downtown central business district each day. This problem is only likely to grow as the population of Greater Accra (now at 4.3 million) is predicted to double by 2035, along with private vehicle use[25]. In Kampala, many of the main roads that were built to ease transportation to the CBD have become the most congested routes into the city. As such, building roads alone is unlikely to be able to keep up with the transportation needs of rapidly growing urban populations using predominantly low-capacity private vehicles.

- Private means of motorized transport may also be **unaffordable** to many households in developing cities, and are also likely to **increase emissions** in a city as compared to public motorised transport.

[23] Figure based on data from the World Bank's 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.
[24] Gilles Duranton and Matthew A. Turner, "The Fundamental Law of Road Congestion: Evidence from US Cities," Working Paper (2009),
[25] Brennan Weiss, "Gridlock in West Africa: Accra's Troubled Attempts to Tackle Its Traffic Crisis," *The Guardian*, 2016

Motorbikes are a common form of private transport in many developing cities. In Hanoi, for example, motorcycles make up 60% of the transport modal share, as compared to public buses that make up 5% of modal share[26]. Though motorbikes are likely to carry greater numbers of passengers on roads per vehicle than cars and with lower costs are able to serve lower-income segments of urban populations, they have a number of disadvantages:

- They are **high emission** vehicles - motorcycle use in many cities has been associated with high levels of local **pollution**[27].
- At the same time, they have also proven to be **extremely dangerous.** In Kampala, for example, through 'boda boda' motorbikes form only 5.9% of trips in the city[28], over 40% of all trauma cases at Mulago Hospital involve these motorbikes[29].
- Motorbikes offer lower capacity than public transport and so in the long run, they are unlikely to solve congestion problems in a city.

Both private cars and motorbikes contribute significantly to congestion in Hanoi

(Photograph: Kham/Reuters)

In order to meet and manage demands for private transport requires additional policies to:

- Regulate the demand of private vehicle use
- Provide alternative public transport options

[26] Vu Anh Tuan and Tetsuo Shimzu, "Modeling of Household Motorcycle Ownership Behaviour in Hanoi City," *Journal of the Eastern Asia Society for Transportation Studies* 6 (2005).
[27] Asif, Weaver Faiz, "Air Pollution from Motor Vehicles : Standards and Technologies for Controlling Emissions" (The World Bank, November 30, 1996)
[28] Lall, "Planning, Connecting, and Financing Cities - Now."
[29] J. Kigera, L. Nguku, and E. K. Naddumba, "The Impact of Bodaboda Motor Crashes on the Budget for Clinical Services at Mulago Hospital, Kampala," *East and Central African Journal of Surgery* 15 (2010)

Managing demand for private motorised transport

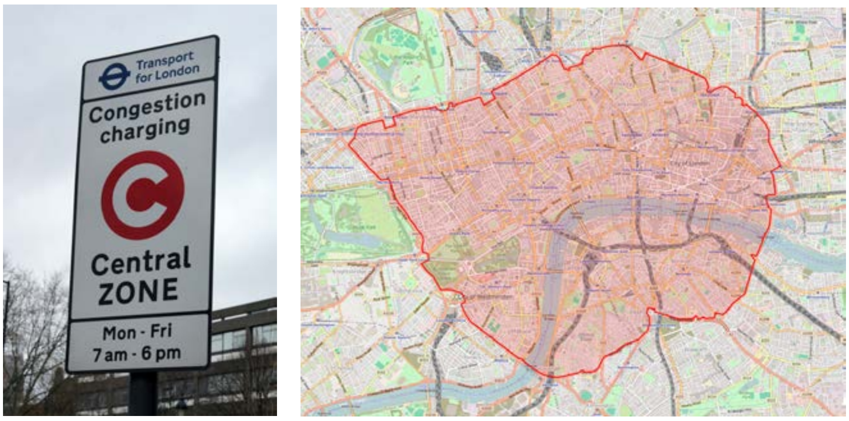
Many forms of private motorised transport require regulation in order to improve safety, reduce emissions, and reduce traffic congestion for improved mobility. Without regulation, private vehicle users do not internalise the costs of their behaviour on the wider urban environment. This is likely to be particularly harmful in central areas of dense cities, where private vehicles contribute significantly to congestion.

In order to reduce transport congestion, and to incentivise private vehicle users to switch to use of public transit services, there are two main types of regulation policymakers can 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, as seen in Singapore. The alternative is to impose an additional price on travel, which travelers can respond to by adjusting their use. Policymakers can impose additional charges directly for vehicle use, through congestion charges where private vehicles pay a daily fee to drive in particular urban areas. They can also charge users indirectly, for example through fuel taxes or parking permits.

Case study: Price restrictions in London and Singapore

In London, the introduction of a congestion charge fee in resulted in a 30% decline in excess delays from traffic congestion[30], and has resulted in a 6 percent increase in the number of passengers using buses during charge hour[31].



Congestion charge signage and zones in London
(Image sources: mariordo59, 2012, ed g2s, 2007)

Another example of effective price restrictions is seen in Singapore's Certificate of Entitlement' (COE) system, whereby 10-year private vehicle permits are auctioned, has been associated with a reduction in the average annual growth of vehicles from 4.4% between 1975-1989 to 2.9% between 1990-2001[32]. Revenues from these auctions have been used to invest in roads and publically provided transport systems.

[30] Gabriel Kreindler, "Driving Delhi: The Impact of Driving Restrictions on Driver Behaviour," 2016.
[31] Lall, "Planning, Connecting, and Financing Cities - Now."
[32] Winston T. H. Koh, "Congestion Control and Vehicle Ownership Restriction: E Choice of an Optimal Quota Policy," Research Collection (Singapore Management University, School Of Economics, 2004),

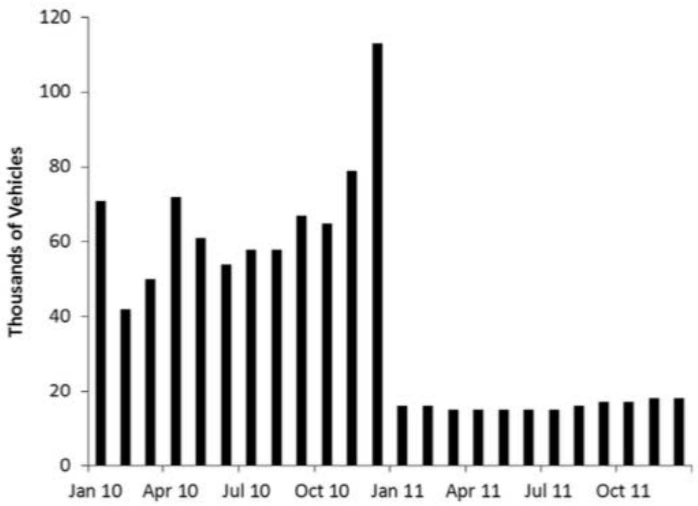
These can be **effective in limiting private vehicle use** at all times of day or in peak hours.

It is important to note that a congestion charge for private vehicle use is already ‘paid’ to some extent by road users in the form of time wasted in higher levels of traffic. Price disincentives offer an alternative way of managing demand whereby private vehicle users instead pay a transfer payment that captures the effect of their vehicle use on overall congestion. The optimal uniform congestion charge is one that charges users in such a way that the costs to society of private decisions to drive do not outweigh the benefits to society as a whole.

2) **Quantity restrictions on vehicle ownership or usage** that do not include overt payments. Again, these can be direct restrictions such as limits on vehicle licenses, “high occupancy vehicle” restrictions that regulate the number of people in a car and “odd-even” policies that only permit certain vehicles to use roads on particular days, or indirect restrictions such as parking space restrictions in a city.

Quantity restrictions on the number of cars licensed can play a significant role in reducing vehicle use, as seen in Beijing.

Case study: Quantity restrictions on ownership in Beijing



Since 2011, vehicle licence plates in Beijing are restricted and allocated to drivers based on a public lottery. Alongside existing financial regulations to reduce vehicle ownership and increased subsidies for public transport, this policy has had a dramatic effect on the growth of individual vehicles and on congestion in the city. The number of vehicles on roads is predicted to have decreased by 11 percent by 2010[33].

However, the effect 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, with varied experiences across different cities. Though there have been short run positive effects of these policies in Delhi, studies have predominantly found that **permanent vehicle use**

[33] Yang et al., “A Review of Beijing’s Vehicle Registration Lottery.”

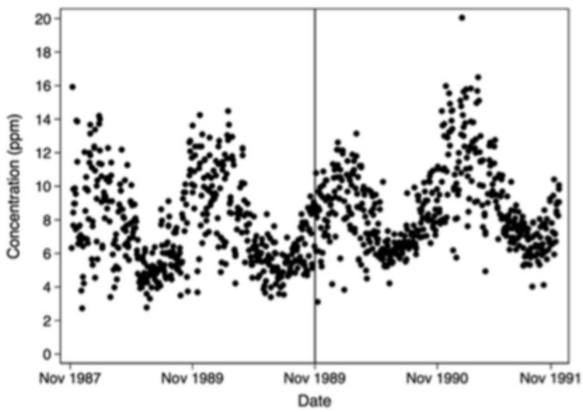
restrictions have not been effective in reducing vehicle use or associated air pollution[34]. In a number of cases, these types of quantity restrictions on vehicle use are circumvented by drivers by buying additional vehicles or adjusting the times they drive, imposing a capital cost on drivers with no strong benefits in terms of reducing vehicle use.

Case study: Quantity restrictions on use in Delhi, Mexico City and Quito

In Delhi, restrictions on 4-wheel vehicles to allow only odd or even number-plated vehicles drive on alternate days over two 15 day rounds in 2016 resulted in significant reductions in delays from traffic congestion of approximately 10% in the weeks it was applied. Though more than half of drivers who stopped using their 4-wheel vehicles were able to legally bypass the legislation by using alternative cars or rickshaws, a small but significant proportion of the population switched to public transportation use. This resulted in an 8-11% increase in public transport use by those restricted by the legislation. Though drivers reported 6-8% lower levels of satisfaction with their commutes on days they were restricted, overall satisfaction across restricted and unrestricted days increased by 15%[35].

However, these results should be taken with caution; given the short time span of this policy experiment, they may not be replicable in the long run.

Mexico City's *Hoy No Circula* (HNC) programme, introduced in 1989 amidst concerns about air quality in the city as a result of high levels of traffic congestion, limits the use of each private vehicle for one weekday between 5am and 10pm, depending on the last digit of their license plate. The effects of this programme have not been clear. Evidence suggests that in the short run, this policy has been associated with an 5-13% reduction in carbon monoxide (a proxy for car use), but that 12 months the programme was associated with an *increase* in vehicle use pollutants by 11% - with even higher increases on weekends[36].



Daily CO records during peak hours in Mexico City, 1987-1991
(Source: Gallego et al., 2013)

[34] Paul E. Carrillo, Arun S. Malik, and Yiseon Yoo, "Driving Restrictions That Work? Quito's Pico y Placa Program," 2013.
[35] Kreindler, "Driving Delhi: The Impact of Driving Restrictions on Driver Behaviour."
[36] Francisco Gallego, Juan-Pablo Montero, and Christian Salas, "The Effect of Transport Policies on Car Use: Evidence from Latin American Cities," *Journal of Public Economics* 107, no. C (2013): 47–62.

Studies suggest that the introduction of this programme incentivised users to switch towards driving more on weekends and late evenings when the HNC regulations were not in place, and that, perversely, in the long run resulted in higher levels of vehicle use and pollution during all periods as drivers bought more than one vehicle – particularly higher polluting used cars - to circumvent the restriction[37].

