ITDP

Medellin, Colombia BRT. Image by: Luc Nadal

Best Practice in National Support for Urban Transportation

Part 1: Evaluating Country Performance in Meeting the Transit Needs of Urban Populations

By: Walter Hook, Colin Hughes and Jacob Mason

Introduction

With the world's urban population projected to increase from 3.4 to 6.4 billion between now and 2050, the sustainability of the earth will depend on these new urban residents living as sustainably as possible. One key element of this will be making sure the majority of these new urban residents can live well without depending on the use of the private automobile. Success in large measure will depend on whether the expansion of urban mass transit systems will be able to keep pace with this rapidly growing urban population. Many innovative cities have, on their own initiative, brought about significant long term shifts away from private car use. Overall, however, cities have not expanded their mass transit infrastructure at a pace sufficient to meet the growing needs of their new urban residents, or to stem the risk of irreversible climate change. In a few countries, like Colombia and Mexico, national governments have played an important role making sure that cities have the financing and technical assistance they need to meet their growing mobility challenges.

This paper explores where, whether, and how cities have obtained sufficient help from their national governments to meet their growing urban mobility challenges. With the growing risk of permanent damage to the earth from climate change, it has become imperative to figure out whether there is a role for national governments, and then what that role is, in scaling up municipal level successes to achieve national level changes in urban mobility patterns.

This paper is the first of a multi-part series that tries to specify the best role that national government has played and can play in helping cities deliver the most and highest quality urban mass transit at the fastest speed. This paper reviews the performance of nine countries in terms of the total amount, the quality and the speed of their mass transit infrastructure expansion. After reviewing that data, the paper finds that high quality BRT has allowed some countries to develop more mass transit faster. It will, then, look at which countries are doing the best at developing high quality mass transit of a scale and speed sufficient to curb climate change.

The countries reviewed are: Brazil, China, Colombia, France, India, Indonesia, Mexico, South Africa, and the United States. This group, which represents nearly half the world's population, is a sample of the most important countries, both developed and developing, urbanized and urbanizing, and those that have and have not historically invested in mass rapid transit.

This first paper develops a basic comparative framework for evaluating the degree to which countries have grown their rapid transit networks since 1980. It looks at the types of infrastructure, the quality of that infrastructure and amounts of money invested in each country. This data is, then, compared to urban population growth.

The second paper in the series will take a bottom-up approach, examining in detail a sample of projects in each of these nine countries to understand how transport infrastructure is financed in each country and the degree to which national policy and funding has influenced municipal actions. The third paper will examine in detail those national policies and funding mechanisms that the bottom-up analysis identified as clearly important. All together, the three papers will offer an understanding of the potential for national government to accelerate the expansion of high quality mass transit. It will identify the national government investment and financing practices that have proven most effective in meeting the rapid rise in demand for mobility in growing cities.

France, as an example of a European approach to urban mass transport, emerges as a clear

standard-bearer, with three times more rapid transit per urban resident than the United States, and nearly five times more than any developing country. France, however, achieved this at a very high cost. The most interesting case study is the fast-paced and inexpensive rise of high-quality, mass rapid transit in Colombia (and, to a lesser degree, Mexico), especially as compared to China's slightly slower and much more expensive growth per urban resident in mass rapid transit.

These case studies demonstrate how some countries, despite recent efforts, are making insufficient progress in growing their rapid transit per urban resident. The differences in national policies and funding that explain these differences will only be addressed in future sections.

Key Findings

- In a sample of 9 key countries, only a few are building quality mass transit fast enough to do more than keep pace with urbanization.
- A good indicator of how well countries are doing is the kilometers of mass rapid transit per urban resident, or RTR.
- By this measure, France, as an example of a European approach, is doing the best, but at a high cost.
- Colombia and Mexico have improved the most at the lowest cost.
- Focusing transit investment on BRT was critical to significant recent growth in kilometers of mass rapid transit in a number of countries.
- The quality of the investment also matters, particularly for BRT. Only projects rated Silver or Gold on the BRT Standard inspired replication and scale up. Again, Colombia and Mexico were best practices.
- The explanation for the differences in performance will be discussed in future chapters.

