Cities that Work

IGC
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SYNTHESIS PAPER

Access to opportunity: policy decisions for enhancing urban mobility

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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.

Urban mobility enables firms and workers to access the large and specialised markets for goods and labour that underpin urban productivity

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.

Expanding roads 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. 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].

Population density is a key determinant of sustainable public transport investments in a city

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).

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.

Across all of these policies, developing clear strategies for the **delivery and financing of infrastructure** and services is key to effective implementation.

In this paper

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. Section 4 discusses linkages between transport and land use planning, and Section 5 looks at effective delivery of these services – in terms of procurement, financing, institutions, and political buy in.

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.

THE BENEFITS OF TRANSPORT FOR JOB MATCHING AND INCOMES: EVIDENCE FROM BOGOTA AND MEXICO CITY

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[3].

In Mexico City, a new subway line was constructed in the early 2000s that connected remote areas with the centre of the city. This reduced commuting costs for individuals living near stations and allowed individuals who were previously working in informal jobs on the outskirts of the city to move into formal employment closer to the city centre. Worker informality rates in nearby locations reduced by 2-4% after the construction of the new line.[4]

3 Nick Tsivanidis, "Commuting Technologies, City Structure and Urban Inequality: Evidence from Bogotá's TransMilenio" (IGC Cities Conference, London, 2016)

4 Román David Zárate, 'Factor Allocation, Informality, and Transit Improvements: Evidence from Mexico City' (2019)

Congestion in Hanoi, Vietnam (Photo: Craig Hastings/Getty Images)

However, in many 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.

Without adequate means of mobility across a city, firms are **unable to access large 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.

In Mumbai, more than 60% of commuters walk to their jobs - the figure is even higher at up to 70% in Kampala

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].

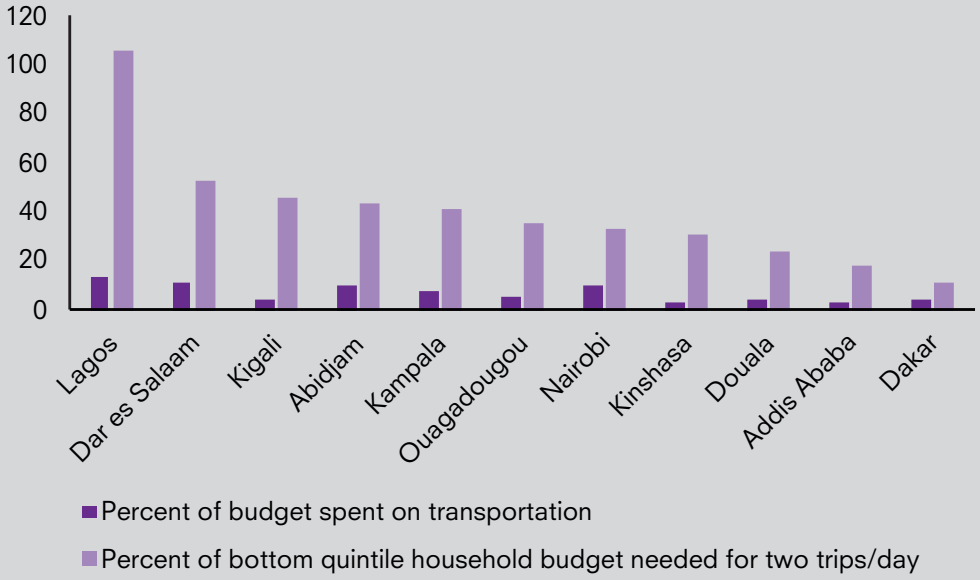
2. **Reducing congestion that negatively impacts these means**. As cities grow, more pressure will be put on existing transport systems, resulting in higher congestion. This is not necessarily a bad thing – it can signal greater economic activity in a growing city. However, measures to reduce congestion can allow for greater access to opportunities, reduce costs of transporting goods, and limit CO_2 emissions. Estimates of the

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).

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].

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

3 **Enhancing affordability of transport systems.** In many developing and middle income cities, effective means of mobility across a city are prohibitively expensive for the majority of citizens. 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 developing 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. 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.

For the poorest households in many developing cities, travelling 10km to work by public transport can cost households up to 30% of their incomes

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

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).

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].

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].

Cross-country evidence suggests opening of subway systems between 2000-2014 have been associated with a 5% reduction in urban air pollution

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 taking place in expectation of future economic activity.

In Barcelona, targeted subsidies for transport are used to improve economic and social integration of different income groups in the 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

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).

Construction along new roads in Addis Ababa (Source: Bird and Franklin, 2015)

Without the government's intervention, potential profitable clustering of investment may not have occurred as no one would be willing to make the first risky investment without assurance others will do the same.

4 **Improved safety.** Currently, 90 percent of traffic mortalities occur in low and middle income countries , with South Africa and Nigeria accounting for more than half of these fatalities in Africa. Enforceable regulations to improve safety can yield significant benefits to users. In South Korea, seat belt use rose from 23% to 98% between 2000-2001 following publicity campaigns, concerted police enforcement and increases in fines. This reduced fatal road accidents by 5.9%[13].

90 percent of traffic mortalities occur in low and middle income countries

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.

To note: public transportation refers here to shared passenger-transport services which are available to the public. These can be privately provided.

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.

13 UN-HABITAT, *Enhancing Urban Safety and Security*, Global Report on Human Settlements (UN-HABITAT, 2007)

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

Private travel includes journeys made by foot, bicycle, motorbike and car. In many developing and middle-income cities, these are the dominant means of travel, providing important means of connectivity where there are limited affordable public transport options.

Making the most of infrastructure for private transportation

Meeting growing demand for private means of transport requires further investment in infrastructure, which includes:

1 **Investment in roads.** This allows for the movement of cars and buses over long distances and at high speeds, crucial for urban connectivity. The density of paved roads in countries in sub-Saharan Africa is **less than a quarter** of that in other low-income countries [14]. Without addressing these deficits, access to opportunities across a city are limited. Initial results from a study of 154 cities in India suggest that around 70% of differences in car speeds in a city are the result of the extent and quality of infrastructure, not of traffic congestion[15].

The density of paved roads in countries in sub-Saharan Africa is less than a quarter of that in other low-income countries

2 **Investments in infrastructure for traffic management**. In Lagos, for example, congestion has been significantly reduced 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 signaling to control traffic flows on particular roads can also be used to improve use of existing road capacity.

3 **Complementary infrastructure for non-motorised forms of transport**. This is to offer low-emission, low cost access across shorter distances that is safer for pedestrians and cyclists. Non-motorised transport can have significant benefits in providing commuters safe and easy 'last mile' access to public

14 Vivien Foster and Cecilia Briceño-Garmendia, "Africa's Infrastructure: A Time for Transformation" (The International Bank for Reconstruction and Development / The World Bank, 2010)

15 Prottoy Akbar et al., "Accessibility and Mobility in Urban India," (2017).

transport modes that would otherwise not be used (see section on public transport below)[16].

Non-motorised infrastructure also comes at relatively low costs; estimates suggest that a pedestrian walkway that can accommodate 4,500 people/hour/direction costs approximately USD$100,000/kilometer. This is up to 50 times less costly than an urban road with a fifth of this capacity[17]. Increasing safety and accessibility of non-motorized means of travel is particularly beneficial for low-income groups to whom this is the primary means of travel.

Non-motorised transport can have significant benefits in providing commuters safe and easy 'last mile' access to public transport modes

Pedestrianisation of particular areas of a city are often resisted on the basis that preventing cars from accessing certain areas will limit performance of local businesses. However, evidence from cities in Germany and the UK highlight that pedestrianization generally has a positive effect on retail, with shops inside these areas reporting increases in annual turnover[18]. Similar results have been found in New York; parts of Columbus Avenue with protected bike lanes experienced 20% higher retail sales over two years after street design changes in 2008 – 11% higher than those without[19].

Investing in infrastructure is not just about construction: by making smart investments in **maintenance**, governments can prevent costly capital investments from going to waste and reduce costs of vehicle maintenance to users[20]. Rates of return on relatively low-cost road maintenance investments are significantly above, in some cases almost double, those on construction projects[21].