In Quito, Ecuador, a similar *Pico y Placa* program has been associated with a reduction in carbon monoxide ambient concentration of around 9 -11% during peak hours, and 6% between 6am and 8pm on working days, suggesting similar magnitudes of reduction in vehicle flows in the city. Though after the initial 20 months of implementation its effect has diminished due in part to more vehicles as a result of population growth in the city, the programme has been found to still have an effect in reducing pollutants with limited evidence of behaviour to circumvent regulations[38]. The relative long-term success of this programme as compared to similar policies in Mexico City and Bogota may be the result of the fact that this programme is subject to review and extension every 6 months. As a result, drivers may be less willing to make large investments in new cars given the uncertainty surrounding the continuation of the policy.

Should policymakers implement price or quantity restrictions?

Though both types of restrictions have proved effective at limiting congestion across cities, financial restrictions are advantageous in three main ways:

- ✓ By allowing an open market to determine who is willing to pay to use their vehicles, user-rights are efficiently allocated to **those who are most willing to pay.**

- ✓ Financial disincentives raise revenues for governments, enabling a **win-win** situation where restrictions on private use can be used to fund public transportation systems. The revenues from private vehicle auctioning in Shanghai, for example, were approximately USD$700 million in 2011. This was estimated to be high enough to cover the cost of all public subsidies for public transport systems in 2012[39]. Because public transport systems are more likely to be more cost efficient the higher urban density (see below on the importance of urban density), price regulation in areas where traffic congestion is highest can help to finance public transport in those same areas where these systems are most cost efficient.

- ✓ As discussed above, some types of quantity restrictions can be easily circumvented by buying more cars. In an attempt to prevent individuals from buying new cars to circumvent restrictions on vehicle use, the municipal government in Quito is considering changing the assignment of license plates to different days of the week so that different license plates would be valuable to have in combination over time[40].

---

[37] density
[38] Carrillo, Malik, and Yoo, "Driving Restrictions That Work? Quito's Pico y Placa Program."
[39] Yang et al., "A Review of Beijing's Vehicle Registration Lottery."
[40] Carrillo, Malik, and Yoo, "Driving Restrictions That Work? Quito's Pico y Placa Program."

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. Financial restrictions may be seen as overly burdensome on poorer section of society – but it is important to note that in practice, more wealthy households are also able to overcome quantity restrictions such as odd-even policies by buying additional cars.

Improving voluntary compliance with regulations

Regulations on private vehicles to address congestion, emissions and safety can be very difficult to implement. They are likely to face significant resistance from private vehicle users and businesses in areas where congestion charges are perceived to reduce numbers of customers. As such, they have had limited traction in developing cities. In London, for example, westward expansion of the congestion charge zone has been met with strong resistance and policy reversal despite the successes of congestion pricing[41].

Case study: plans for a congestion charge in Manhattan halted by State Legislature

In 2007, New York Mayor Bloomberg proposed a congestion charge in New York's Manhattan area between 6am and 6pm. Despite projections that this charge would reduce traffic by 6%[42] and generate significant revenues for new transportation projects of over US$490 million per year[43], these plans were shelved by the New York State Assembly. Due to strong opposition to the charge, the Assembly decided not to vote on the proposal that would make the city eligible for US$354 million in federal funding needed to implement this programme.

The majority of voters, who stood to lose out on toll-free access to Manhattan, opposed the plans. Critics argued that:

- The tax was regressive – poorer residents would feel the effect of this tax more heavily.
- There was a lack of transparency in how revenues would be invested in public transport
- The charge would increase congestion and pollution in surrounding neighbourhoods as people would park just outside the congestion zone.
- Charges could rise significantly over time once implemented

It is important to note, however, that evidence suggests that the majority of low-income house commuters in Manhattan already did not drive to work, and that therefore the tax policy and resultant increased spending on public transport could have in fact been progressive[44]. In addition, if this policy was able to fund greater investments in public transport, this could enable households to switch to public transport services that would

[41] Dave Hill, "Who Will Speak up for the Congestion Charge?," *The Guardian*, January 7, 2014
[42] Orla Ryan and agencies, "New York Assembly Shelves Manhattan Congestion Charge," *The Guardian*, April 8, 2008
[43] William Neuman, "State Commission Approves a Plan for Congestion Pricing," *The New York Times*, February 1, 2008,
[44] Tri-State Transportation Campaign, "New Data Proves Congestion Pricing Is Progressive Policy" (Tri-State Transportation Campaign, 2007); Jarrett Murphy, "Debate Fact Check: Is Congestion Pricing Regressive?," *Citylimits.Org*, 2017.

reduce car usage both within the congestion zone and in surrounding areas. However, aggressive lobbying tactics used by Bloomberg and his

progressive[45]. In addition, if this policy was able to fund greater investments in public transport, this could enable households to switch to public transport services that would reduce car usage both within the congestion zone and in surrounding areas. However, aggressive lobbying tactics used by Bloomberg and his supporters ultimately failed to convince enough members of the Legislature of the benefits of this scheme[46].

Subsequent attempts to introduce congestion charges in the city have met with similar resistance.

Effective implementation of these controls requires efforts to improve compliance through incentivising those affected to support regulation, and by improving monitoring and enforcement capacity.

Support for regulation can be encouraged through:

1) **Effective communication with and feedback from the public in designing regulations.** This will help to address specific needs and concerns associated with these regulations. For example, before the congestion charge scheme was introduced in London in 2003, the Mayor invited feedback on proposed legalisation from a wide range of stakeholders, in particular those citizens who were most likely to have their journeys and residential areas affected. Based on feedback received on the widely-publicised proposals, modifications were made which allowed for greater public ownership and acceptance of the scheme[47].

2) **Awareness campaigns to inform the public** of the social benefits of regulations in terms of reduced traffic, improved air quality, better safety procedures, and the opportunities for public transport services that can minimise transport times and costs for everyone. This may be particularly important when targeting centrally located residents who are **more likely to be inclined to reduce regulate private transport** in their area (provided this is not likely to reduce nearby central retail activity[48]).

Though many resistant to congestion charges argue that these charges reduce travel in a city and thus have negative effects on commercial business, there is limited evidence to suggest this is the case in highly congested areas. Congestion charges in areas where there is severe traffic, as in central business districts of many developing cities, can in fact *increase* the throughput of vehicles in the area by reducing gridlock[49].

[45] Tri-State Transportation Campaign, "New Data Proves Congestion Pricing Is Progressive Policy" (Tri-State Transportation Campaign, 2007); Jarrett Murphy, "Debate Fact Check: Is Congestion Pricing Regressive?," *Citylimits.Org*, 2017.
[46] Nicholas Confessore, "$8 Traffic Fee for Manhattan Gets Nowhere," *The New York Times*, April 8, 2008
[47] Dirk van Amelsfort, "Introduction to Congestion Charging: A Guide for Practitioners in Developing Cities" (Asian Development Bank and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH., 2015).
[48] Bruno De Borger and Antonio Russo, "The Political Economy of Pricing Car Access to Downtown Commercial Districts (Working Paper)" (Centre for Economic Studies/IFO Institute, 2016).
[49] Amelsfort, "Introduction to Congestion Charging: A Guide for Practitioners in Developing Cities."

3) **Sufficient investment and/or subsidies in public transport supply** to address the additional demand generated by reduced private transport use. Without this investment in public transport systems, increased fees on private vehicle use to reduce congestion will simply limit accessibility of those previously able to afford this form of transport. Attempts to ban motorbikes to improve safety in Kigali, Rwanda in 2006, for example, without adequate affordable and timely alternatives for mass transportation, have been met with strong political resistance. By contrast, in London and Oslo resistance to congestion and toll charges was overcome by transparently **linking these fees with public investment.** In 1990, the city of Oslo decided to use 20% of revenues from toll charges for public transport investment to reduce resistance to the introduction of these charges[50].

   Improving accessibility, regularity and comfort of public transport services may also be vital in gaining acceptance of private vehicle regulation and encouraging use of public transport services by higher-income individuals for whom modes of transport are often seen as a status symbol. Park and ride facilities, for example, can allow private vehicle owners to use their vehicles to travel across low density areas in order to easily access public transport services. In many developing cities, the importance of improving not just the affordability but also the quality of public services in attracting new users is evident from growing use of motorbike taxis by lower income households, despite the fact that these services are more expensive than public buses[51].

   > Policymakers face a **trade-off** here: subsidising fares can expand affordable access to the poor, but using funds to improve service quality are more likely to incentivise middle income groups to switch to public transport.

   These investments can be useful not only in encouraging acceptance of regulation but in incentivising switching to public transport use. Evidence from the UK suggests that subsidising public transport fares in an effort to encourage vehicle users to switch to public transport have very limited effects in the short run[52]. However, investments in improving travel time and service quality of public transport can have much stronger effects on mode choice[53].

4) **Incremental increases and expansion of such policies** is likely to be crucial in gaining support through a virtuous cycle of improved private and public transport – if people are able to experience the benefits of private vehicle regulation through reduced congestion and improved public transport services, they are more likely to support increases in financial disincentives and expansion of regulation.

Fees such as congestion charges may also be easier to implement amongst people who are less used to driving for free. Such charges may therefore be well suited for cities at early stages of development where the percentage of people who own cars and other private vehicles is relatively low (alongside investments in public transport alternatives).

---

[50] Ryan and agencies, “New York Assembly Shelves Manhattan Congestion Charge.”
[51] Kumar, “Understanding the Emerging Role of Motorcycles in African Cities: A Political Economy Perspective.”
[52] MZ Acutt and JS Dodgson, “Cross-Elasticities of Demand for Travel,” *Transport Policy* 2, no. 4 (October 1, 1995): 271–77,
[53] Ken Gwilliams, “Transport Pricing and Accessibility” (Brookings: Moving to Access, 2017).

Effective enforcement of all of these regulations requires:

1) Substantial **investment in technological and monitoring capacity** of regulators and enforcers, such as police forces, environmental regulators and state and municipal revenue departments. CCTV cameras have proved particularly cost effective in reducing speeding and other offenses across high-income countries, with cost-benefit ratios of up to 1:27[54].

2) At the same time, investment is needed in **effective monitoring of regulators** charged with enforcing these regulations to prevent corruption and informal bargaining, which can otherwise replace formal regulation. E-ticketing systems, for example, can automatically dispense tickets according to CCTV footage, eliminating the opportunity for informal fee bargaining and thus further reducing congestion in cities[55].

Though these investments are likely to be substantial, they play a key part in transforming a city's transport system. In Uganda, enhanced traffic safety patrol teams to enforce traffic regulation on roads into Kampala in 2004 resulted in a 17 percent decrease in road mortality by 2005[56].

Case study: congestion pricing in Stockholm

In 2007, the city of Stockholm introduced a congestion charge to reduce traffic flows in the inner city. The introduction of this scheme was based on a seven-month trial period in 2006, followed by a public referendum in support of the introduction of this system. As a result of this charge, traffic volumes in the city reduced by approximately 21% by 2007[57]. The system continues to enjoy public support[58].