Measuring Mass Rapid Transit Growth

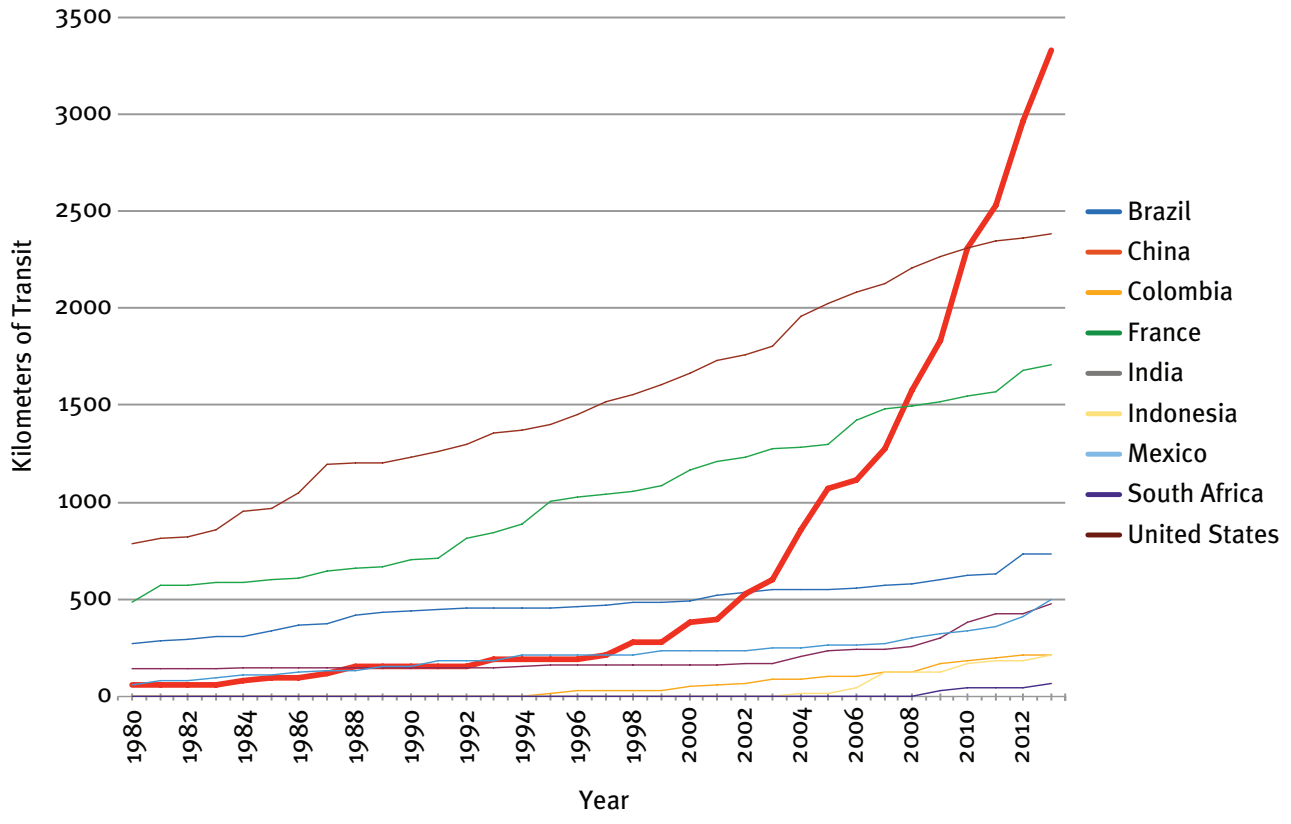
Overall, mass transit investment has taken off in the last two decades in these nine countries, as shown in Figure 1 below. The simplest way to look at the growth in mass rapid transit is by the number of kilometers of rapid transit built since 1980. Mass rapid transit, for the purposes of this report, is taken to include urban-scaled, intra-city bus rapid transit (BRT) that meets the "BRT basic" standard, light rail transit (LRT), and urban heavy metro rail (metro). (Bus services that operate in mixed traffic do not qualify as "rapid transit," and inter-city commuter train services are not included.)