Rates of return on relatively low-cost road maintenance investments are significantly above, in some cases almost double, those on construction projects

The limitations of expanding effective road supply

Although investing in roads is necessary for high speed connectivity across a city, it is not sufficient.

✗ Construction of roads take time and come at a significant cost (approximately $1.5 million per kilometre for two-lane concrete

16 For more on benefits, challenges, and implementation of non-motorised transport, see UNHABITAT and African Bicycle Network "Promoting non-motorised transport options and compact cities as complements to public transport" (2011) and Clean Air Asia Center. "Promoting Non-Motorized Transport in Asian Cities: Policymakers' Toolbox" (2013).

17 Phillip Rode et al., "Accessibility in Cities: Transport and Urban Form," New Climate Economy Cities (LSE Cities, 2014).

18 C. Hass-Klau, "Impact of Pedestrianization and Traffic Calming on Retailing. A Review of Evidence from Germany and the UK," *Transport Policy* 1, no. 1 (1993), https://trid.trb.org/view/408042.

19 New York City Department of Transportation, "The Economic Benefits of Sustainable Streets," 2013.

20 Felix Rioja, "What Is the Value of Infrastructure Maintenance?" (Lincoln Institute of Land Policy, 2013).

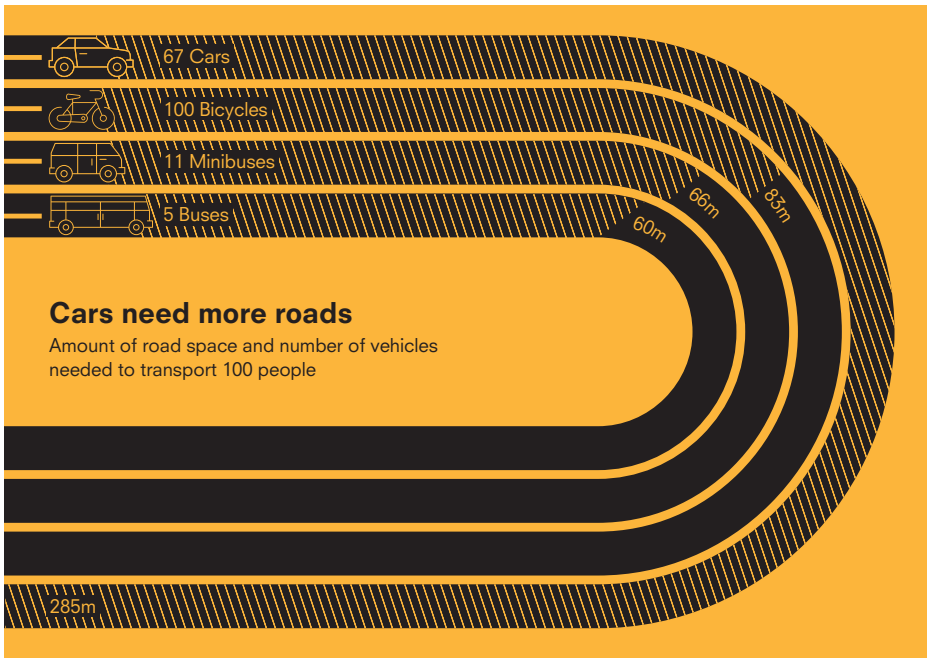
21 Edward M. Gramlich, "Infrastructure Investment: A Review Essay," *Journal of Economic Literature* 32, no. 3 (1994): 1176–96; World Bank, "World Development Report 1994 : Infrastructure for Development," 1994; Rioja, "What Is the Value of Infrastructure Maintenance?"

highways[22]). Given this high cost and limited land space for roads in many cities, policies aimed instead at encouraging **shared transport modes** that use less road space are likely to be a more cost-effective way of improving mobility.

Policies aimed at encouraging shared transport modes are likely to be a more cost-effective way of improving mobility than constructing new roads

✗ At the same time, as incomes rise, evidence from US cities suggests that there is a **fundamental law of highway traffic**: expanding roads allows for a higher volume of travel, yet newly induced travellers eventually lead to the same level of congestion. Hence, this evidence suggests that expanding roads per se **will not solve a city's congestion problem**. This is because car use will rise to fill these new roads[23].

✗ 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.



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

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

23 Gilles Duranton and Matthew A. Turner, "The Fundamental Law of Road Congestion: Evidence from US Cities," Working Paper (National Bureau of Economic Research, September 2009), http://www.nber.org/papers/w15376.

Motorbikes are a common form of private transport in many 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[24]. Though motorbikes are likely to carry greater numbers of passengers on roads per vehicle than cars and 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[25].
- ✗ 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[26], over 40% of all trauma cases at Mulago Hospital involve these motorbikes[27].
- ✗ Motorbikes offer lower capacity than public transport and so in the long run, they are unlikely to solve congestion problems in a city.

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

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.

Without regulation, private vehicle users do not internalise the costs of their behaviour on the wider urban environment

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:

24 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).

25 Asif, Weaver Faiz, "Air Pollution from Motor Vehicles : Standards and Technologies for Controlling Emissions" (The World Bank, November 30, 1996)

26 Lall, "Planning, Connecting, and Financing Cities - Now."

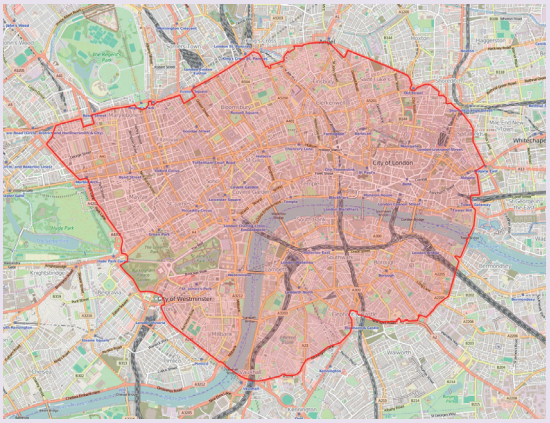
27 J. Kigera, L. Nguku, and E. K. Naddumba, "The Impact of Bodaboda Motor Crashes on the Budget for Clinical Services at Mulago Hospital, Kampala," *East and Central African Journal of Surgery* 15 (2010)

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. This can also be done through measures such as congestion charges and parking fees that impose an additional private cost on driving on urban roads.

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[28], and has resulted in a 6 percent increase in the number of passengers using buses during charge hour[29]. After the first year of its implementation, CO2 emissions reduced by almost 20% in the charging zone as a result of both fewer cars and lower levels of stationary traffic in the city centre[3031].

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 publicly provided transport systems.



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

28 Gabriel Kreindler, "Driving Delhi: The Impact of Driving Restrictions on Driver Behaviour," (IGC/J-PAL, 2016).

29 Somik V. Lall, "Planning, Connecting, and Financing Cities - Now : Priorities for City Leaders" (The World Bank, 2013)

30 Sean D. Beevers and David C. Carslaw, "The Impact of Congestion Charging on Vehicle Emissions in London," *Atmospheric Environment* 39, no. 1 (January 1, 2005): 1–5,

31 For more information on regulations to reduce air pollution, see *Cities that Work* Framing Paper on 'Embedding resilience: city responses to acute shocks and chronic stresses'

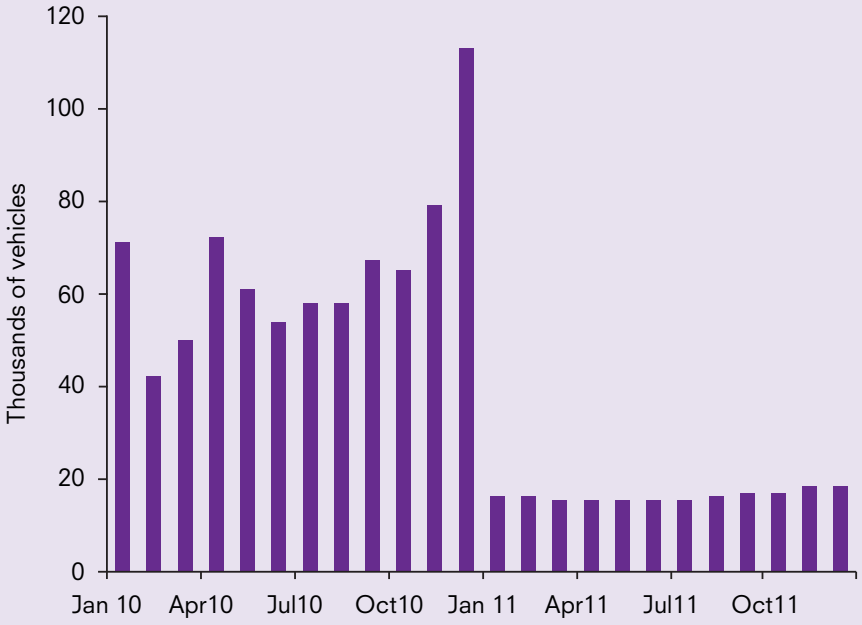
32 Winston T. H. Koh, "Congestion Control and Vehicle Ownership Restriction: E Choice of an Optimal Quota Policy," Research Collection (Singapore Management University, School Of Economics, 2004),

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

Monthly changes in new vehicle registration in Beijing, 2010–2011



Source: Yang et al. (2014)

Though many resistant to policies such as 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[34].