For four decades, congestion pricing in the city had been a source of ongoing contention and negotiation among politicians, opposed by Liberal and Conservative politicians who favoured expanding infrastructure to meet transport demand. The Mayor of Stockholm between 2002-2006, Annika Billström, a member of the Social Democrat Party, had herself promised that road pricing would not be introduced during this period[59]. However, pressure from coalition Green Party members at the national and local level meant that Billström was forced to take actions to implement a **trial congestion charge**. As a result of this trial, traffic volumes over the six-month trial period reduced by approximately 22%, resulting in significantly reductions in congestion and travel time[60]. Following this, a public referendum resulted in 53% of Stockholm citizens voting to introduce the charges permanently.

---

[54] Margie Peden et al., "World Report on Road Traffic Injury Prevention" (Geneva: World Health Organisation, 2004),
[55] Emmanuel Akinwotu, "Beatings and Bribes: The Corruption behind Lagos's Traffic Jams," *The Guardian*, February 25, 2016,
[56] D. Bishai et al., "Cost-Effectiveness of Traffic Enforcement: Case Study from Uganda," *Injury Prevention* 14, no. 4 (August 1, 2008): 223–27, https://doi.org/10.1136/ip.2008.018341.
[57] Maria Börjesson et al., "The Stockholm Congestion Charges—5 Years on. Effects, Acceptability and Lessons Learnt," *Transport Policy*, URBAN TRANSPORT INITIATIVES, 20, no. Supplement C (March 1, 2012): 1–12,
[58] Ibid.
[59] Ibid.
[60] Jonas Eliasson et al., "The Stockholm Congestion – Charging Trial 2006: Overview of Effects," *Transportation Research Part A: Policy and Practice*, Stockholm Congestion Charging Trial, 43, no. 3 (March 1, 2009): 240–50,

A number of factors allowed for the introduction of a publically accepted congestion charge:

- **Incremental introduction.** By implementing the charge first as a trial phase, citizens could see the benefits of the charge for themselves before deciding on whether they supported this policy change.

"If you confront people with a congestion tax, most people will say no. But if people saw that traffic was reduced and not hard to handle, they will be more in favor"

Louise Jarn Melander, Spokeswoman for the Swedish Road Administration's congestion tax department[61]

- **Adequate resources for initial capital investment.** Significant national government funding for the initial trial was essential for investing in the technology that could effectively deliver visible reductions in congestion. Over US$220 million was spent on this experiment with significant investments in computer systems and camera with number plate recognition software to ensure the system would work and be enforced effectively[62]. Stockholm benefited from the fact that the central part of the city is on islands, and thus required fewer control points to monitor use of the congestion zone, reducing the cost of implementing the system[63].

- **Public investments and awareness campaigns.** At the same time, communication drives clearly linked congestion charge payments made as part of this trial programme to the benefits they brought. By justifying the pilot charge on the grounds of financial, and not just environmental, reasons, Billström was able to ensure a broader base of support. Transport planners and administrators invested significantly in improvements such as bus service expansions and new rolling stock for subways during the trial period to reveal the benefits such a charge could offer citizens[64].

- **Public participation through a referendum.** By introducing a trial phase of the congestion charge programme in 2006 that was to be followed by a public referendum on whether to introduce the charge permanently, Billström ensured that whatever the outcome, it would be politically acceptable.

---

[61] Ken Belson, "Importing a Decongestant for Midtown Streets," *The New York Times*, March 16, 2008

[62] Jonas Eliasson, "A Cost-Benefit Analysis of the Stockholm Congestion Charging System," *Transportation Research Part A: Policy and Practice* 43, no. 4 (2009): 468–80.

[63] Erik Hysing and Karolina Isaksson, "Building Acceptance for Congestion Charges – the Swedish Experiences Compared," *Journal of Transport Geography* 49, no. Supplement C (December 1, 2015): 52–60,

[64] TUT-POL, "Congestion Charging in Stockholm: The Path from Opposition to Advocacy," TUT-POL Case Study (Transforming Urban Transport – The Role of Political Leadership, 2016).

Stockholm's roads before and after the congestion trial. Extensive mass media was used to highlight the effects of the charge on congestion.

These features of the trial programme were crucial in maintaining and growing public support for policy change. An advisory referendum, held in the City of Stockholm and surrounding municipalities, revealed a majority in support for keeping the charges in the City of Stockholm (though an overall minority when accounting for surrounding municipalities that arranged referendums[65]). The results of the public referendum, alongside the demonstrable role of congestion pricing in financing long term transport investments in the city, motivated the newly elected Centre-right coalition to introduce the congestion tax, with revenues used to fund new road infrastructure. Similar decreases in traffic volumes of 21% were seen after the congestion charge policy was permanently introduced in 2007[66].

[65] Börjesson et al., "The Stockholm Congestion Charges—5 Years on. Effects, Acceptability and Lessons Learnt."
[66] Börjesson et al.

Which investments in public urban transport systems are most appropriate for a city?

Investments in public transport systems are vital to improve accessibility and reduce congestion of mobility options in a city. However, public transport systems can be costly, and careful **cost benefit analysis** of these systems is key to successful public investment in transport. Though different public transport systems can be implemented as part of a multi-modal system for a city, these offer different benefits in terms of their carrying capacity, sustainability, regularity and speed, and come with a wide range of capital and operating costs.

Public transport mode	***Carrying capacity/ effect on reducing congestion***	***Capital and operating costs***	***Effect on emissions***	***Average proximity of residents to transport mode***	***Resistance from existing transport operators***
Minibuses	Low	Low	High	High	Low
Public buses	Medium	Low-medium	Medium	Medium	High
BRTs	Medium – High (depending on type of BRT)	Medium – High (depending on type of BRT)	Medium	Medium	High
LRTs	Medium – High	Medium – High (higher than equivalent capacity BRTs)	Low	Medium - Low	Low
MRTs	High - Very High	Very High	Low	Low	Low

Careful consideration of the current and future relative costs and benefits of public transport systems for a particular city can prevent over- or under-capacity in urban mobility. Whether to invest in a BRT system, for example, depends in large part on projected levels of **urban population density** that determine transport demand. Without sufficient demand, investing in more expensive higher capacity vehicles is not necessary nor is it financially sustainable.

At the same time, planning investments **for the future** (with the exact time frame for planning depending on how long these investments take) is crucial. The costs of retrofitting necessary infrastructure when demand exists can be prohibitively expensive as compared to planning for future development (see paper on *institutions and incentives for infrastructure and service delivery*).

The status quo: semi-formal paratransit services

In many developing cities across Africa and South Asia, access to public transit services such as buses and trains are severely limited. Whilst growing use of private vehicles has impeded the mobility and profitability of mass public transport, limited public resources dedicated to public transport systems mean that the quality and quantity of services remain low. Currently less than half of Kigali's citizens, for example, have access to a bus station within 500m of their homes[67].

In this context, informal or semi-formal 'paratransit' services in the form of medium capacity minibuses (that carry between 8-25 passengers), taxis and motorbikes are the predominant form of public transport in many African and Asian cities. In Dakar, for example, semi-formally provided minibus services account for over 80 percent of all public transport demand in the city[68]. In Dar es Salaam, the 6,000 minibuses in operation service 43 percent of commuters in the city[69].

There is tremendous variation in the operation of these semi-formal transport services. In Mexico City, for example, minibus operators can own thousands of vehicles and run multiple routes. In other cities such as Lagos, most operators own their own vehicles. Though this sector is usually made up of a number of self-employed entrepreneurs, these services are coordinated by formal or informal cooperatives of operators to ensure fairness and efficiency of services in the interests of their members.

What differentiates these services from formal public transport is that they lack one of the following:

- Necessary permits for vehicle use or for access to particular markets
- Necessary certification requirements for operation, including quality of vehicles
- Official legally required documentation such as liability insurance

Limited enforcement of regulations on transport in many developing cities mean that these services are able to operate and fill the gap left by a lack of adequate formal public transport. In many cases, these services can offer better and more reliable services than existing formal transport systems. Motorcycle taxis in cities such as Lagos, Kampala and Douala have resulted from the collapse of public bus services and subsequent deregulation of the transport sector[70].

---

[67] Jitendra N. Bajpai, Roberto Ottolenghi, and Toma Berlanda, "**Sustainable Urbanization in Support of Economic Transformation: A Rwanda Study" (IGC, 2012).
[68] Ajay Kumar and Christian Diou, "The Dakar Bus Renewal Scheme: Before and After" (Sub-Saharan Africa Transport Policy Program, 2010).
[69] Matteo Rizzo, "The Political Economy of an Urban Megaproject: The Bus Rapid Transit Project in Tanzania," *African Affairs* 114, no. 455 (April 1, 2015): 249–70, https://doi.org/10.1093/afraf/adu084.
[70] Kumar, "Understanding the Emerging Role of Motorcycles in African Cities: A Political Economy Perspective."

Case study: public buses, minibuses and motorbikes in Douala, Cameroon

Until 1995, public bus services in Douala was were provided by a state-owned company, the *Société des transports urbains du Cameroun*. However, limited resources for subsidies,

combined with the company's reluctance to increase fares, meant that this service became increasingly financially unsustainable and eventually closed down. The government liberalised the transport sector, in an effort to improve competition and service levels in the city. A private bus company, the *Société camerounaise de transports urbains*, was contracted by the government in 2001 to operate on particular routes. This company was protected from competition from minibuses, with regulations in place to prevent their operation on the majority of routes. However, inefficiencies in these services that led to rising costs, alongside fixed fares, meant that these buses too were forced reduced their services. The fleet was reduced from 109 in 2001 to 70 by 2005[71].

The gaps in service that left unmet demand in the city, alongside regulations to limit minibus operation, have meant the emergence of shared motorbike 'moto-taxis'. Taxi and moto-taxis form approximately 75 – 80% of all motorized trips in the city[72]. Approximately half of these are owner-operated, providing low-income jobs for relatively young and educated individuals.

	Walk	*Personal 2-wheeler*	*Private vehicle*	*Taxi*	*Moto-taxi*	*Other PT**	*Total (trips/day/person)*
Poor	3.27	0.07	0.05	0.52	0.40	0.07	4.38
Non-poor	2.25	0.15	0.45	1.06	0.79	0.12	4.82
Average	2.88	0.1	0.20	0.72	0.55	0.09	4.54

**Public transport*
Source: SITRASS, 2004

Number of trips per day, by mode and income class
(Source: Kumar, 2011)

There are a number of benefits of these services that have led to their dominance over public transport markets:

- ✓ **Relatively cheap to invest in.** The size and age of semi-formal, older minibuses, for example, make them relatively cheap to invest in compared to higher capacity buses. A five - seven year old second hand 14 seater *matatu* bus in Nairobi costs around USD$11,800, with net daily returns to owners of approximately $21 per day. This means that capital costs of the vehicle would be recouped within the first two years of vehicle operation. By contrast, a new 35 seater *matatu* costs around USD$46,000[73]. A new motorcycle costs only $700 in Lagos or Douala, and are largely self- or

[71] Kumar.
[72] Kumar.
[73] Kumar and Barrett, "Stuck in Traffic: Urban Transport in Africa."

informally financed, with operators in Lagos earning a net average of $16-20 per day[74].

Not only does this mean that these services can be provided by the private market in **greater supply to meet transport demand** (with greater financial viability for access to public transport in low-density areas), but also that **lower fares** can be charged for these services whilst remaining financially self-sufficient. Ease of entry into these markets because of low capital costs means lower fares are usually charged for these services in practice.

> Importantly, this means that minibuses and motorbikes can play an important complementary role to formal transport services by providing **'feeder' services** that provide citizens access to mainline services. As feeder routes usually involve transporting fewer people from low density urban areas, these can often be provided more cost-effectively by smaller vehicles.