In 1980, over 85 percent of the total mass rapid transit in all of nine of these countries was located in the United States (55 percent) and France (33 percent). However, the vast majority of growth in mass rapid transit since then has been in the other countries. Since 2000, over 50 percent of the growth in mass rapid transit kilometers in this sample has occurred in China. This includes approximately 1,500 kilometers of metro rail that China has built since 2000, as well as more than 500 kilometers of high-quality BRT built since 2005. In absolute numbers, China dominates. However, those numbers are not enough to understand the degree to which China's growth in mass rapid transit is keeping pace with its urbanization rate.

China has the world's largest population and third largest land area, and the country is undergoing continued rapid urbanization; it is therefore no surprise that a high proportion of the world's transit is being built there. But comparisons of the growth of urban mass rapid transit are more revealing when they are normalized by urban population. A key indicator in determining whether a country's mass rapid transit infrastructure is keeping pace with urban growth is the number of kilometers of mass rapid transit per million urban residents, or **the ratio of rapid transit to residents (the RTR ratio)**.

This indicator facilitates comparison between large, fast-growing countries like China and smaller, slower-growing countries like Mexico. Indirectly, it may also prove to be a strong proxy-indicator of whether the cities

Figure 1: Growth of Rapid Transit by Country, 1980 - 2013



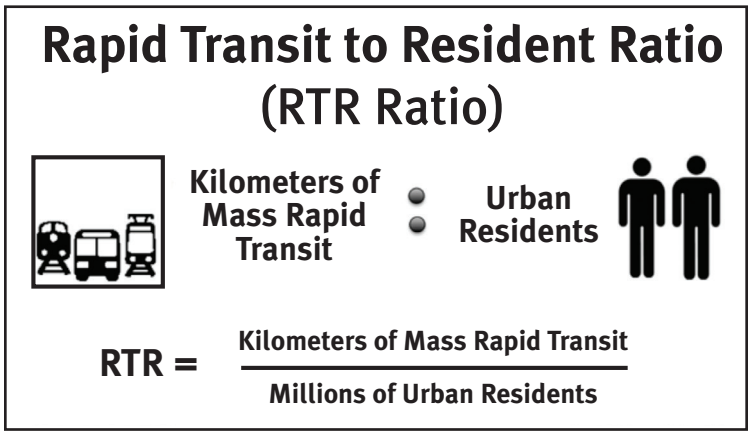
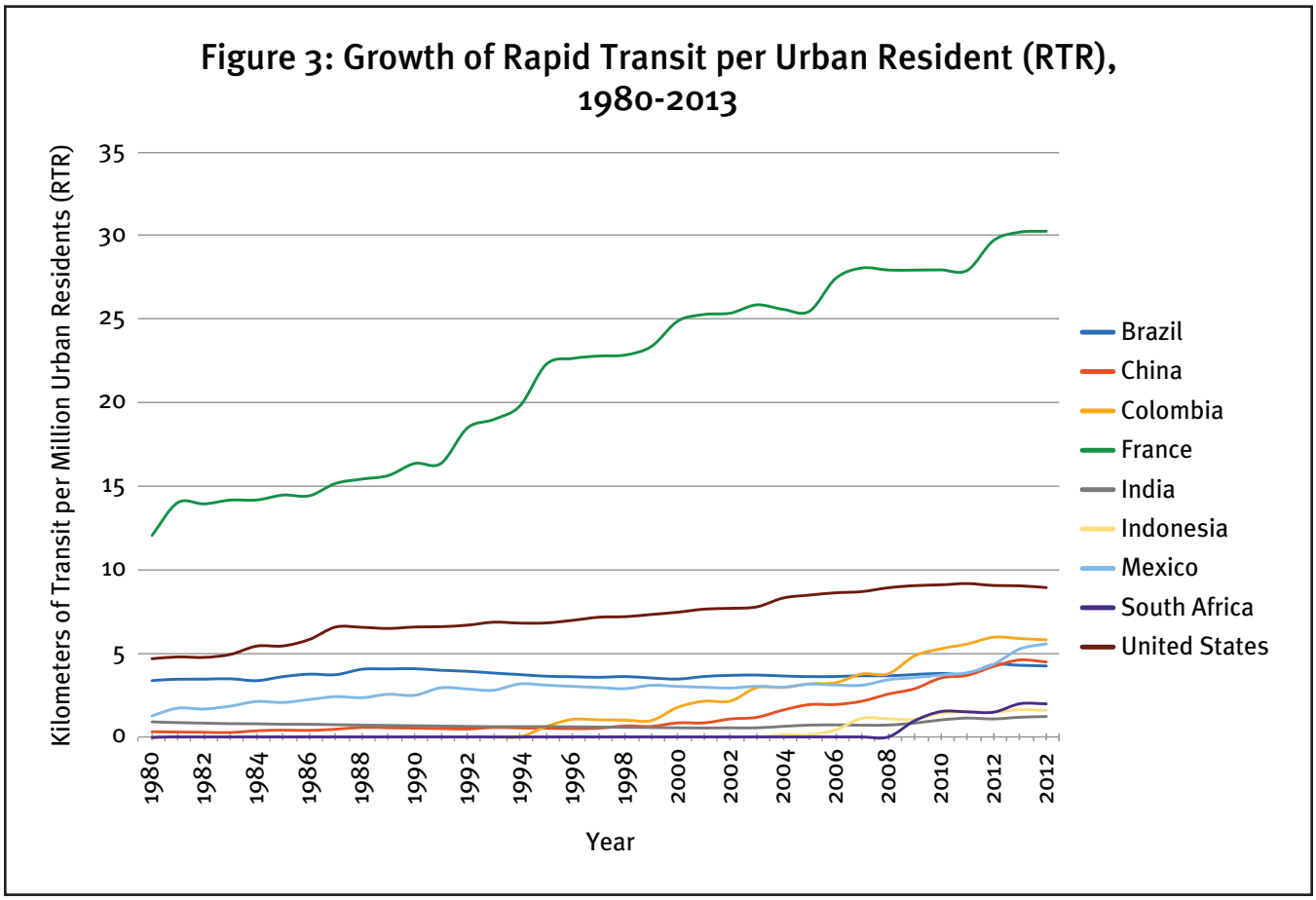


Figure 2: Rapid Transit to Resident (RTR) Ratio

in that country will have a high quality of life, health, and economic competitiveness. Linking RTR ratios to outcomes in these cities is an area of study that is ripe for future research.