Congestion charges in areas where there is severe traffic can *increase* the throughput of vehicles in the area by reducing gridlock

33 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

34 Amelsfort, "Introduction to Congestion Charging: A Guide for Practitioners in Developing Cities."

Prices or quotas?

Though both types of restrictions have proven effective at limiting congestion across cities, financial restrictions have significant advantages:

- ✓ By allowing people to pay for the right to use their vehicles, user-rights are efficiently allocated to **those who are most willing to pay**.

- ✓ Additional fees on cars also raise revenues for governments, enabling a **win-win** situation where restrictions on private use can be used to fund maintenance of existing infrastructure and public transportation systems. The revenues from private vehicle auctioning in Shanghai, for example, were approximately USD$700 million in 2011 - roughly enough to cover the cost of all public subsidies for public transport systems in 2012[35].

Revenues from private vehicle auctioning in Shanghai in 2012 were roughly enough to cover the cost of all public subsidies for public transport systems that year

In addition, 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 evidence across different cities:

- — There have been short run positive effects of these policies on incentivizing public transport use in cities such as Delhi[36], and on reducing congestion in cities such as Beijing[37]. Evidence also suggests that such restrictions have been successful in reducing emissions in Quito and Beijing[38].

- — There is also evidence to suggest that in the long run these policies incentivise drivers to switch to driving at non-peak hours and days[39].

- — However, studies have found that permanent vehicle use restrictions have had limited impact in reducing overall vehicle use or associated air pollution[40].

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. In an attempt to prevent individuals from buying new

35 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.

36 Gabriel Kreindler, "Driving Delhi: The Impact of Driving Restrictions on Driver Behaviour," (IGC/J-PAL, 2016).

37 Yizhen Gu, Elizabeth Deakin, and Ying Long, "The Effects of Driving Restrictions on Travel Behavior Evidence from Beijing," *Journal of Urban Economics* 102, no. C (2017): 106–22.

38 Paul E. Carrillo, Arun S. Malik, and Yiseon Yoo, "Driving Restrictions That Work? Quito's Pico y Placa Program," 2013; V. Brian Viard and Shihe Fu, "The Effect of Beijing's Driving Restrictions on Pollution and Economic Activity," *Journal of Public Economics* 125 (May 1, 2015): 98–115, https://doi.org/10.1016/j.jpubeco.2015.02.003.

39 Paul E. Carrillo, Arun S. Malik, and Yiseon Yoo, "Driving Restrictions That Work? Quito's Pico y Placa Program," 2013; Lucas W. Davis, "The Effect of Driving Restrictions on Air Quality in Mexico City," *Journal of Political Economy* 116, no. 1 (2008): 38–81, https://doi.org/10.1086/529398.

40 Paul E. Carrillo, Arun S. Malik, and Yiseon Yoo, "Driving Restrictions That Work? Quito's Pico y Placa Program," 2013.

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[41].

In many cases, quantity restrictions on vehicle use are circumvented by drivers by buying additional vehicles or adjusting the times they drive

CASE STUDY: QUANTITY RESTRICTIONS ON USE IN DELHI AND MEXICO CITY

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%[42].

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. However, the results of this policy have been limited. Though in the short run this policy was associated with a 5-13% reduction in carbon monoxide (a proxy for car use), evidence suggests that in the long run the introduction of this programme actually incentivised users to switch towards driving more on weekends and late evenings when the HNC regulations were not in place, and to using more taxis and purchasing more (high polluting used) vehicles to circumvent the restriction. This has resulted in an increase in the total number of cars in circulation, and a long term *increase* in vehicle use pollutants at peak hours by 11% - with even higher increases on weekends[43].

41 Carrillo, Malik, and Yoo.

42 Gabriel Kreindler, "Driving Delhi: The Impact of Driving Restrictions on Driver Behaviour," (IGC/J-PAL, 2016).

43 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.

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

Improving voluntary compliance with regulations

Implementing regulations on private transport require **overcoming resistance** from existing users and **enforcing compliance**. Such policies often face significant resistance from private vehicle users and businesses in areas where congestion charges are perceived to reduce numbers of customers.

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%[44] and generate significant revenues for new transportation projects of over US$490 million per year[45], 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

44 Orla Ryan and agencies, "New York Assembly Shelves Manhattan Congestion Charge," *The Guardian*, April 8, 2008

45 William Neuman, "State Commission Approves a Plan for Congestion Pricing," *The New York Times*, February 1, 2008,

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[46]. 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, Bloomberg and his supporters ultimately failed to convince enough members of the Legislature of the benefits of this scheme[47]. Subsequent attempts to introduce congestion charges in the city have met with similar resistance.

Successful cases of reform highlight some key principles for building up support for private vehicle restrictions:

— Public consultation to highlight benefits of these policies and take into account concerns. 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[48].

— Investing in expanding and improving public transport to assure means of mobility for those otherwise restricted. In Oslo, resistance to the introduction of a toll charge in 1990 was overcome by use 20% of revenues from toll charges for public transport investment. In many 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[49].

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

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.

46 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.

47 Nicholas Confessore, "$8 Traffic Fee for Manhattan Gets Nowhere," *The New York Times*, April 8, 2008

48 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).

49 Ajay Kumar, "Understanding the Emerging Role of Motorcycles in African Cities: A Political Economy Perspective" (Sub-Saharan Africa Transport Policy Program, 2011).

— 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).

Complementing these policies with investment in police forces, CCTV cameras and e-ticketing systems for effective and transparent enforcement can build a culture of compliance with regulations.

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[50]. The system continues to enjoy public support[51].

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 instead favoured expanding infrastructure to meet transport demand. Pressure from coalition Green Party members at the national and local level meant that the Mayor of Stockholm, Annika Billström, was forced to take actions to implement a **trial congestion charge** in 2006. 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[52]. Following this, a public referendum resulted in 53% of Stockholm citizens voting to introduce the charges permanently.

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

— **Incremental introduction** to allow citizens to see the benefits of the charge for themselves before deciding on whether they supported this policy change.

50 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,

51 Ibid.

52 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,

"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

Source: Ken Belson, "Importing a Decongestant for Midtown Streets," *The New York Times*, March 16, 2008

— **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[53].

— **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. 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[54].

— **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.

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.

53 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.

54 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).

PROACTIVE PLANNING FOR RIDE SHARING

In many cities, we see the rise of **ride sharing** companies such as Uber that offer another way for individuals to travel around the city. Effective public planning for transport requires policymakers to consider the costs and benefits of such system for a city in how they affect both accessibility and living standards for workers, and to proactively regulate these services accordingly. Without doing so, these companies can fall into a legal grey area and operate without sufficient oversight of worker or consumer welfare. In cities such and London and New York, concerns over safety standards and drivers' incomes have resulted in stronger efforts to regulate the sector. At the same time, it is important to ensure that new transport services do not become overly regulated at the cost of consumers and drivers.

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

Effective multi-modal transport requires careful cost benefit analyses for a city

Investments in multi-modal public transport systems are vital to improving accessibility and reducing congestion in a city. This integration can take a number of forms, including:

— Physical integration between transport modes so citizens can easily switch between modes

— Operational integration in the form of coordinated ticketing systems, fares and consumer information

— Institutional integration to allow for coordinated management of different transport modes[55]

By integrating different transport modes, cities can improve ease and therefore attractiveness of public transport. In Singapore, integration of transport modes with each other and with land use planning have allowed for public transport to make up 67% of motorised trips in 2018[56].