- ✓ **Flexibility.** Because of their relatively smaller size when compared to high capacity buses, minibuses, taxis and motorbikes are able to travel almost anywhere where roads exist. As such, they are likely to be more geographically accessible than other forms of transport. In many areas of the city, therefore, using these services may be the only feasible way for residents to access public transport services. Because of their size, these services are also more able to manoeuvre potholes in roads and existing heavy traffic to allow for shorter travel times.

  These vehicles are also flexible in their geographical use and so are able to be more responsive to changing market conditions, which can be crucial for cities at early stages of development where future transport needs are difficult to predict.

- ✓ **Employment.** Semi-formal transport operation provides a significant source of low-wage employment to semi-skilled and unskilled workers in many developing cities. In Dhaka, informal transport comprises almost 30 percent of total employment[75].

As such, integration of semi-formal services to allow them to complement more complex mobility systems is extremely important in providing employment opportunities in a city, and in allowing policymakers to meet mobility demand in a city, maintain financially sustainable services in low density areas, and maintain access to areas where roads are incapable of carrying larger vehicles.

[74] Kumar, "Understanding the Emerging Role of Motorcycles in African Cities: A Political Economy Perspective."
[75] Robert B. Cervero, "Informal Transport in the Developing World" (UN-HABITAT, 2000).

However, semi-formal services, particularly when unregulated, often cause a number of problems for urban mobility:

Problems due to capacity/design

- **Congestion.** As they are medium capacity vehicles, minibuses contribute significantly to traffic congestion in cities.

- **Cost.** The cost per passenger of motorbike taxis is not necessarily lower than than providing transport through high capacity public buses.

Matatu minibus taxis in Kampala queuing for the taxi park

(Photo: Dillon Marsh, 2011)

Problems due to lack of regulation

- **Irregular stops.** The issue of traffic congestion caused by many medium-capacity minibuses is compounded by their lack of regular bus stops. In Kampala, for example, it is estimated that 64% of congestion is due to the frequent and irregular stops made by minibuses, slowing down these buses with severe knock-on effects for other motorized transport[76]. These problems are particularly severe near major bus terminals and marketplaces.

- **Long waits.** In many cities, in order to ensure sufficient revenues, buses wait at terminals until fully loaded. As a result, there are often long waiting times for passengers who catch these buses at bus stops and terminals and commuters often cannot board the bus along its route.

- **Lack of safety.** Without appropriate regulation, these services can be highly unsafe. Lack of training along with hyper-competition associated with semi-formal transport sectors often results in aggressive, reckless and illegal driving, increasing chances of road accidents. Two-thirds of moto-taxi drivers in Douala have been victims of traffic accidents[77].

- **Pollution.** Poor vehicle maintenance such as underinflated tires and high-emission engines increases pollution in cities and results in traffic collisions.

[76] Patricia Jones et al., “Kampala: A Policy Narrative” (World Bank, 2016).
[77] Kumar, “Understanding the Emerging Role of Motorcycles in African Cities: A Political Economy Perspective.”

Can regulating and integrating semi-formal services help improve mobility?

In many cities, governments have worked to regulate and formalise semi-formal services to mitigate their potential downsides, with mixed success. Attempts to regulate these services often seek to manage and enforce features such as entry into the market altogether (through operating permits), pricing, quality of service (such as maximum passenger loads, vehicle age, safety and emission standards), and liability insurance.

Potential benefits of regulation

Regulations *can* be beneficial in improving the quality of services and limiting supply where necessary:

- ✓ 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 .
- ✓ Regulations to cap fares can promote **more affordable** transport services are useful in combatting monopolistic pricing. In Santiago, Chile, deregulation of the urban transport sector in 1980 resulted in monopolistic behaviour on the part of route associations that formed cartels and colluded in raising fares without improving the quality of transport services – in fact, quality of services declined. In response to this, city officials have now opted to grant competitive franchise contracts with regulated fares for central areas of the city[78]
- ✓ Regulation to restrict the supply of low capacity services on particularly busy routes may be important to reduce congestion and improve financial sustainability of higher capacity buses that can carry greater numbers of passengers with less road space. In Kampala, for example, private investment in high capacity buses remains low due in part to strong competition faced on routes from minibuses[79].

Case study: *Matatu* safety reform in Kenya

In October 2003, legislative reform was implemented in Kenya to regulate safety and route operations of the *matatu* minibus sector. This involved fitting *matatus* with 'speed governors' that limited speeds at 80km/hour, alongside regulation of the use of seatbelts, uniforms and regular testing of drivers. These reforms, alongside less temporary arrangements for employment of drivers and badges and prominent photo IDs for drivers, were strictly enforced by fines. This was met with strong resistance and strikes from *matatu* operators, organised by associations such as the Matatu Owners Association and the Matatu Welfare Association. However, high level political support from the President suppressed resistance and resulting strict enforcement meant that *matatu* accidents fell by 73 percent in the first 6 months of implementing these policies[80].

[78] Cervero, "Informal Transport in the Developing World."
[79] Jitendra N. Bajpai and Astrid Haas, "A Framework for Initiating Public Transport Reform in the Greater Kampala Metropolitan Area," IGC Policy Brief (IGC, 2017).
[80] UN-HABITAT, *Enhancing Urban Safety and Security*, Global Report on Human Settlements (UN-HABITAT, 2007), Preston O. Chitere and Thomas N. Kibua, "Efforts to Improve Road Safety in Kenya: Achievements and Limitations of Reform in the Matatu Industry" (Nairobi: Institute of Policy Analysis and Research, 2012).

Case study: Regulation, formalisation and integration of minibuses in Turkey

In Turkey, *dolmuş* ‘minibuses’ emerged in cities such as Istanbul and Ankara in the 1930s and became a popular form of informal transport to fill the gap in public transport systems provided by the state. Predominately privately operated, *dolmuş* formed 10 percent of public transport provided by the municipality in Istanbul in 1950, growing to 20 percent by 1955[81]. These vehicles were often locally modified large cars with an expanded capacity of seven people.

In 1954, the city of Istanbul established regulations over these vehicles which gave them legal status. Larger capacity minibuses were added to the fleet after 1960, and by the 1970s these buses accounted for almost 50 percent of public transport in the city. Over time, these minibuses have become increasingly organised and integrated into the formal transport network through regulation of routes, schedules, fares and vehicles. The allocation of vehicles across routes is also regulated by the government[82].

However, reorganisation of routes and operations to reduce competition with higher capacity rapid transport systems have proved difficult given the large number of politically powerful owner-drivers that must be negotiated with. Proposed regulations for *dolmuş* vehicles to provide disabled access (in line with all other public transport vehicles), for example, were dropped when owners claimed this would represent too high a cost in remodelling their vehicles[83]. At the same time, the use of cash payments on these services means that fares are difficult to regulate. The city now has plans to include *dolmuş* minibuses in the existing contactless smart card payment system that applies to other forms of public transport including high capacity buses and the Istanbul LRT system[84]. If implemented, this would allow for regulation of fares and prevent informal bargaining.

The downsides of regulation

However, regulations come with potential costs:

- Any attempt to improve quality of services is liable to come at the cost of affordability for commuters
- Regulations to cap fares are unlikely to improve services in what are already usually highly competitive markets – instead, lower fares are likely to be met with a **deterioration in the quantity or quality of services**. In Colombo, for example, competition from subsidised fares for high capacity buses offered by the publically owned Central Transport Board are sufficient to force private bus operators to keep prices low without fare or route regulation[85].
- In addition, as mentioned, route regulation can come at the **cost of competitive transport services**, and may not be necessary or advisable in many cities where

[81] Murat Gül, *Architecture and the Turkish City: An Urban History of Istanbul since the Ottomans* (I.B.Tauris, 2017).
[82] Dorina Pojani and Dominic Stead, *The Urban Transport Crisis in Emerging Economies* (Springer, 2016).
[83] Ibid.
[84] Pojani and Stead, *The Urban Transport Crisis in Emerging Economies*.
[85] Cervero, “Informal Transport in the Developing World.”

high capacity public transport does not already exist. Where the quantity of semi-formal services is regulated to reduce competition with high capacity transport systems, this regulation can come at the cost of higher transport expenses for commuters.

In these cases, restrictions on particular types of transport services that leave demand unfilled can actually encourage other, potentially more damaging forms of transport to emerge. In Douala, for example, the emergence of motorcycle taxis has resulted from government policy that banned minibus operation to protect the public transport market[86].

In many cases, the best way for governments to improve semi-formal services is to provide the finance, or access to private finance, that allows operators to maintain and improve their vehicles. By allowing operators to move away from predatory lending schemes, it may be more feasible to see improvements in service quality.

Case study: Regulation and renovation of minibuses in Dakar

In Dakar, Senegal, the government in 2005 attempted to regulate and renovate the stock of '*car rapide*' minibuses in the city. The approximately 25,000-3,000 informal minibuses in the city provided 80% of public transport demand, largely provided by small scale private operators. However, vehicles were largely old and in bad condition, with operators unable to pay for vehicle maintenance, resulting in low quality service and a shortage of public transport.

The 2005 programme involved leasing out new minibuses, providing training for operators as well as improving access to credit for private operators for vehicle purchase and maintenance in exchange for scrapping older, high-polluting vehicles. Private operators formed cooperative groups in order to collectively access credit for these buses and to receive formal operating contracts specifying route allocation and fare structures.

By 2008, 505 new minibuses, around one fifth of all minibuses in the city, were operated under this scheme. This allowed for newer, more sustainable and more comfortable urban mobility options. The available evidence suggests that they are also faster and cheaper for passengers because of their regulated routes and stops. Minibus operators have been able to cover the total costs of operation after initial government assistance in the form of overcompensation for scrapped vehicles, credit schemes and training. However, these minibuses operate alongside informal operators that undermine formal revenue generation by creating excess supply on allocated routes[87].

The need for enforcement capacity

Any attempts at effective regulation rely on adequate enforcement capacity. Regulating informal transport, particularly when done in an effort to accommodate higher capacity

[86] Kumar, "Understanding the Emerging Role of Motorcycles in African Cities: A Political Economy Perspective."
[87] For more on this, see Kumar and Diou, "The Dakar Bus Renewal Scheme: Before and After."

transport modes, can be extremely difficult to implement due to strong resistance from existing operators. In many developing cities, however, this capacity to effectively monitor regulations is weak. In these cases, overly ambitious regulations that exceed capacity and undermine the rule of law can actually be more damaging than having no regulations at all.

Case study: Limited scope for regulation without enforcement capacity in South Africa

In South Africa, deregulation in 1987 also brought previously informal minibus taxis into the formal transport system. However, in this case formalisation involved limited effective government control over their operation[88]. Limited capacity for regulation alongside government corruption meant that taxi associations continued to informally manage the industry.

Over time, the influence of these associations grew and violent conflict between competing taxi organisations became rife. Subsequent government attempts to re-regulate the industry through limiting the issue of permits, legislation over operating hours and working conditions and registering taxi routes to improve access and safety have led to violent resistance by politically powerful taxi operators and have been undermined by ownership of taxis by police and government employees[89].

Working with citizens to enforce regulations can significantly reduce monitoring costs of enforcement. In Kenya, for example, a random sample of over 1000 *matatu* minibuses were randomly selected to have stickers placed on them that encouraged passengers to report when drivers were driving dangerously. This so called “Heckle and Chide” experiment provided the sense of social unity and motivation to encourage passengers to pressure drivers into driving more safely. Speeds of those *matatus* with stickers fell significantly when compared to those not selected for the treatment.