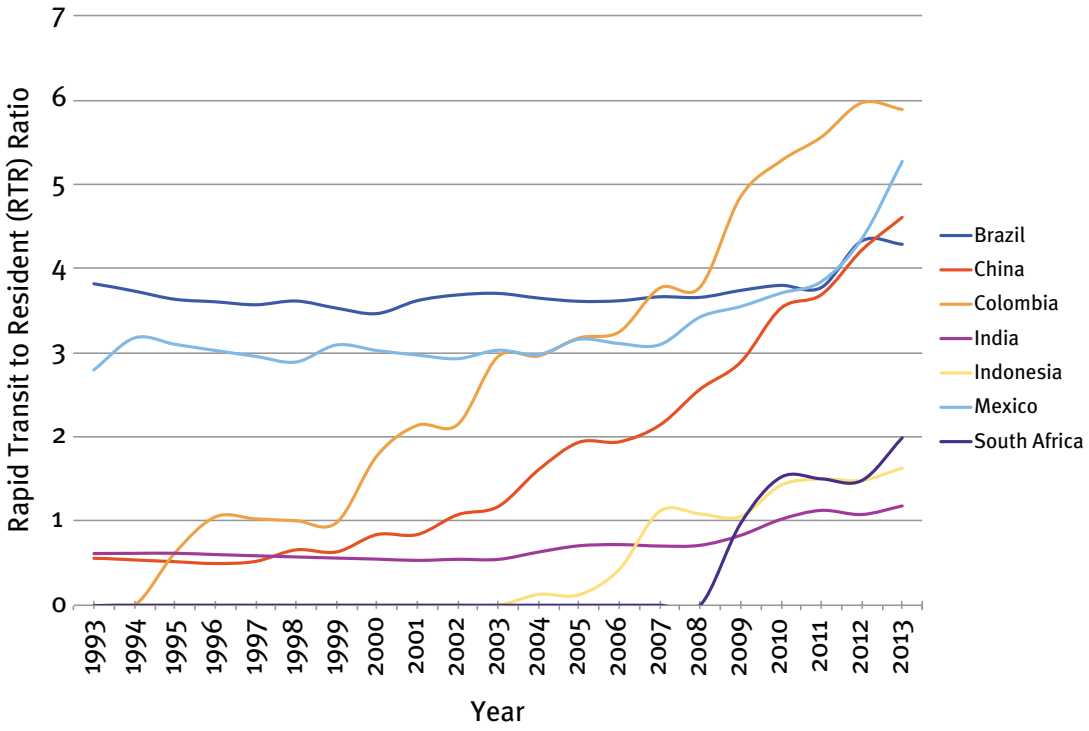
Figure 3, below, is identical to Figure 1 except that the y-axis represents kilometers of rapid transit per million urban residents (RTR) instead of the total number of kilometers and paints a very different picture of which countries have high levels of rapid transit and growth in rapid transit. In Figure 3, France's current 30 kilometers of rapid transit per million residents dwarfs all other countries including the US, which has less than one-third the RTR ratio at 8.8 kilometers per million urban residents. And China's soaring growth in rapid transit is much tempered in Figure 3. Although China's growth in kilometers of mass rapid transit was huge in absolute terms in Figure 1, when normalized by its urban population growth in Figure 3 it arrives at a modest RTR ratio of 4.4 kilometers of rapid transit per million urban residents - half that of the US and well behind Colombia (5.8) and Mexico (5.2) in 2013. Most other countries have significantly flatter growth showing that rapid transit made only small gains over urban population growth. Most troublingly, despite many billions invested in metro rail in recent years, India has virtually no transit access for its citizens with just 0.84 kilometers of rapid transit per million residents.