In Singapore, integration of transport modes with each other and with land use planning have allowed for public transport to make up 67% of motorised trips in 2018

However, investing in public transport systems can be costly, and careful **cost benefit analysis** of these systems is key to their success. An effective multi-modal transport system incorporates different modes of transport appropriate for different areas of a city. Various public transit options offer different benefits in terms of their carrying capacity, sustainability, regularity and speed, and come with a wide range of capital and operating costs.

Careful consideration of the current and future relative costs and benefits of public transport systems for a particular city can prevent over- or under-investment in capacity. Without sufficient demand, investing in more expensive higher capacity vehicles is not necessary nor is it financially sustainable.

55 For more on different forms of multi-modal transport integration, see Cities that Work cluster paper on 'Key considerations for integrated multi-modal transport planning'

56 TODAY (01 March 2018): "Proportion of peak hour trips made on public transport have gone up." Accessed from https://www.todayonline.com/singapore/proportion-peak-hour-trips-made-public-transport-have-gone on 02 November 2018

Costs and benefits of different public transport modes

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

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.

In Dakar, semi-formally provided minibus services account for over 80 percent of all public transport demand in the city

The status quo: semi-formal paratransit services

In many developing and middle-income cities, informal, low-medium capacity vehicles such as minibuses form the dominant means of public transport. These 'paratransit' systems provide an essential means of mobility, offering in many cases better and more reliable services than existing formal transport systems – as well as a significant source of employment. In Dakar, for example, semi-formally provided minibus services account for over 80 percent of all public transport demand in the city [57], whilst in Dhaka, informal transport comprises almost 30 percent of total employment in the city[58].

57 Ajay Kumar and Christian Diou, "The Dakar Bus Renewal Scheme: Before and After" (Sub-Saharan Africa Transport Policy Program, 2010).

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

WHY ARE INFORMAL, LOW CAPACITY VEHICLES SO COMMON?

Due to their relatively smaller size when compared to high capacity buses, minibuses, and taxis are relatively cheap to invest in; a 14-seater minibus in Nairobi, for example, costs almost 4 times less than a 35-seater bus[59]. These lower costs mean private operators can profitably supply these services in greater quantity and at lower fares. These vehicles can also travel almost anywhere where (even low quality) roads exist, and as such, are likely to be able to get commuters closer to their destinations.

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

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

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 often 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:

— Required 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.

59 Ajay Kumar and Fanny Barrett, "Stuck in Traffic: Urban Transport in Africa," Africa Infrastructure Country Diagnostic (World Bank and SSATP, 2008).

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. 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[60].

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 formed approximately 75 – 80% of all motorized trips in the city by 2011[61]. Approximately half of these taxis are owner-operated, providing low-income jobs for relatively young and educated individuals.

Despite their importance, informal low capacity services present significant challenges for long term mobility in a city:

- ✗ As these vehicles are at best medium-capacity, large numbers of vehicles are required to provide mass transport. This, combined with their irregular stops, mean that these vehicles contribute significantly to **traffic congestion** in city centres. 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[62]. These problems are particularly severe near major bus terminals and marketplaces.

In Kampala, it is estimated that 64% of congestion is due to the frequent and irregular stops made by minibuses

- ✗ In an effort to cut costs and improve profitability in highly competitive markets, informal vehicles are often **poorly maintained, overcrowded and 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[63].

60 Kumar.

61 Kumar.

62 Patricia Jones et al., "Kampala: A Policy Narrative" (World Bank, 2016).

63 Kumar, "Understanding the Emerging Role of Motorcycles in African Cities: A Political Economy Perspective."

Comparison of designed seating capacity and average occupancy on informal public transport modes

Mode	Designed seating capacity	Average occupancy	Ratio of average occupancy and designed seating capacity
Auto-rickshaw (Piaggio/Atul)	3	9.5	3.2
Vikram	6	14	2.3
Tata Magic	7	13	1.9
Mahindra Gio	6	8	1.3
Chakda[b]	10	14	1.4
Kaduka[b]	20	30	1.5
Maruti Omni	7	12	1.7
Jeeps	10	14	1.4
Mini bus	20	30	1.5

Note: a Designed capacity does not include additional capacity for retrofitting. b Designed seating capacity as stated by driver; for the rest of the modes, the designed capacity was assumed to be the number stipulated in their respecitve permits.
Source: Kumar et al. (2016)

- ✗ **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.

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

Replacement or improvement: what is the role of policy?

In many developing and middle-income cities, policymakers have attempted to overcome the challenges of informal transport services by banning their operations and replacing them with formal transport services. This has had limited success, in part due to the difficulty of enforcing regulation on politically influential operators. At the same time, replacement may not be appropriate in all circumstances: 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.

High-capacity buses are less appropriate for low-density, low-income areas that will not generate sufficient demand to cover costs of provision

Instead, lower capacity public transport systems can offer **complementary services** to higher capacity transport, serving low density areas where congestion is lower and demand is too low to cover enough of the costs of high capacity transport. Policy is likely to be better targeted to improving, rather than replacing, existing informal systems through:

— Regulation to improve the quality of vehicles and services such as health and safety regulations.

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[64].

— **Regulation of quantity in particular areas of a city.** As passenger volumes rise above around 5,000 in each direction per hour, high capacity buses can become more cost effective when accounting for commuters' time otherwise wasted in waiting for transport[65]. In many cities, attempts to introduce higher capacity systems have failed because these systems are undercut by informal minibuses and motorbikes. Under these circumstances, restrictions on medium-capacity services on particular lanes can have significant public benefits.

As passenger volumes rise above around 5,000 in each direction per hour, high capacity buses can become more cost effective

Challenges of regulation

However, it is important to note that the benefits of imposing safety or other quality regulations are by no means guaranteed. Without additional public or private funding , any attempt to improve quality of services is liable to **come at the cost of affordability**, and any attempt to cap fares is liable to be met with a *deterioration in the quantity or quality* of services.

Without additional public or private funding, regulating existing informal transport may come at the expense of affordability, quantity or quality

64 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).

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

At the same time, any attempts at effective regulation rely on adequate enforcement capacity. Regulating informal transport, particularly when done in an effort to accommodate higher capacity 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[66]. Limited capacity for and enforcement of regulation 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[67].

Enforcing regulation

Successful experiences from a number of cities suggest that in many cases, the best way for governments to overcome both of these challenges is to work with informal providers to combine regulation with **finance, or access to private finance**, to maintain and improve vehicles:

— Expanding access to new vehicles, credit and training to collectives of informal private operators in Dakar, Senegal, has allowed for renovation and route regulation of around a fifth of minibuses in the city between 2005-2008[68].

— 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

66 Jackie Dugard, "From Low Intensity War to Mafia War: Taxi Violence in South Africa (1987 - 2000)," 2001.

67 Dugard.

68 Ajay Kumar and Christian Diou, "The Dakar Bus Renewal Scheme: Before and After" (Sub-Saharan Africa Transport Policy Program, 2010).

combined with regulation to enforce exclusive use of particular routes. Public transport needs were met and congestion was reduced while maintaining crucial political support for the introduction of higher capacity buses. Lower capacity services then complemented formal transport services by providing feeder services from low density areas to higher capacity systems in denser areas.

At the same time, 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.

(Source: 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%[69].

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 high capacity bus or rail-based transport systems.

Broadly speaking, there are four types of higher capacity transport system:

— **High-capacity buses**

— **Bus Rapid Transit** (BRT) systems where buses have priority or sole use on dedicated lanes. BRT systems of varying sophistication and technology have been implemented in over 150 cities across the world, including Bogota, Cape Town, Lagos, Yangon and Lima.

— **Light Rail Transit** (LRT) systems where trains 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.

69 Habyarimana and Jack, "Heckle and Chide: Results of a Randomized Road Safety Intervention in Kenya."

Traffic congestion before and after the construction of a BRT system in area surrounding Ganging station in Guagzhou, China (Source: World Bank, 2017)

— **Metro or mass rapid transit** (MRT) systems that 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.