Image: Habyarimana and Jack, 2010

In part as a result of this low-cost intervention, insurance claims by the selected *matatu* drivers across the country fell by between a half and two-thirds between 2006 and 2009 with claims involving death or injury falling by over 50%[90].

Investing in higher-capacity buses may be necessary as density rises

It is important to note that taxis, motorbikes and minibuses are at best medium-capacity vehicles, and thus in many cities, investment in higher-capacity shared transport modes may be necessary to prevent congestion in high density areas. As passenger volumes rise above around 5, 000 in each direction per hour, high capacity buses can become more cost

[88] Jackie Dugard, “From Low Intensity War to Mafia War: Taxi Violence in South Africa (1987 - 2000),” 2001.
[89] Dugard.
[90] Habyarimana and Jack, “Heckle and Chide: Results of a Randomized Road Safety Intervention in Kenya.”

effective when accounting for commuters' time otherwise wasted in waiting for transport, whilst also reducing congestion in a city[91].

Because of their higher carrying capacity, larger buses can facilitate the mass movement of people when compared to lower capacity cars, bikes or minibuses. Whilst minibuses that are approximately 7 meters long can transport around 30 passengers per vehicle, high-capacity double decker buses such as those operating in London can carry up to 87 passengers with a 15-meter length[92]. This means that approximately **35 percent more road space** is needed per person when travelling by minibus as compared to high capacity public buses as seen in cities such as London. Evidence from Jakarta, Indonesia, suggests that the per-passenger use of road space for a standard bus is approximately half that of a minibus[93].

Bangalore Metropolitan Transport Corporation (BMTC). 6166 of these buses service over 5 million passengers every day in Bangalore, India[94].

(Image source: Hayathkan.h, 2014)

Type of infrastructure	Capacity (persons/hour/direction)
Urban street (car use only)	800
Bike path	3,500
Pedestrian walkway	4,500
Dual lane highway	2,000
Bus lane	10,000

Estimated capacity of different transportation infrastructure
(Source: Rode et al., 2014[95], based on based on Rode and Gipp 2011, Litman 2009, Wright 2002, and Brilon 1994)

[91] Cervero, "Informal Transport in the Developing World."
[92] Transport for London, "Route 66 Switches to Double Decker," *Transport for London*, 2014
[93] Cervero, "Informal Transport in the Developing World."
[94] BMTC, "BMTC at a Glance," 2017, https://www.mybmtc.com/bmtc_glance.
[95] Rode et al., "Accessibility in Cities: Transport and Urban Form."

However, the need to invest in higher capacity systems **does not mean replacing lower capacity systems entirely:**

- As high-capacity buses are more expensive to invest in than semi-formal services, they are therefore less appropriate for low-density, low-income areas that will not generate sufficient demand to cover costs of provision. In Dakar, Senegal, new high-capacity buses can cost over 10 times the price paid for minibuses, and as such fares charged for these can reach USD$0.90 where minibuses usually do not charge more than USD$0.25[96]. A rough estimate suggests that across Mexico's 100 largest cities (excluding Mexico City, Guadalajara, and Monterrey), in order for a BRT system to make up even 25% of urban transport (roughly half of public transport trips), estimated capital costs would range from $13,554 to $528,997[97]. Even in the most optimistic scenario, this would mean a BRT of this scale would cost approximately 3% of GDP of these cities – as compared to the 3.7% of GDP the Mexican government spend on education in 2013. At worst, this would cost 125% of GDP[98].

- Without additional investment in widening and improving the quality of roads and well as regulating private transportation, simply increasing the number of public buses on existing roads may create further challenges. In particular, this may contribute to issues of gridlock, resulting in slow journeys with higher emissions. Large municipal buses in Accra, for example, have been unable to compete with minibus services due to their inability to maintain adequate speeds and regular schedules[99]. High capacity buses work most effectively on dedicated lanes, as seen in BRT systems (see section below).

- The introduction or expansion of a mass public bus system is likely to face **resistance** from semi-formal transport operators for whom these investments can act as competition for their services and jobs.

Lower capacity services provided by buses, taxis and motorbikes can instead **complement** formal transport services by providing **'feeder' services** from low density areas that provide individuals access to higher capacity systems in higher density areas of a city.

[96] "Senegal's Legendary 'Car Rapides' Reaching the End of the Line," *Reuters*, November 13, 2015
[97] Erick Guerra et al., "High Capacity Transit, Sprawling Density, and Commute Choice in Mexico's 100 Largest Cities," 2017.
[98] Guerra et al.
[99] Cornelius Nuworsoo, "New Public Transit System for Accra, Ghana," *Focus* 3, no. 1 (April 1, 2006),

How can policymakers decide on additional investments for mass capacity public transport?

For cities at higher levels of density and with greater resources for public transport investment, a key decision facing policymakers is whether to, and what extent to, invest in Bus Rapid Transit (BRT) or rail-based transport systems. An effective transport strategy for a city is one that invests in alternative complementary modes of transport across a city depending on their suitability to particular areas.

BRT systems

Bus Rapid Transit (BRT) systems are bus systems that aim to mimic the regularity and speed of rail-based transit by providing lanes where BRT buses have priority or sole use. A BRT system was first developed in Curitiba, Brazil, as a cost-cutting way to provide high speed mass transport in the city. BRT systems of varying sophistication and technology have been implemented in over 150 cities across the world, including Bogota, Cape Town, Lagos, Yangon and Dar es Salaam. There are two main forms of BRT seen in cities:

1. **High-end or full-service BRT systems**: These have specific traffic lanes exclusively designated for BRT buses. Full service BRT systems have high-quality raised platforms with pre-boarding fare collection to speed up the boarding process. In addition, these systems often use advanced technologies to manage traffic signalling and provide real-time information on bus timings. Such BRT systems are seen in cities such as Bogota, Dar es Salaam, Lima, Jakarta, and Guangzhou.

2. **"BRT Lite" systems**: These BRT buses are given some form of signal priority and some dedicated marked lanes, alongside some mixed traffic lanes, but not fully physically separated busways. BRT Lite systems often have more simple bus shelters instead of raised stations. These systems are often less technologically intensive, less costly and can involve fare collection on buses rather than before boarding. These kinds of system are seen in Lagos, Johannesburg and Cape Town.

Traffic congestion before and after the construction of a BRT system in area surrounding Ganging station in Guagzhou, China

(Source: World Bank, 2017)

By allocating specific lanes for buses, BRT systems combine the benefits of high capacity and low congestion for efficient, regular and low-emission connectivity. The benefits of BRTs in reducing congestion through high capacity transport are **more pronounced for full-service BRT lanes**. The quality of busways significantly affects the speed of BRT travel, with mixed use lanes offering the slowest means of transport[100]. However, high end BRTs come with additional capital and operating costs. Often these two 'types' of BRTs can be seen in the same city, as in Beirut, for example, where a full-scale BRT operates in the city centre, and a BRT Lite system in surrounding areas.

The BRT system launched in Lagos in 2008 served over 200,000 passengers daily in its first year of operation and cut average in-vehicle journey times by 40 percent and waiting times by 35 percent[101], despite the fact that BRT buses only make up 4% of vehicles on Lagos's roads[102].

Rail based transit: light rail and mass rapid transit systems

More complex (and costly) rail based transport include:

- **Light rail transit (LRT) systems**. These systems operate using trains that run mostly over-ground using an electrified line. These are higher capacity than trams, and operate on an exclusive dedicated line. LRTs generally operate at lower speeds and have a lower carrying capacity than regular railway or metro systems.

- **Mass rapid transit (MRT) metro/commuter railway systems.** These trains transport passengers on trains that run on tracks over- or underground in a city. These tracks are not accessible by pedestrians or other vehicles and often operate underground or on elevated structures above street level. Such systems include the New York City subway and the Shanghai Metro.

Addis Ababa's Light Rail system in 2015

New York City's subway system

(Photo: Moreira, 2008)

100 Robert Cervero, "Bus Rapid Transit (BRT): An Efficient and Competitive Mode of Public Transport (Working Paper)" (Berkeley Institute of Urban and Regional Development, 2013).
101 Mobereola, "Lagos Bus Rapid Transit: Africa's First BRT Scheme."
102 Gordon Pirie, "Sustainable Urban Mobility in 'Anglophone' Sub-Saharan Africa," Thematic Study Prepared for Global Report on Human Settlements 2013 (Nairobi: UN-HABITAT, 2011), http://www.unhabitat.org/grhs/2013.

The LRT system opened in Addis Ababa in 2015 is estimated to save each traveller 63 hours per year in travel time, with projected estimates of total time saved in 2020 alone valued at a US$39.5 million[103] - approximately 12% of the initial capital costs of construction.

Carrying capacity and costs of these systems

	BRT	Light Rail	Metrorail
Construction time	1-2 years	2-3 years	4 – 10 years
Maximum capacity (passengers/vehicle unit)	160 – 270	170 – 280	240 - 320
Line capacity (passengers/direction/hour/lane)	2,500-22,500[1]	12,000 – 27,000	24,000[2] – 72,000
Maximum speed (kph)	60 -70	60 – 80	70 – 100
Average capital costs^ (US$million/km)	8.4	21.5	104.5
Average operating costs^ (US$ / vehicle revenue km)	2.94	7.58	5.30

Adapted from Cervero (2013)

^Capital and operating costs calculated from US case studies, using 2000 $USD Consumer Price Index average

Carrying capacities

Experience from a number of cities reveals that while most well-functioning traffic lanes can accommodate around 800 vehicles per hour past a given point, by allocating specific lanes for buses, BRT lanes can accommodate the movement of over 9,000 people per hour[104].

LRTs generally have higher capacities than BRT systems on dedicated lanes. The two-line 34km LRT system opened in Addis Ababa in 2015, for example, is estimated to have a carrying capacity of **15,000 passengers**/hour/direction/line past a particular point[105]. This is compared to Lagos's 22km BRT system that is able to transport **10,000 people per hour** per lane in peak hours[106]. However, in the case of more sophisticated BRTs, LRTs may actually have lower capacity. For example, Bogota's high capacity TransMilenio BRT is able to carry over **20,000 passengers** per hour per direction on each lane[107].

MRTs, on the other hand, usually have higher carrying capacities than bus-based systems, at **over 30,000 passengers** per hour per direction[108]. As such, investments in these systems can be transformative for rapidly growing cities.

---

[103] Dipti Ranjan Mohapatra, "An Economic Analysis of Light Rail Transit in Addis Ababa Ethiopia.pdf," 2015
[1] 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).
[2] Minimum line capacity based on projections for Jakarta's MRT from Raditya Margi, "LRT to Move 24,000 Passengers per Hour," *The Jakarta Post*, 2015
[104] World Bank, "Bus Rapid Transit for Greater Kampala Final Report."
[105] Leyland Hazlewood, *Doing Business in Africa: Nuts and Bolts of Succeeding in Business* (Motivational Press, 2016); Centre for Public Impact, "Light Rail Transit in Addis Ababa," *Centre for Public Impact*, 2016,
[106] Orekoya, "The Bus Rapid Transit System of Lagos, Nigeria."
[107] Cervero, "Bus Rapid Transit (BRT): An Efficient and Competitive Mode of Public Transport (Working Paper)."
[108] UN-HABITAT, "Metro, Light Rail and BRT," 2013.