Case Study: Colombia

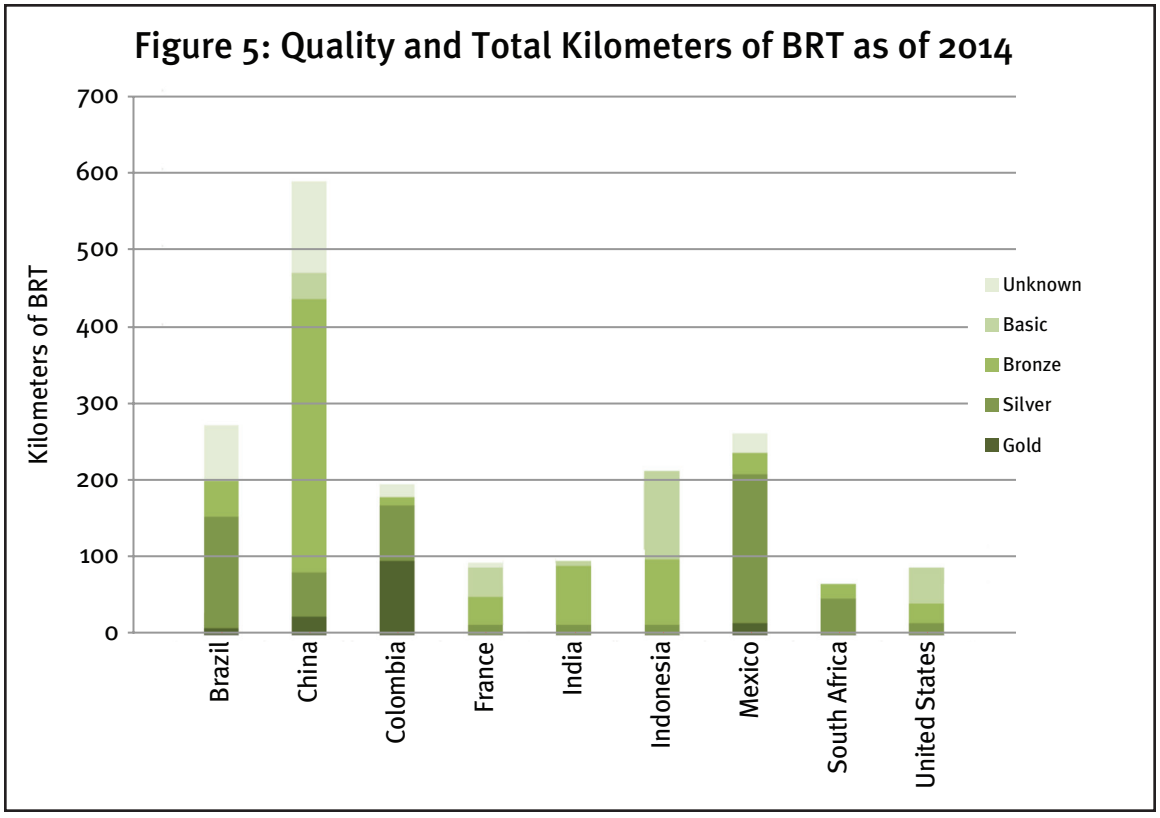
In 1995, Colombia had zero kilometers of mass rapid urban transit. Less than ten years later, Colombia had more kilometers of rapid transit per urban resident than any other developing country in this analysis, including China, which has been vaunted for its rapid metro development. Not only did Colombia increase the number of kilometers of mass rapid transit per urban resident 30 percent more than China did between 2000 and 2010, but it did so while spending 50 percent less money per urban resident. Why was Colombia so successful in raising its RTR ratio?

Figure 4: Change of RTR Ratio in Seven Countries, 1993 – 2013



The acceleration in Colombia's RTR ratio was made possible by the demonstration of a successful, robust BRT system in Bogotá, developed by visionary mayor Enrique Peñalosa. The success of Bogotá's system inspired a national program to strategically invest in BRT in Colombia's largest cities. (BRT was chosen due to its low-cost and quick implementation compared to metro and LRT.)

The RTR ratio is effective not only for comparing urban rapid transit access in countries of different sizes, but also for monitoring a single country over time as it grows, urbanizes, and builds additional urban rapid transit. Of the nine countries examined here, all managed to grow their mass rapid transit systems more quickly than they urbanized, though the rate of growth in RTR ratio varied. France's high RTR ratio growth rate, which is due to continued investment in mass rapid transit, is especially impressive given its already-high 1980 RTR ratio, which was higher than the 2013 RTR ratio in the United States. Colombia, Mexico, and China are also exhibiting strong growth. Brazil has experienced a period of decline followed by very slow growth. It is, however, expected to climb quickly to an RTR ratio of 8.0 between 2014 and 2016, as it builds rapid transit in advance of global sporting events. (South Africa



managed to achieve a bump in its RTR ratio due to investments made prior to the World Cup held there in 2010.) The United States, Indonesia, and India, however, are barely adding enough new kilometers of mass transit to grow their transit faster than their urban populations. This is especially disconcerting in the case of India, which has a low RTR ratio, with little growth.

Where countries have had a big change in the RTR ratio, bus rapid transit systems have helped achieve the dramatic change.