Investing in public buses that simply operate on already congested lanes may have limited impact on traffic. It is unlikely that many people will choose to use public transport systems if they do not offer gains in speed, and as a result, the potential impact of these systems in reducing other vehicles on the road is limited. Experiences from 'BRT' systems in Jakarta and Accra highlight this – without effective enforcement of separated lanes, these systems have been plagued with low take-up rates and have had limited impact on congestion. The TransJakarta BRT makes up only 4.3% of mode share in Jakarta (compared to 26% seen with Bogota's TransMillenio) and has actually *increased* commuting times by simply adding to vehicles on congested roads.[70]

It is unlikely that many people will choose to use public transport systems on already congested lanes if they do not offer gains in speed

By contrast, investing in separated BRT, LRT or MRT systems are likely to have significant positive impacts on mobility in 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 and waiting times by 35 percent[71], despite the fact that BRT buses only make up 4% of vehicles on Lagos's roads[72]. 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[73] - approximately 12% of the initial capital costs of construction. However, unlike bus systems, these higher capacity transit systems **lack flexibility** and so careful cost benefit analysis is needed to determine where and what to invest in.

By contrast, investing in separated BRT, LRT or MRT systems are likely to have significant positive impacts on mobility in a city

70 Gaduh et al. 'Life in the Slow Lane: Bus Rapid Transit and Commuting Outcomes in Jakarta' 2019

71 Dayo Mobereola, "Lagos Bus Rapid Transit: Africa's First BRT Scheme," Urban Transport Series (The International Bank for Reconstruction and Development / The World Bank, 2009).

72 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.

73 Dugard.

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[74]	12,000 – 27,000	24,000[75] – 72,000
Maximum speed (kph)	60 -70	60 – 80	70 – 100
Average capital costs[76] (US$million/km)	8.4	21.5	104.5
Average operating costs[77] (US$ / vehicle revenue km)	2.94	7.58	5.30

Source: Adapted from Cervero (2013)

Carrying capacities

These systems have a wide range of carrying capacities and costs across countries. BRT systems, depending on their level of complexity, can range from being able to transport around **2,500 – 20,000 people/hour/lane**[78]. LRT systems can have higher capacities but generally fall somewhere in this range.

MRTs, on the other hand, usually have higher carrying capacities than bus-based systems, at **over 30,000 passengers** per hour per direction[79]. As such, investments in these systems can be transformative for rapidly growing cities.

74 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).

75 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.

76 Capital costs calculated from US case studies, using 2000 $USD Consumer Price Index average.

77 Operating costs calculated from US case studies, using 2000 $USD Consumer Price Index average.

78 World Bank, "**Bus Rapid Transit for Greater Kampala Final Report" (World Bank, 2014); Robert Cervero, "Bus Rapid Transit (BRT): An Efficient and Competitive Mode of Public Transport (Working Paper)" (Berkeley Institute of Urban and Regional Development, 2013).

79 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 7.8km LRT system built in Singapore in 1999, for example, cost USD$285 million to construct[80].

— 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[81].

By comparison, most BRT systems cost well under USD$10 million per kilometre to construct[82]. The 22km BRT system in Lagos cost just USD$37.4 million to build, including the cost of stations, road partitions and 220 buses[83]. BRT systems are likely to be particularly cost effective if road lanes can easily be transformed and a bus system is already in place.

BRTs are likely to be the most cost-effective option for mass public transport when taking into account capital, operating and delay costs. This only changes in very high-density areas where hourly passenger volumes are in excess of 30,000

Analysis from U.S. cities suggests that that BRTs are likely to be the most cost-effective option for mass public transport when taking into account capital, operating and delay costs[84]. This only changes in very high-density areas where hourly passenger volumes are in excess of 30,000, where a bus-based system could result in significant and costly delays. The higher construction and operation costs associated with rail-based systems, as well as the likely need for higher public subsidies, may instead be justified on the basis of other benefits, including environmental sustainability and the opportunity costs of land required.

80 The Independent, "Built at a Cost of $285 Million, Bukit Panjang LRT May Be Scrapped," *The Independent* (blog), accessed October 31, 2018, http://theindependent.sg/built-at-a-cost-of-285-million-bukit-panjang-lrt-may-be-scrapped/.

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

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

83 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.

84 John Robert Meyer, John F. Kain, and Martin Wohl, *The Urban Transportation Problem* (Harvard University Press, 1965); Kenneth A. Small and Erik T. Verhoef, *The Economics of Urban Transportation* (Routledge, 2007); Arthur O'Sullivan, *Urban Economics*, 8 edition (New York, NY: McGraw-Hill Education, 2011); 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).

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.

- ✓ **More flexible than rail-based systems.** Depending on the complexity of infrastructure involved, policymakers can relatively quickly shift bus systems and reassign bus lanes if needed as a city develops. This is easier to do that shifting railway tracks.

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[85]. A study of the impact of the low sulphur diesel run, dedicated lane Rea Vaya BRT system in Johannesburg suggests that it has saved South Africa up to USD$890 million as a result of improvements in travel time, road safety and carbon emissions[86]. This is over three times the total construction budget for the project which in 2010 stood at $233 million[87].

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

- ✓ **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.

85 UN-HABITAT, "Metro, Light Rail and BRT," 2013.

86 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).

87 Rea Vaya Johannesburg, "Rea Vaya: Comprehensive Project Update," 2010

- ✓ **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[88]. 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.

The importance of urban density

One key determinant of what transport investments would be valuable to undertake is **urban density**. The higher the urban density, the more people can benefit from access to a station – and relatedly, the lower the cost per person of connecting people to the system . This means that the costs of building and operating these transport systems can be more easily recouped from users through **user fees**. It is estimated that BRT systems, for example, can only remain financially viable if there are at least 10 passengers boarding per kilometre per day per bus[89]. This requires both sufficient density and pedestrian access to bus stops.

The higher the urban density, the more people can benefit from access to a station – and relatedly, the lower the cost per person of connecting people to the system

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[90]. 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.

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

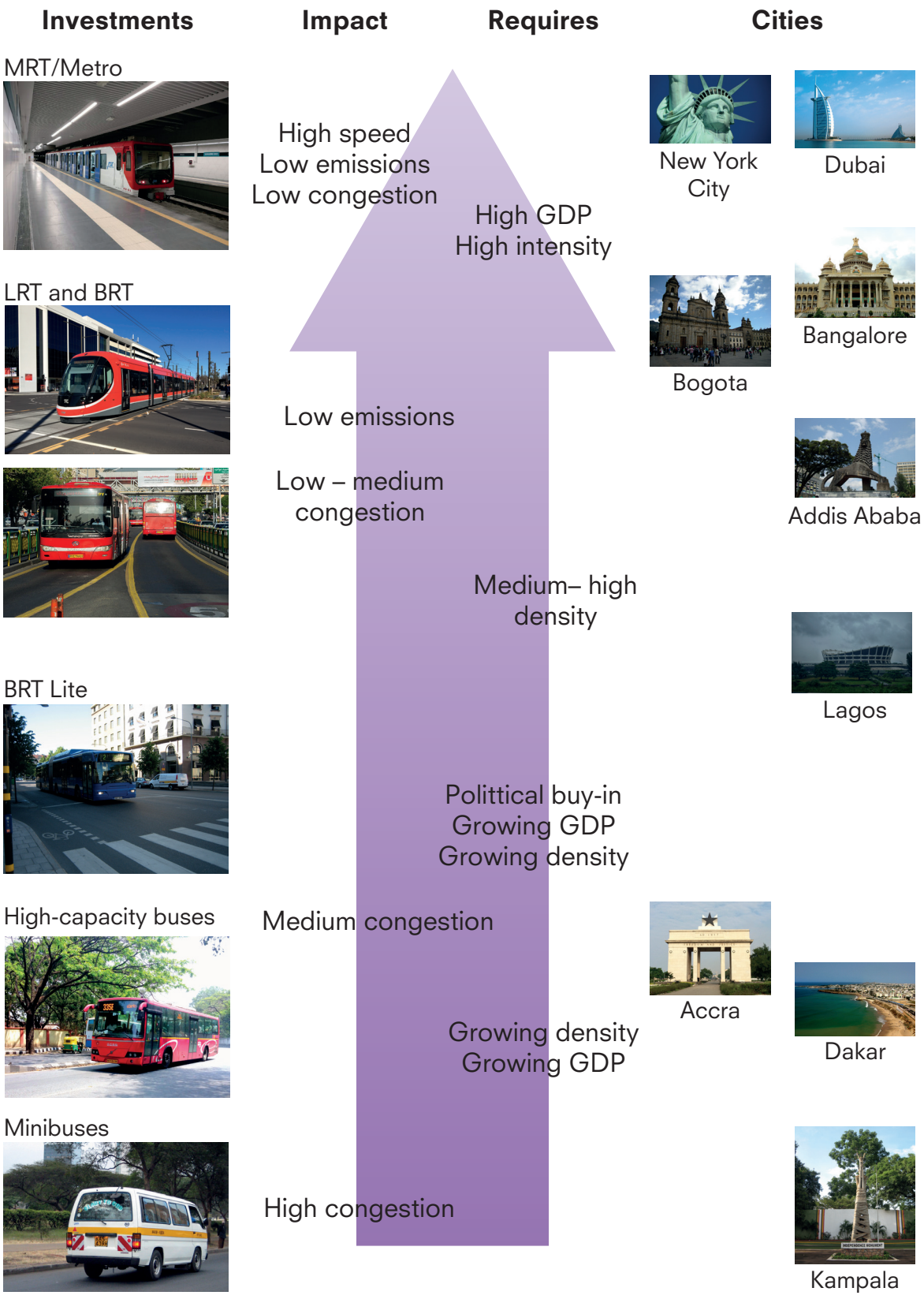
The spatial form of a city will also play an important role in determining the costs per passenger of transport provision, because with different urban forms come different distributions of density along particular routes. Polycentric urban forms, for example, with multiple high-density urban areas,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