Costs

Costs of these systems include land acquisition costs, capital investment costs, costs of operation and costs of enforcement. For BRT systems, for example, there may be significant costs and enforcement capacity needed to restructure road traffic laws and, most importantly, regulate use of BRT lanes so that they are only used by BRT vehicles.

LRT systems are generally more expensive to construct than BRT systems, and MRT rail systems, particularly underground systems, have even higher costs of construction, at approximately five times the cost of LRT systems:

- The 34km LRT system in Addis Ababa, for example, including tracks, locomotives and communications systems, cost USD$475 million to construct.
- The initial 23.3 km North-South line (including electrical systems and rolling stock) of Jakarta's MRT system is estimated to cost over USD$1.7 billion, with the first 15.7 km phase of is estimated at US $1.29 billion[109].

By comparison, most BRT systems cost well under USD$10 million per kilometre to construct[110]. The 22km BRT system in Lagos cost just USD$37.4 million to build, including the cost of stations, road partitions and 220 buses[111]. 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.

There are, of course, exceptions to this. In Kampala, for example, where land is difficult to acquire and the city lacks an extensive road network and public bus system, infrastructure for a pilot 25km BRT system that could carry 37,000 passengers per day is estimated to cost USD$429 million.[112]. This is 71% higher than the cost per kilometre of most other BRT systems across the world.[113]

Cost analyses from U.S. cities suggests that BRT systems with buses operating on exclusive lanes generally have significantly **lower total costs per passenger**, including operating costs and capital costs, in all cases except where residential densities are very high and where hourly one-way passenger volumes are in excess of 30,000[114].

109 Ayomi Amindoni, "MRT Jakarta: DIgging the City," *The Jakarta Post*, 2016,

110 David Hensher and Thomas Golob, "Bus Rapid Transit Systems: A Comparative Assessment," *World Transit Research*, January 1, 2008

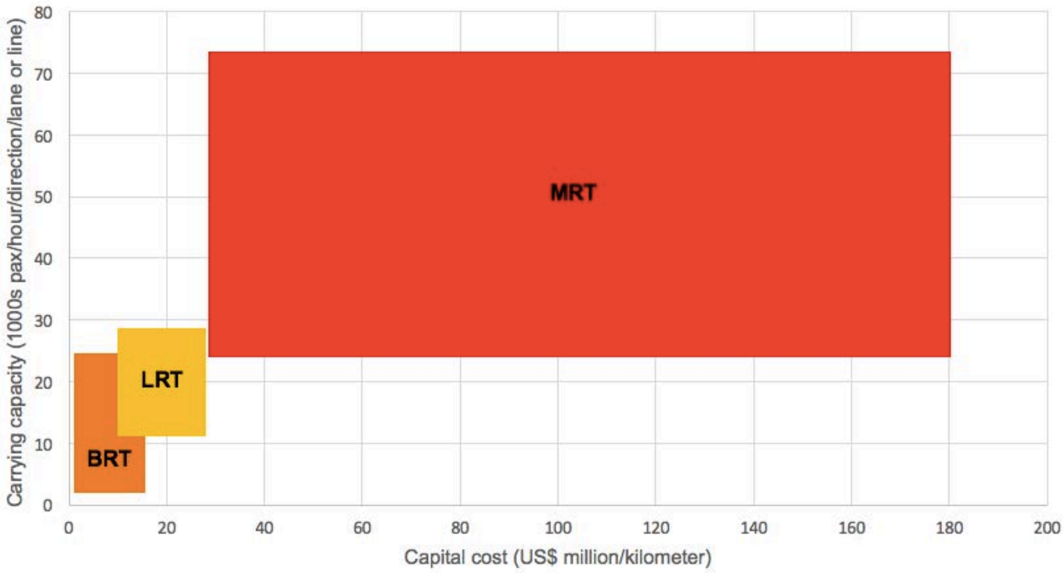
111 Cervero, "Bus Rapid Transit (BRT): An Efficient and Competitive Mode of Public Transport (Working Paper)"; David O. Omole and Julius M. Ndambuki, "Sustainable Living in Africa: Case of Water, Sanitation, Air Pollution and Energy," *Sustainability* 6, no. 8 (August 12, 2014): 5187–5202, https://doi.org/10.3390/su6085187.

112 World Bank, "Bus Rapid Transit for Greater Kampala Final Report."

113 David Hensher and Thomas Golob, "Bus Rapid Transit Systems: A Comparative Assessment," *World Transit Research*, January 1, 2008

114 John Robert Meyer, John F. Kain, and Martin Wohl, *The Urban Transportation Problem* (Harvard University Press, 1965); Jose A. Gomez-Ibanez, William B. Tye, and Clifford Winston, *Essays in Transportation Economics and Policy: A Handbook in Honor of John R. Meyer* (Brookings Institution Press, 2011); Arthur O'Sullivan, *Urban Economics*, 8 edition (New York, NY: McGraw-Hill Education, 2011).

Because of its substantially lower cost, the city of Quito has also been able to build a BRT transport system that covers nearly 20 times the distance that would have been possible in a metro rail system with the same resources[115].



Carrying capacity and cost of different transport systems
(Figures calculated from Cervero 2013 and UN-HABITAT 2013)

These costs may in turn have implications for sustainable **affordability of fares** that can be charged for an LRT or MRT system, and also have implications for how fast the system can be expanded to meet rapidly growing populations in a city.

Determining investments for a city: an illustrative example

In deciding to what extent to invest in these different technologies, policymakers will need an idea of how many people travel, or are predicted to travel, across different areas of a city. Using this, it is possible to ascertain what kinds of public transport systems may benefit mobility in a city. If, for example, a city were to want to transport 100,000 people from the outskirts of a city 20km away to the city centre each morning, this can be compared to carrying capacities and cost estimates of different systems. To give an example:

Transport type	Carrying capacity/direction/hour/lane	Annualised capital and operating costs (including cost ^of land acquisition)/lane km
BRT	10,000	$250,000
LRT	12,500	$600,000
MRT	50,000	$2.5 million

115 Cervero, "Bus Rapid Transit (BRT): An Efficient and Competitive Mode of Public Transport (Working Paper)."
^It is important to note that capital and operating costs per kilometre are unlikely to be constant due to economies and diseconomies of scale, where average costs fall or rise as output increases. It is also important to note that these costs should include provisions for unexpected capital enhancements and expected and necessary capital renewal.

Given the carrying capacities listed above, to transport 100,000 people (assuming commuting journeys no longer than 1 hour) would require:

- 10 x 20km BRT lanes, with a total annual cost of $50 million or
- 8 x 4m x 20km LRT lanes, with a total annual cost of $96 million, or
- 2 x 5m x 20km MRT lanes, with a total annual cost of $100 million

Or some combination of these modes. In this way, the need to meet a particular level of mobility demand can be compared to constraints on **capital and operating cost** and **land availability** to determine which investments are feasible for a city.

In this example, we do not consider the **additional cost** associated with using large amounts of land for transport systems. This is the 'opportunity cost' of land – the cost that cities incur by giving up prime urban land which can serve other productive uses. If we assume that an MRT can be constructed below ground, and that any land used for transportation for a BRT or LRT could instead have been used for more productive activity, **these costs can be substantial** and are likely to affect the viability of a BRT system for large cities.

Estimating financial sustainability

Comparing those options that meet the budget and land availability constraints of city governments with income levels for fare payments and other sources of funding a city can give a sense of the **financial sustainability** of a given system. For example, if average income levels are approximately $5,000, and from survey data this suggested that daily fares affordable to the target 100,000 commuters should be set at $1.50 for public transport, daily total revenues would equal:

Number of commuters x fare for individual travel = 100,000 x $1.50 = $150,000[i].

This would mean a total annual revenue of **$54.75 million**. This can be added to any annualised funding from commercial revenues, property value-related income and land value capture mechanisms that increase as a result of public transport system investments. In this example, if we assume that a city government is able to pay the initial capital costs for all of these systems, that sufficient land is available for all three, and that all funding is to come from transport fares, this means that for the three feasible systems:

- A 10 lane BRT system is **self-sufficient**; annualised revenues > annualised costs
- An 8 lane LRT system is not self-sufficient; annualised revenues < annualised costs. This would require an **annual subsidy of $41.25 million**
- A 2 lane MRT system is not self-sufficient; annualised revenues < annualised costs. This would **require an annual subsidy of $45.25 million**.

In reality, most forms of public transport will require some level of subsidy, with the exception of semi-formal transport services and those higher capacity mass transit systems that are

[i] It is important to note that this assumes a fixed number of commuters. In practice, the number of commuters and the fare charged for travel are interdependent.

partly funded through land value capture (see paper on *institutions and incentives for infrastructure and service provision)*. Where subsidies are required for transport investments, cost benefit analysis is required to determine whether the quantifiable **benefits** of these systems to passengers and to society more broadly outweigh the costs.

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 fares. In many cases, subsidies on high capacity transport implemented in an effort to reduce congestion can allow for a **positive cycle of financial sustainability**. With higher investment, better and more frequent public services are provided, increasing ridership as a result which in turn increases revenues from fares.

The importance of urban density and form

Urban density is therefore key to transport decision making. The higher the urban density, the more riders there are likely to be on each kilometre of public transport systems. Higher population density for serviced areas therefore allows providers to spread costs in charging fares whilst also reducing costs by allowing existing buses or trains to be used to full capacity. Put differently, the higher urban density, the lower the distance required for transport services to service a given number of riders, and the lower the costs of construction of public transport systems.

Urban density levels differ across and between cities. In South Asian cities, density levels are particularly high, with population density in Dhaka, for example, reaching 372 persons per hectare[116]. By comparison, in sub-Saharan African cities such as Kampala, urban densities are lower, at approximately 59 persons per hectare[117]. In Nairobi, urban density can range from 5 to 1,200 persons per hectare, depending on the neighborhood[118]. Though acceptable walking times vary with the culture and income of a city, surveys on 'accessibility' worldwide have indicated that most people will only find public transport acceptable if it requires no more than 10 minutes of walking to reach a station. This means public transport stops have a catchment radius of approximately 800 meters[119]. The population density in this area can thus help determine the financial viability of transport projects. It is estimated that BRT systems, for example, can only remain financially viable if there are at least 10 passenger boardings per kilometer per day per bus[120]. The higher the density of a city, the more likely it is that a large group of individuals live close enough to a station for it to remain financially sustainable.

A similar relationship exists between riders and density for LRT and metro systems; because LRT systems have higher capital costs per kilometre, they require higher urban densities (and therefore demand) than bus-based systems to remain sustainable whilst still charging affordable fares. MRT systems would require even higher levels than this.

---

[116] NYU Urban Expansion Program, "Atlas of Urban Expansion" (Marron Institute of Urban Management and the Stern School of Business of New York University, 2017).
[117] NYU Urban Expansion Program.
[118] Global Site Plans - The Grid, "Nairobi, Kenya's 1973 Master Plan Receives an Update," *Smart Cities Dive*, 2014,
[119] Alain Bertaud, "The Spatial Organization of Cities: Deliberate Outcome or Unforeseen Consequence? (Working Paper)," *Institute of Urban and Regional Development*, IURD Working Paper Series, 2004, http://escholarship.org/uc/item/5vb4w9wb.
[120] Adam Greenfield, "Buses Are the Future of Urban Transport. No, Really," *The Guardian*, August 27, 2014, sec. Cities

	Built-up Density: People Per Hectare of Land in Urban Use	Residential Density: People Per Hectare of Residential Land
One bus per hour	21	30
Two buses per hour	31	44
Light rail	37	53
Heavy rail	50	71

Notes: Hectare = 2.5 acres; intermediate service = 40 buses per day; high service = 120 buses per day.
Source: J. Holtzclaw, *Using Residential Patterns and Transit to Decrease Auto Dependence and Costs.* Washington DC: Natural Resources Defense Council, June 1994.