88 Jason Margolis, "8 Million People. No Subway. Can This City Thrive without One?" *Public Radio International*, 2015

89 Adam Greenfield, "Buses Are the Future of Urban Transport. No, Really," *The Guardian*, August 27, 2014, sec. Cities, https://www.theguardian.com/cities/2014/aug/27/buses-future-of-urban-transport-brt-bus-rapid-transit.

90 Greenfield, "Buses Are the Future of Urban Transport. No, Really."

Summary of the impact and requirements of different public transport systems



Source: Infographic adapted from Planet Projects, 2017

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

The introduction of high capacity buses and BRT systems are often strongly resisted by private vehicle users as well as existing formal and semi-formal public transport providers. In addition to providing financial support to existing operators to invest in these new systems (see above), overcoming this resistance 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.

3 **Employment opportunities for existing bus operators.** In addition to financing, 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[91].

   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.

91 Diane de Gramont, "Governing Lagos: Unlocking the Politics of Reform" (Carnegie Endowment for International Peace, 2015).

CASE STUDY: COMMUNICATION TO ADDRESS RESISTANCE IN LAGOS

In Lagos, for example, the cooperation of politically powerful National Union of Road Transport Workers (NURTW) 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.

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[92]. 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.

92 Cervero, "Bus Rapid Transit (BRT): An Efficient and Competitive Mode of Public Transport (Working Paper)."

4. Connecting transport with land use planning

The importance of urban density in improving the financial sustainability of transport systems highlights a key role for active land use planning to complement transportation investments.

— In particular, there is a key role for **transport orientated development (TOD)** i.e. planning policies to encourage higher density in areas surrounding BRT lines and major roads. By encouraging development around public transport nodes, policymakers can improve ease of access and therefore encourage greater use of public transport. Evidence suggests that zoning regulations to increase building densities in and around stations in Bogota's TransMillenio would have improved overall commuter gains by up to 24%[93].

— 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[94].

Evidence suggests that zoning regulations to increase building densities in and around stations in Bogota's TransMillenio would have improved overall commuter gains by up to 24%

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[95].

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. In Cape Town, for example, a lack of central density in the city means that 86% of residents cannot affordably access marketplaces[96].

93 Nick Tsivanidis, "The Aggregate and Distributional Effects of Urban Transit Infrastructure: Evidence from Bogotá's TransMilenio" (University of Chicago Booth School of Business, 2018).

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

95 Prottoy Akbar et al., "Accessibility and Mobility in Urban India," (2017).

96 Laura Sara Wainer, Billy Ndengeingoma, and Sally Murray, "Incremental Housing, and Other Design Principles for Low-Cost Housing" (IGC, 2016).

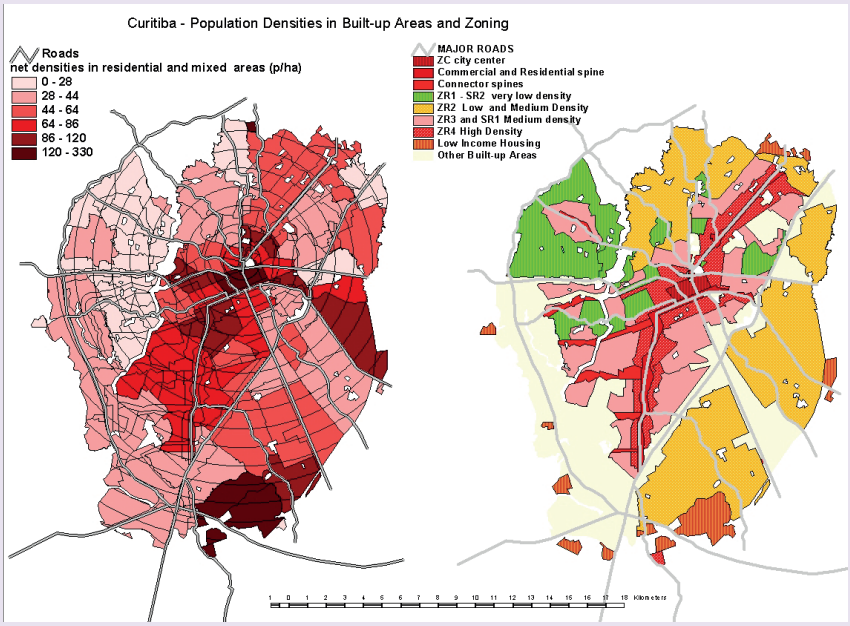
CASE STUDY: LAND USE TO COMPLEMENT TRANSPORT INVESTMENTS IN CURITIBA, BRAZIL

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[97]:

— Land use regulation to encourage transport orientated development. 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[98]. 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[99].



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)

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

98 Gwilliams.

99 Federal Transit Administration and Volpe National Transportation Systems Center, "Issues in Bus Rapid Transit," Prepared for the Bus Rapid Transit Forum, 1998.

The importance of proximity highlights another key role for **urban land use policy** to complement investments in mobility through greater proximity. 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.

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

5. Delivering and financing improvements to mobility

Who should provide and maintain infrastructure and services for transport?

Governments have two broad choices in providing and maintaining public transport services and infrastructure:

1 Provision by the **state or a parastatal organisation**, where different aspects of the provision and maintenance of infrastructure and services is directly contracted by the state or a semi-independent government owned and funded agency.

2 Provision by **public-private partnerships** (PPPs), whereby some or all aspects of long-term financing, design, construction, operation and maintenance of infrastructure is conducted by a private special purpose vehicle (SPV) or project company given a contract by a government procurement authority for a particular period of time. Approximately 10% of funding for PPP projects are usually provided by the firms sponsoring the project which can in turn further motivate these firms to ensure successful completion of the project. The other 90% is funded by debt or equity investment. Revenues generated from infrastructural investments through government transfers or user fees are used to pay back equity or debt financiers.

Potential benefits of public-private partnerships (PPPs)

There are a number of key potential advantages of PPP delivery and maintenance:

✓ **Bundling for overall cost efficiency**. By integrating the management of design, construction, operation and maintenance of infrastructure and service provision in an SPV, investments at each stage are likely to be made that will take into account the cost effect on other aspects of service delivery, thus allowing for cost reductions and reduced delays across the life-cycle of the PPP. Cost overruns on directly procured infrastructure are on average 24% greater than for PPPs[100].

Cost overruns on directly procured infrastructure are on average 24% greater than for PPPs

100 Blanc-Brude, Goldsmith, H. and T. Välilä, "A Comparison of Construction Contract Prices for Traditionally Procured Roads and Public-Private Partnerships," *Review of Industrial Organization* 35, no. 1–2 (2009): 9–40.

✓ **Greater incentives to improve maintenance of existing systems**. Under PPPs, firms managing the infrastructure and services usually have relatively higher incentives to maintain infrastructure so that they can maintain revenues through user fees and/or conditional government transfers.

✓ **Overcoming short-term credit constraints**. By harnessing private investment contributions, governments may be able to invest in urban service provision even when severely credit constrained. However, it is important to note that this will only apply where income streams from the project are sufficiently credible to assure private investors they will obtain returns on their investments in future, despite a credit-constrained government. This may be most applicable in cases where government credit-constraints are short-term.

However, the **evidence on the effects of using PPPs in urban infrastructure and service delivery is mixed** – in some cases, these arrangements can allow government to achieve policy goals, whilst in others, contracts are poorly allocated, overly renegotiated, quality is subject to minimal monitoring, and PPPs are simply used as a way to bypass budgetary constraints[101]. In Mexico, for example, road toll projects awarded under PPPs without rigorous cost benefit analysis resulting in higher costs, with overruns of approximately 25 percent, and approximately 30 percent lower revenues than forecasted[102].

Potential disadvantages of public-private partnerships (PPPs)

These experiences highlight the potential disadvantages of PPP provision:

✗ **Cost minimization over quality**. Given that private firm decisions are largely driven by profit maximization, this can in some cases result in efforts to minimise costs at the expense of long run quality or sustainability. This is particularly likely to be a problem if PPPs are used solely in the construction, rather than the long run maintenance and operation, of infrastructure.

✗ **Public finance requirements and the private premium**. Though PPPs save government spending on initial lump-sum investments in transport infrastructure that can be substantial, they do not substantially affect a government's budget over time as these projects must be paid for by annual government payments or in the form of relinquishes revenues from user fees. In fact, because PPPs require returns to be made on investments by equity investors, they are likely to cost governments more in the long run than financing through public debt. Privately raised capital for the transit sector costs approximately $20-40 million more per $100 million

Privately raised capital for the transit sector costs approximately $20-40 million more per $100 million raised over a 35-year term, as compared to the cost of finance available to governments

101 Eduardo Engel, Ronald Fischer, and Alexander Galetovic, "Public-Private Partnerships: When and How," Documentos de Trabajo (Centro de Economía Aplicada, Universidad de Chile, 2008), https://ideas.repec.org/p/edj/ceauch/257.html.

102 Somik V. Lall and The World Bank, *Planning, Connecting, and Financing Cities — Now: Priorities for City Leaders* (World Bank Publications, 2013).

raised over a 35-year term, as compared to the cost of finance available to governments[103].

✗ Experience of PPPs in Latin America highlight the problem of **renegotiation**. In Chile, 78% of the amounts awarded in PPP renegotiations have occurred during construction[104]. Renegotiation is often done at the expense of the government and public funds.

✗ Where renegotiation of contacts is not possible, experience of PPP contracts in the UK, US and Australia highlight the potential for costly **disagreement and legal action** between private and public actors because of disagreements over compliance with PPP contracts[105].

As such, PPPs require **strong public oversight** to work well, and should not be seen as a costless source of funding for transport.

Enabling conditions for success

Effective provision of infrastructure and services through a PPP is aided by:

1 The ability to **contract and effectively monitor and enforce quality** of infrastructure and service provision. If this is not possible, the SPV can pursue cost-cutting measures that reduce the quality of urban services. This can be overcome to an extent by contracting quality of inputs, but this limits the ability of private firms to innovate in providing cost-effective urban services.

2 **Clear and reasonable terms for renegotiation** to ensure revenue streams continue to allow for reasonable profits, based on new information, proposed policy changes, environmental changes, or errors in the original design of the PPP contract. A key part of designing reasonable terms for renegotiation includes designing so-called 'off ramp' clauses for PPP contracts whereby if the length of contracts is shortened based on renegotiations, there are clear formulas for paying off existing debt and equity. Renegotiation for other reasons to benefit either the government or private firms is done at the expense of efficient use of taxpayer money - to prevent this, independent panels can be set up to monitor the terms of contract renegotiations.

3 **Effective systems for sharing risk** between public and private actors. The three major risks on large infrastructure projects are **construction risks** leading to cost overruns and delays; **availability risk** that the project is out of service and therefore not delivering public benefit or collecting revenue; and the risk of facility **demand** and revenues falling below

103 Matti Siemiatycki and Ronald McQuaid, "The Theory and Practice of Infrastructure Public-Private Partnerships Revisited: The Case of the Transportation Sector," 2012

104 Eduardo Engel and Alexander Galetovic, "Urban Transport: Can Public-Private Partnerships Work?," Policy Research Working Paper (World Bank Sustainable Development Network, Urban and Disaster Risk Management Department, 2014).

105 Matti Siematycki, "Delivering Transportation Infrastructure Through Public-Private Partnerships," *Journal of the American Planning Association* 76, no. 1 (2010): 43.

predicted levels. In practice, many governments have sought to allocate as much risk as possible to the private sector partner, believing that this would protect government from costly and embarrassing procurement challenges. However, this increases private risk premiums and makes contracts highly unstable. Transferring availability and demand risk in particular has resulted in contracts that are often inflexible and limit policy reform in the public interest[106]. Instead, it makes sense to **allocate risk according to the ability of private and public actors to manage this risk , so that these risks can be minimised by those able to do so**.

It makes sense to allocate different types of risk according to the ability of private and public actors to best manage (and minimise) these

4 Further **institutional reforms** to ensure that the SPV best suited to meeting public needs is chosen and is most able to provide these services. This includes adequate competition and transparency at the procurement stage, with SPVs selected on the basis of rigorous feasibility studies by independent external evaluation boards where possible[107].

Given high deal structuring costs, PPPs are best suited for large projects that cost at least $50 million[108].

Where governments have had the **necessary capacity to implement the principles outlined above, PPPs can be implemented successfully**. This was seen, for example, in Chile, where between 1993 and 2001 the government awarded 21 contracts for road construction, incrementally expanding the size of projects contracted based on previous successes. A transparent bidding process between over 40 domestic and international companies with a strong focus on public awareness of the project was accompanied by room for flexible adjustments to contracts where necessary[109].

How can public transport be funded and financed?

Key to planning for transport investment is considering options for financing and funding[110]. There are a number of options for transport financing which can be considered, including government bonds, private equity investments and international loans. Large infrastructure projects usually draw on a number of sources of finance, with equity investment offering the most readily available

106 For more on this, see Matti Siematycki, "Delivering Transportation Infrastructure Through Public-Private Partnerships," *Journal of the American Planning Association* 76, no. 1 (2010): 43.

107 For more on procurement practice more generally, see Cities that Work policy paper on 'Strategies for effective procurement and public-private partnerships in the transport sector' (Siemiatycki, 2018)

108 Siematycki, Matti, "Strategies for Effective Procurement and Public-Private Partnerships in the Transport Sector" (IGC, 2018).

109 Lall and Bank, *Planning, Connecting, and Financing Cities — Now.*

110 Financing refers to the source of money used to initially pay for construction and maintenance, while funding refers to the revenue streams that will be used to eventually pay back the project finance. For more on funding and financing options for transport reform, see *Cities that Work* papers on financing and funding options for 19 middle income cities

finances but at a high cost. Transport infrastructure projects are typically financed using 80-90% debt and 10-20% equity[111].

There are two key sources of funding for transport projects; user fees, such as congestion charges, fuel taxes and transit fares, and government subsidies. User fees for infrastructure and services can play a key role in providing **sustainable funding** for maintenance and extension of infrastructure and services whilst at the same time providing a useful tool for **managing demand**. Tolls on roads and other infrastructure for private transport, for example, can improve revenue generation from infrastructure whilst also reducing congestion and emissions from private transport.

However, user fees above a certain level can **severely limit the accessibility** of both private and public transport to low-income groups, which can be particularly harmful to public transport systems. Johannesburg's BRT line, for example, has had limited impact on low-income households because its pricing scheme is targeted to middle-income groups[112]. Though Bogota's TransMillenio is able to operate without subsidies, the fees it charges at $0.60 per ride can be up to one third of daily wages and as such, are often unaffordable to workers, leading to public protests[113]. Evidence from Lagos, Nairobi and South Africa suggests that poorly regulated transportation fares in cities means low-income households can be forced to pay between 15 – 54 percent of their income on transportation[114].