Minimum densities needed to support mass transit (O'Sullivan, 2011)

Given the variety of costs involved in BRT and rail based systems, they are therefore **less appropriate for low density urban areas,** where congestion is not sufficient to warrant these investments, and demand is not sufficient to recover some or all of the costs. As urban areas begin to increase in density, bus-based systems may be most appropriate where population growth, income levels and density are not yet high enough to justify costly investments in rail-based systems.

In cities such as Cape Town and Johannesburg, low-density urban sprawl has meant that the figure for BRT passenger boarding is closer to 2. This has been a key reason why BRTs have been unable to meet financial or passenger targets[121]. This is in contrast to cities such as Paris and Barcelona, where high urban density allows for sustainable provision of high cost public transit services.

The spatial form of a city will also play an important role in determining the costs per passenger of transport provision, because with different urban forms come different distributions of density along particular routes. Polycentric urban forms, for example, with multiple high density urban areas will require multiple lower capacity transport routes when compared to monocentric city structures with one dense urban centre. They may therefore be less able to support high capacity, high cost rail based systems.

Additional relative costs and benefits of these systems for a city

Relative benefits of BRT systems

- ✓ **Faster to construct.** Compared to other high capacity public transit services, BRT systems, particularly BRT Lite systems, are relatively quick to build and expand, and can begin operations before an entire system is completed, making these systems well suited for rapidly expanding urban areas.

Relative benefits of rail based systems

- ✓ **Environmental sustainability.** As LRT and MRT systems run on electricity and do not generate tailpipe emissions, they also have lower greenhouse gas emissions than buses and private vehicles[122]. A study of the impact of the low sulphur diesel run, dedicated lane Rea Vaya BRT system in Johannesburg suggests that it has

[121] Greenfield.
[122] UN-HABITAT, "Metro, Light Rail and BRT."

saved South Africa up to USD$890 million as a result of improvements in travel time, road safety and carbon emissions[123]. This is over three times the total construction budget for the project which in 2010 stood at $233 million[124].

- ✓ **Limited land requirements in some cases.** MRT systems on elevated structures or underground do not usually require substantial displacement of existing development on urban land, avoiding to some extent the challenges of land acquisition other than for station entry/exits. In Kuala Lumpur, for example, a subway system is being built on raised tracks to prevent disrupting the existing road network. Though this comes at substantial capital costs for investment in tunnels or raised platforms, public investments in MRT systems may be socially optimal in cities with high opportunity costs for land use.

- ✓ **Limited need for enforcement of use.** In cities such as Bogota, Accra, Lagos and Yangon, the inability of officials to fully enforce regulations on the use of BRT lanes means that private vehicles often use these lanes, significantly impairing the BRT system as a means of rapid connectivity. LRTs and MRTs do not face a similar magnitude of problem in enforcement.

- ✓ **Reductions in delay and scheduling costs**. Because of the lower capacity of BRT systems, these are likely to approach capacity in high density cities. As such, commuters can face overcrowded carriages, long queues for transport, and 'rescheduling costs' associated with having to leave earlier for work. This is important for cities such as Bogota, where overcrowding on the BRT system means that at peak times passengers can wait up to 45 minutes to board a bus[125]. Depending on the value of people's time, these costs can be substantial for high density cities.

- ✓ **Limited resistance from existing road users.** The introduction of a BRT system, particularly one that encroaches on existing roads, is likely to face significant resistance from private vehicle users and other existing bus providers.

Case study: resistance to BRT reform in Dar es Salaam

In Dar es Salaam, for example, plans to introduce a World Bank funded BRT project initiated in 2002 were significantly resisted by local informal *daladala* minibus drivers. This was because the introduction of the BRT system was seen to offer no real employment opportunities for existing informal operators would significantly reduce employment and revenues. As such, the construction of the BRT system was very slow to progress, due in large part to limited will on the part of the Tanzanian government to challenge these politically powerful transport operators[126].

---

[123] Andy Gouldson et al., "Accelerating Low-Carbon Development in the World's Cities (Working Paper)," Supporting Document for the 2015 Report of the Global Commission on the Economy and Climate, Seizing the Global Opportunity: Partnerships for Better Growth and a Better Climate (The New Climate Economy, 2015).
[124] Rea Vaya Johannesburg, "Rea Vaya: Comprehensive Project Update," 2010
[125] Jason Margolis, "8 Million People. No Subway. Can This City Thrive without One?" *Public Radio International*, 2015
[126] Rizzo, "The Political Economy of an Urban Megaproject."

How can policymakers address challenges to the introduction of both BRT and mass public bus systems?

Operational challenges when investing in high capacity buses and BRT systems are presented by the strong resistance of private vehicle users as well as existing formal and semi-formal public transport providers (see above on the challenges of high capacity buses and BRTs). To mitigate these requires:

1) **Enforcement capacity, which often needs strong high-level political commitment**. Strong commitment to the effective implementation of transport systems has been crucial in pursuing mobility investments despite political resistance and providing the necessary confidence to private investors for the delivery of public transport systems across developing cities such as Bogota, Seoul and Lagos.

2) **Communication with existing bus operators** to discuss the employment opportunities offered by BRT systems and the benefits of these systems to existing operators when part of an integrated system.

> **Case study: communication to address resistance in Lagos**
>
> In Lagos, for example, the cooperation of politically powerful National Union of Road Transport Workers in the development of a new BRT system launched in 2008 was needed to avoid lengthy protests and disruption of public services. At the same time, in order to attract private investors to pay for more expensive BRT vehicles, the government needed to assure these investors that they would not face a backlash from the bus union. In order to address political resistance, the government in Lagos undertook extended negotiations with the bus union, where they attempted to convince union officials of the widespread benefits of a BRT system and how in other countries the system had been integrated with existing bus services. LAMATA sponsored visits by union officials to Latin America to see the BRT system operating alongside other bus services in practice. As a result, the bus union agreed to allow a BRT system to operate in Lagos.

3) **Employment opportunities for existing bus operators.** Resistance to these systems from existing operators can be addressed to a large extent by providing employment opportunities to existing operators. For example, in Johannesburg, minibus taxi operators were included in negotiations from the start, allowing them to become drivers and shareholders in the new BRT system and limiting resistance[127].

   Integration of existing transport vehicle owners may require government finance, or support to access private finance, in order to invest in higher capacity buses. In Lagos and Accra, 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

[127] Lily Kuo and Lily Kuo, "How a Public Bus System in Johannesburg Saved South Africa $890 Million," *Quartz* 2017

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.

At the same time, successful integration requires significant investment in training and re-skilling for drivers to ensure a regular and efficient service on high-capacity buses. In Lagos, though depots, terminal and lanes for the BRT system have been provided by the state, the system is operated by a NURTW-affiliated cooperative. However, NURTW leaders lack the experience and incentive to improve customer experiences on the BRT system, resulting in low quality service and maintenance of the system[128].

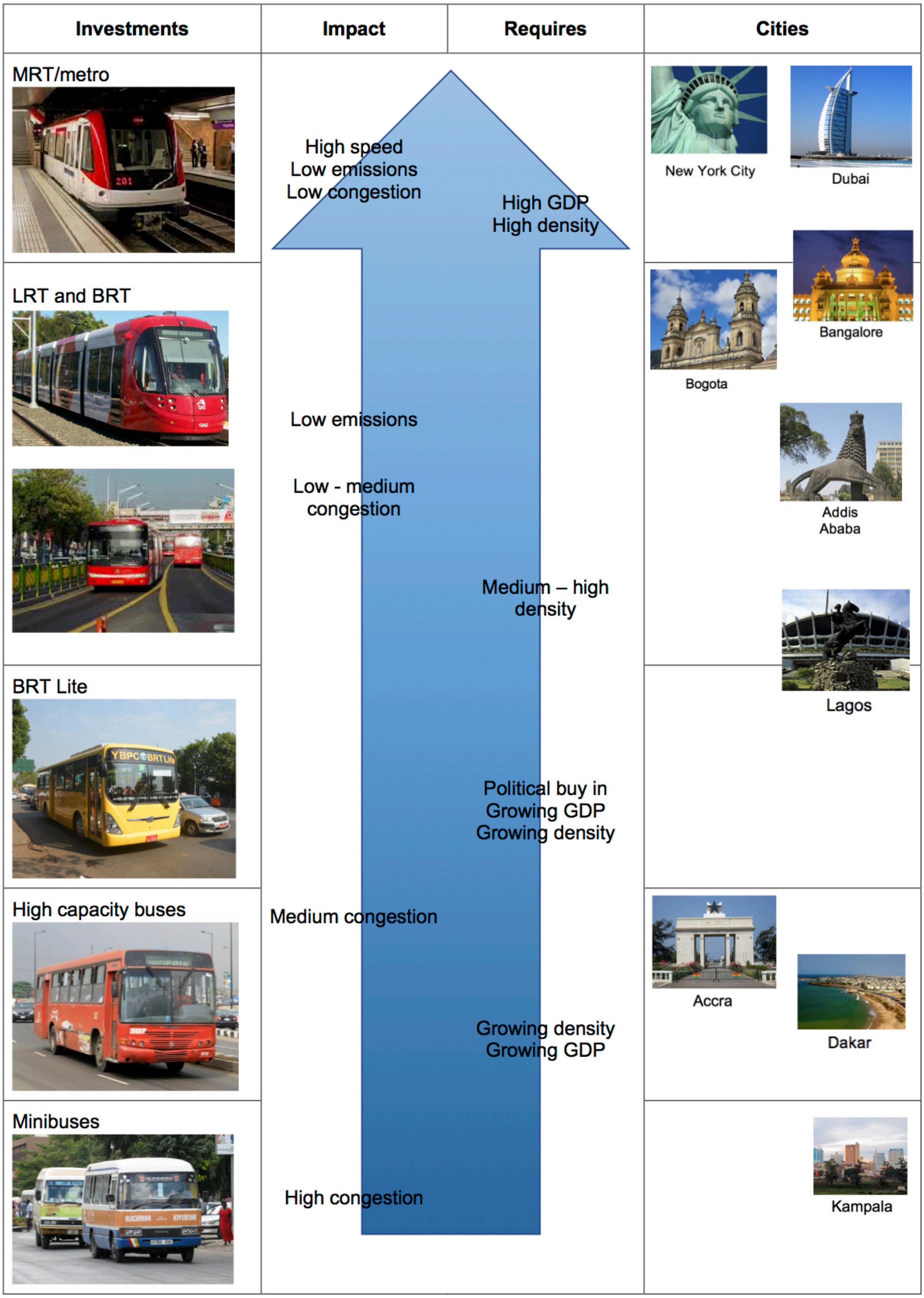
In the long run, introduction of high-capacity buses to compete with minibuses for transport services will inevitably reduce drivers' employment in the sector, given that a greater capacity of passengers can be transported with less drivers under higher capacity bus and BRTs systems. As such, reducing resistance from existing operators may require additional measures to provide jobs in the transport or other sectors.

4) **Greater communication with middle income commuters.** These are the commuters who stand to benefit most from a high-capacity bus or BRT system, particularly if these systems can be subsidised. Therefore, they can be instrumental in supporting the government on the introduction of these buses.

5) **Incremental introduction of these systems.** The introduction of a BRT or high capacity bus system across a city in stages can allow the benefits of enhanced urban mobility can be demonstrated to users. In Lagos, for example, introduction of a BRT system despite resistance from more vocal private vehicle users improved their public support in the long run as bus users began to experience the benefits of a BRT system.

6) **Land acquisition to expand roads for BRTs, where possible.** If buses are separated from cars by building new dedicated lanes, rather than by using existing road space, BRT systems can improve connectivity for those travelling on the buses in the system. At the same time, they can also increase the speed of other road traffic, as seen in Seoul[129]. This can reduce the resistance to BRTs by private vehicle users. Policymakers thus face a trade-off here between efficiency and political resistance of private vehicle users, and the cost and political resistance associated with land acquisition (see Paper on *institutions and incentives for infrastructure and service delivery*).

[128] Diane de Gramont, "Governing Lagos: Unlocking the Politics of Reform" (Carnegie Endowment for International Peace, 2015).
[129] Cervero, "Bus Rapid Transit (BRT): An Efficient and Competitive Mode of Public Transport (Working Paper)."



Summary of the impact and requirements of different public transport systems

(Infographic adapted from Planet Projects, 2017)

The importance of complementary urban land use planning for urban accessibility

Land use regulations in many developing cities restrict urban density through unrealistic minimum plot sizes. In Dar es Salaam, for example, the minimum lot size is 375m^2 – as compared to 28m^2 in Philadelphia, US, at early stages of development. As a result, 90% of the city does not comply with this regulation[130]. Redesigning housing and land use policy[^] to address this, particularly around transport terminals, can play a key role in **increasing the financial sustainability** of transport systems through higher urban density. At the same time, inclusionary urban land use and housing policies can help governments to mitigate the negative effects of transport investments on the affordability of surrounding areas for low-income households[131].

Case study: land use to complement transport investments in Curitiba, Brazil

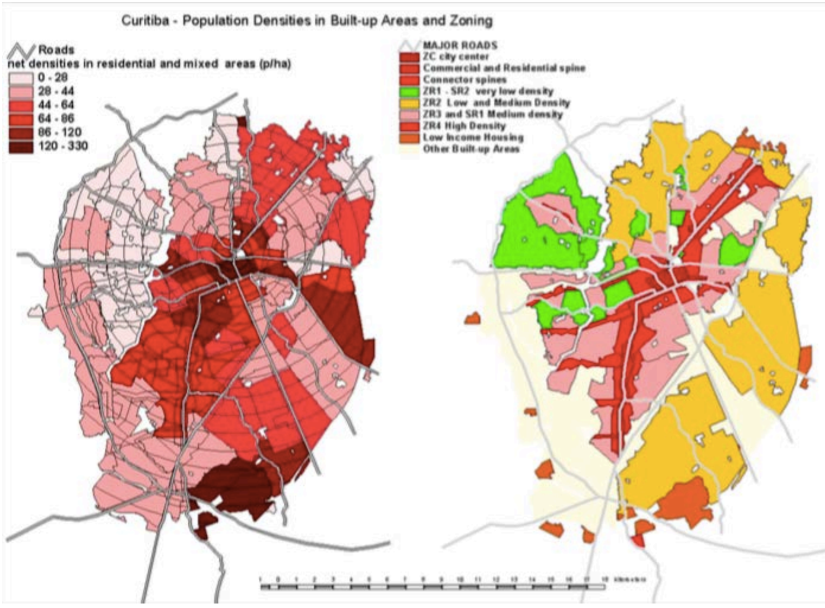
In Curitiba, Brazil, complementary reforms to land use planning alongside transport investments have ensured financial viability and popularity of their BRT system, implemented in 1974. This has been achieved in two main ways[132]:

- Land use regulation to encourage "transport orientated development" in the form of 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. As such, 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 (and not private) 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 only approximately 10 percent of income on travel[133]. As a result of improving convenience, affordability and proximity of this system, by 1991 it was estimated that 28% of commuters has switched from car to BRT travel[134].

[130] Somik V. Lall, "Opening Doors to the World: Can African Cities Deliver on the Promise of Growth?" (WRI Ross Center for Sustainable Cities, 2016).
[^] For more information on improving proximity through urban land use planning, see *Cities that Work* Policy Brief on Urban Land Use Planning (forthcoming).
[131] Gwilliams, "Transport Pricing and Accessibility."
[132] Gwilliams.
[133] Gwilliams.
[134] Federal Transit Administration and Volpe National Transportation Systems Center, "Issues in Bus Rapid Transit," Prepared for the Bus Rapid Transit Forum, 1998.



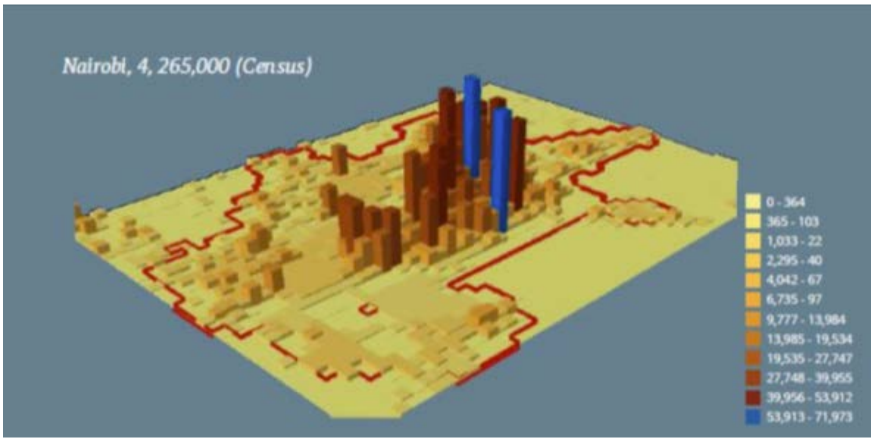
Population density and zoning regulations in Curitiba. Zoning has been implemented to encourage high density development along transport corridors, but further reforms to encourage more marketable land rights can allow for greater central urban density.

(Source: Bertaud, 2002)

Policies to improve mobility in cities are, however, only one piece of the puzzle. People's access to job opportunities and urban services can also be expanded by **increasing their proximity to each other**. Initial findings from accessibility in Indian cities finds that proximity alone can explain up to 81% of the differences in citizens' access across these cities[135]. In a city like Bokaro (in Jharkhand, India), well maintained roads mean that cars can travel high speeds, but accessibility is hampered by the fact that there are long distances between locations.

Current patterns of land intensive and fragmented 'leapfrog' urban growth in many developing cities increase average distances between people's homes and jobs, limiting workers' accessing job opportunities across a city. By preventing businesses from locating in certain areas, people have to travel long distances to access jobs. In Cape Town, for example, a lack of central density in the city means that 86% of residents cannot affordably access marketplaces[136].

[135] Akbar et al., "Accessibility and Mobility in Urban India."
[136] Laura Sara Wainer, Billy Ndengeingoma, and Sally Murray, "Incremental Housing, and Other Design Principles for Low-Cost Housing" (IGC, 2016).



Fragmented development in Nairobi

(Source: Lall et al., 2017)

The importance of proximity highlights a key role for **urban land use policy** to complement investments in mobility. In some cities, this will involve decentralisation of particular types of economic activity such as hairdressers and grocers into mixed use neighbourhoods that allow consumers easier access. In many developing cities, there is also a need to intensify urban density, particularly for firms that offer employment opportunities in central urban areas and in surrounding residential areas. By relaxing unnecessarily stringent density regulations, policymakers can encourage more compact urban growth. This can expand access to opportunities without having to expand means of mobility (whilst also increasing the financial sustainability of existing transport systems).

Coordinating land use and housing policy with transport investments, particularly on the outskirts of a city, can rapidly improve accessibility in many developing cities.

Concluding remarks

Urban policy to address constraints to mobility in developing cities is crucial to improving their liveability, productivity and sustainability. Mobility policy can act through three main channels: provision and management of core infrastructure such as roads and pavements, regulation of private use, and regulation and investment for public means of transport.

Investment in roads and pavements provides the foundation for accessibility in cities. However, evidence from developed cities shows that more roads will not solve problems of congestion in cities, unless accompanied by measures to regulate private use and invest in public transport systems. In this context, financial disincentives to vehicle use and ownership can represent 'win-win' solutions to restrict use and finance public transport infrastructure.

Public transport in many developing cities primarily takes the form of semi-formally provided paratransit services, with informal minibuses acting as the backbone of urban access in many cities. Policy to regulate these systems must take into account the key role they play as a low-cost means of urban mobility. When investing in higher capacity public transport systems, the choice of technology involves a trade-off between cost and carrying capacity. In many cities, BRTs have offered a relatively low-cost and high capacity system, but tailoring technologies to the transport needs of the cities involves detailed cost-benefit analysis. Urban density plays a key role here in determining the financial feasibility of different systems. Any subsidies required to supplement individual user fees can be considered alongside the additional benefits and costs the system is expected to provide, with political resistance to transport investments a key challenge to be factored into this analysis.

Critical to the success of any urban mobility policy is the need for adequate planning, legal and regulatory institutions, as well as appropriate arrangements for providing and financing effective infrastructure and service delivery. Options for financing and provision of transport infrastructure and services, as well as the necessary institutional reform required to effectively address mobility concerns, are addressed in *institutions and incentives for infrastructure and service delivery*.

Alongside mobility policy, improvements in urban accessibility will require complementary policies to manage land use in a city that can both improve the financial sustainability of transport investments, but also increase access through greater proximity of opportunities and services.

Recommended further reading

Amelsfort, Dirk van (2015), "Introduction to Congestion Charging: A Guide for Practitioners in Developing Cities". Asian Development Bank and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

Cervero, Robert (2013), "Bus Rapid Transit (BRT): An Efficient and Competitive Mode of Public Transport" (Working Paper), Berkeley Institute of Urban and Regional Development

Cervero, Robert (2000), "Informal Transport in the Developing World" UN-HABITAT

Collier, Paul and Venables, Tony (2016), "Urban infrastructure for development". *Oxford Review of Economic Policy*

De Gramont (2015), "Governing Lagos: Unlocking the Politics of Reform", Carnegie Endowment for Peace

Gwilliams, Ken (2017), "Transport Pricing and Accessibility", Brookings: Moving to Access

UN-HABITAT (2013), "Global Report on Human Settlements: Planning and Design for Sustainable Urban Mobility".

More interesting case studies of political processes behind transport reforms are also available from Transforming Urban Transport- The Role of Political Leadership (TUT-POL) at http://www.transformingurbantransport.com.

Please cite the contents of this document as follows: Collier, P., Glaeser, E., Venables, A., Manwaring, P., and Blake, M. (2017) *Accessing opportunities: policy decisions for enhancing urban mobility – version 2.* IGC *Cities that Work* Policy Brief.

The International Growth Centre (IGC) aims to promote sustainable growth in developing countries by providing demand-led policy advice based on frontier research.

Find out more about
our work on our website
www.theigc.org

For media or communications
enquiries, please contact
mail@theigc.org

Subscribe to our newsletter
and topic updates
www.theigc.org/newsletter

Follow us on Twitter
@the_igc

Contact us
International Growth Centre,
London School of Economic
and Political Science,
Houghton Street,
London WC2A 2AE

IGC
International Growth Centre

Cities that Work

DIRECTED BY
LSE
UNIVERSITY OF OXFORD

FUNDED BY
UKaid
from the British people

Designed by soapbox.co.uk