To prevent user fees from overly restricting access to transport systems from low income groups, **cross-subsidisation** may be necessary.

Bogota's TransMillenio is able to cross-subsidise and cater to low income groups in two ways:

— The system operates using a single fare pricing system, so that fares are fixed regardless of the length of the journey.

— The single fare system also extends to feeder buses, so that passengers using the feeder network do not have to pay an addition fare on top of the ticket fare for the BRT.

At the same time, it is important to note that because of the **significant public benefits** of investments such as public transport services, governments should not necessarily expect them to recover costs purely through user fees. International experience highlights that, unlike toll roads where capital and operating costs can often be recouped through user fees, both capital and

International experience suggests that user fees typically cover 30-80% of the operating costs of transit infrastructure

111 Matti Siematycki, "Options for Financing and Funding Transportation Infrastructure" (IGC, 2018).

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

113 Adam Greenfield, "Buses Are the Future of Urban Transport. No, Really," *The Guardian*, August 27, 2014, sec. Cities,; 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, h

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

operating costs of public transport systems are rarely covered by user fees. International experience suggests that user fees typically cover 30-80% of the operating costs of transit infrastructure[115].

In many large cities, public transit fares do not cover operating costs

Source: World Bank (2013)

As such, government subsidies also play a key role in funding transport systems. These subsidies in turn can be obtained from source such as:

— General revenue sources, such as sales tax and income taxes

— Transport related taxes and levies e.g. vehicle registration taxes

— Land value capture, such as land and property taxes and betterment fees that tax landowners based on the rising value of their land from a transport investment. International experience suggests that 10-20% of infrastructure projects can be financed through land value capture [116].

International experience suggests that 10-20% of infrastructure projects can be financed through land value capture

— 'Exactions' that can be levied on property developers in exchange for planning permissions to be granted. This may be a particularly valuable option for financing in cities such as Belo Horizonte, where 'transport orientated' development is being encouraged around the planned Expresso Amazonas transport corridor.

— Donor grants or concessional loans

115 Matti Siematycki, "Options for Financing and Funding Transportation Infrastructure" (IGC, 2018).

116 Ibid

Ideally, subsidies to invest in urban transport should be funded by local taxes, so that the costs of these systems are borne by urban residents who enjoy their benefits.

Infrastructure for Bogota's TransMilenio, provided through traditional procurement, was funded by a combination of national government funds (20%), World Bank loans (6%), funds from the Bogota Mayor's Office, and fuel taxes (46%)[117]. Government funds were in part raised by a 20% surcharge on gasoline sales in Bogota, of which half the revenues were allocated to infrastructure for the TransMilenio. In this way, private vehicle use cross-subsidised public transportation to improve access and sustainability of urban transport[118]. The operation of TransMillenio services is funded entirely by user fees which not only cover costs but allow operators to make a profit[119].

117 "Bogota, Colombia Bus Rapid Transit Project - TransMilenio. Case Study - (Transportation)," n.d., http://www.esc-pau.fr/ppp/documents/featured_projects/colombia_bogota.pdf.

118 Cervero, "Bus Rapid Transit (BRT): An Efficient and Competitive Mode of Public Transport (Working Paper)."

119 Myung-Kyoon Lee, "TransMilenio Bus Rapid Transit System of Bogota, Colombia," Good Practices Inventory (Asia-Pacific Environmental Innovation Strategies (APEIS) Research on Innovative and Strategic Policy Options (RISPO), 2003).

6. Enabling institutions for planning and delivery

Key to the delivery of transport plans and policies are effective and coordinated institutions responsible for delivering transport improvements, not only in the city, but in the surrounding metropolitan area.

Clear mandates

In many cities, overlapping mandates between local and national government bodies undermines the potential for coordinated policymaking and delivery. Even in cities such as Lagos, where Lagos Metropolitan Area Transport Authority (LAMATA) has principal responsibility over transport in the city, disagreements between federal and state governments over who regulates waterways have stalled the implementation of water transport services.

Metropolitan coordination

At the same time, many cities have limited coordination between municipalities in the city responsible for transportation, or between municipalities in the city and surrounding districts in the metropolitan area. Without effective sharing of responsibilities and resources, improvements to mobility needed in the city centre are likely to be prohibitively expensive to local governments responsible for undertaking these, and there is limited opportunity to benefit from economies of scale. At the same time, building roads or public transport systems that facilitate ease of movement within city or municipality boundaries are unlikely to solve problems of connectivity if poor transport options just outside these boundaries create bottlenecks for commuters. Clarity and coordination of institutional mandates is particularly important given the changing nature of actual 'urban' boundaries over time. Although administrative urban boundaries may be fixed, residential and commercial development that is geographically or economically linked often extends far beyond these.

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Coordination between local authorities, ideally in the form of a dedicated metropolitan transport agency, can help to overcome these issues.

THE IMPORTANCE OF (BIG) DATA FOR TRANSPORT

Effective planning and operation of transport services in middle income cities relies crucially on the use of data, both for operators to plan routes and services, and for consumers to plan their journeys. New technology is providing new ways of gathering data for transport from commuters and from operators. Increasing use of mobile phones and smart cards, for example, offer a rich source of big data from which to better understand commuter flows to better design urban transport planning. Big data on both transport demand and supply can also be used to enable real-time traffic management in response to unexpected events, to evaluate the impact of infrastructural investments, and to regulate privately provided transport. Effective use of big data requires:

1. Technological systems in place to capture data. In many cases, the same data sources can be used to help provide information to operators and consumers, and for multiple transport modes.

2. Effective technological and institutional coordination to combine datasets where useful for policy e.g. on housing, land use, and transport flows. In cities such as Recife and Belo Horizonte in Brazil, there is limited standardisation and integration of data that is collected by multiple municipal departments, such as on commuter behaviour flows, limiting the effective use of this data and the coordination of transport planning with land use.

3. Adequate training for staff in analysing big data for policy, to ensure that the information encapsulated in expensive datasets can be turned into actual benefits for users and operators.

4. Adequate legislation in place to protect data privacy where data is personalised[120].

The City of Boston has partnered with ride-sharing company Uber, whereby in exchange for operating in the city, the company shares anonymised big data they collect on distances and speeds travelled. These kinds of agreements allow policymakers to capitalise on private technology and human resources for transport planning.

120 For more information on the use of data for transport reform, see Cities that Work paper on 'Data-oriented urban transport reform in middle-income and developing cities'

7. Concluding remarks

Urban policy to address constraints to mobility 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 cities primarily takes the form of semi-formally provided paratransit services, and 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.

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.

Critical to the implementation of transport policy is clear responsibilities for delivery of infrastructure and services, and appropriate arrangements for providing and financing effective infrastructure and service delivery.

RECOMMENDED FURTHER READING

Amelsfort, Dirk van (2015), "Introduction to Congestion Charging: A Guide for Practitioners in Developing Cities". Asian Development Bank and (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

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

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 at http://www.transformingurbantransport.com.

Annex: determining high capacity investments: a basic illustrative example

In deciding to which transport modes to invest in, policymakers will first need an idea of how many people travel, or are predicted to travel, across different areas of a city. Using this information, it is possible to determine what kinds of public transport systems may be most appropriate.

Take an example: 100,000 people need to be transported from one area of the suburbs to the city centre – a distance of 20km - each morning. The costs and carrying capacities of different transport systems in this city are:

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

Note: [a]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 above, to transport 100,000 people (assuming commuting journeys should be 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 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. Given that MRT systems can be constructed below ground, the opportunity cost of land for these systems can be significantly lower than for BRTs or LRTs. The opportunity cost of land can be substantial and is likely to affect the viability of BRT systems 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.

To take our example further: if survey data suggests that daily fares affordable to the target 100,000 commuters should be set at $1.50 for public transport, daily total revenues from this commute would equal:

Number of commuters x fare for individual travel
= 100,000 x $1.50 = $150,000[121].

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 our example, if we assume that a city government is able to cover 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 options outlines above:

— 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**.

121 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.

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