The Quality of Transit Investments

Most of the metro and light rail investment has been of reasonably good quality. BRT, however, has been of much more variable quality. This paper relies on *The BRT Standard* to assess the quality of BRT investments. Much of the BRT in China, Indonesia, and the United States is of fairly low quality. As seen in Figure 5, the quality of BRT systems varies widely and where a gold-standard or silver standard BRT served as a pilot or demonstration project, a greater replication of higher standard BRT has occurred. Colombia, as discussed previously (on page 6), did the best in part because TransMilenio served as a catalytic gold-standard BRT project. Mexico City led the way with a silver-standard BRT. Without those high quality demonstration projects, there is a problem with high quality BRT projects reaching scale.

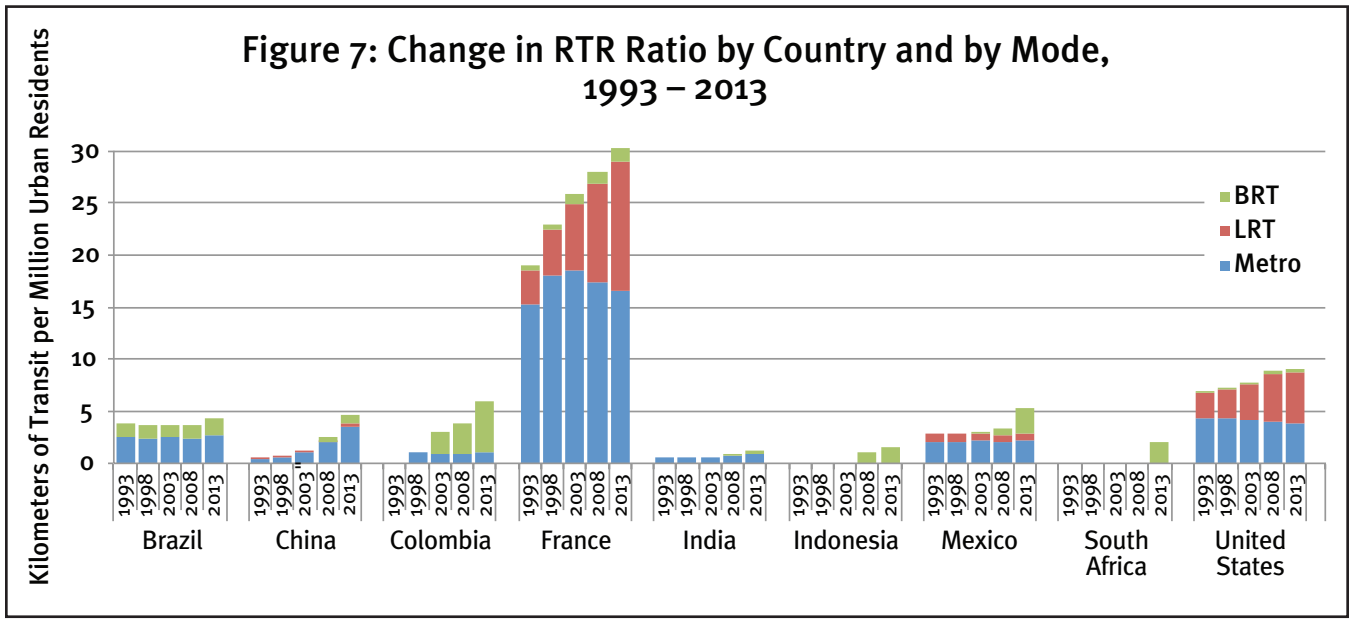
RTR Ratio Growth by Mode

Country	GDP per Capital[1]	2013 RTR Ratio (Kilometers of rapid transit per million urban residents)
France	$35,784	30.2
United States	$53,101	8.9
Colombia	$11,189	5.8
Mexico	$15,563	5.6
China	$9,844	4.5
Brazil	$12,221	4.3
South Africa	$11,259	2.0
Indonesia	$5,214	1.6
India	$4,077	1.2

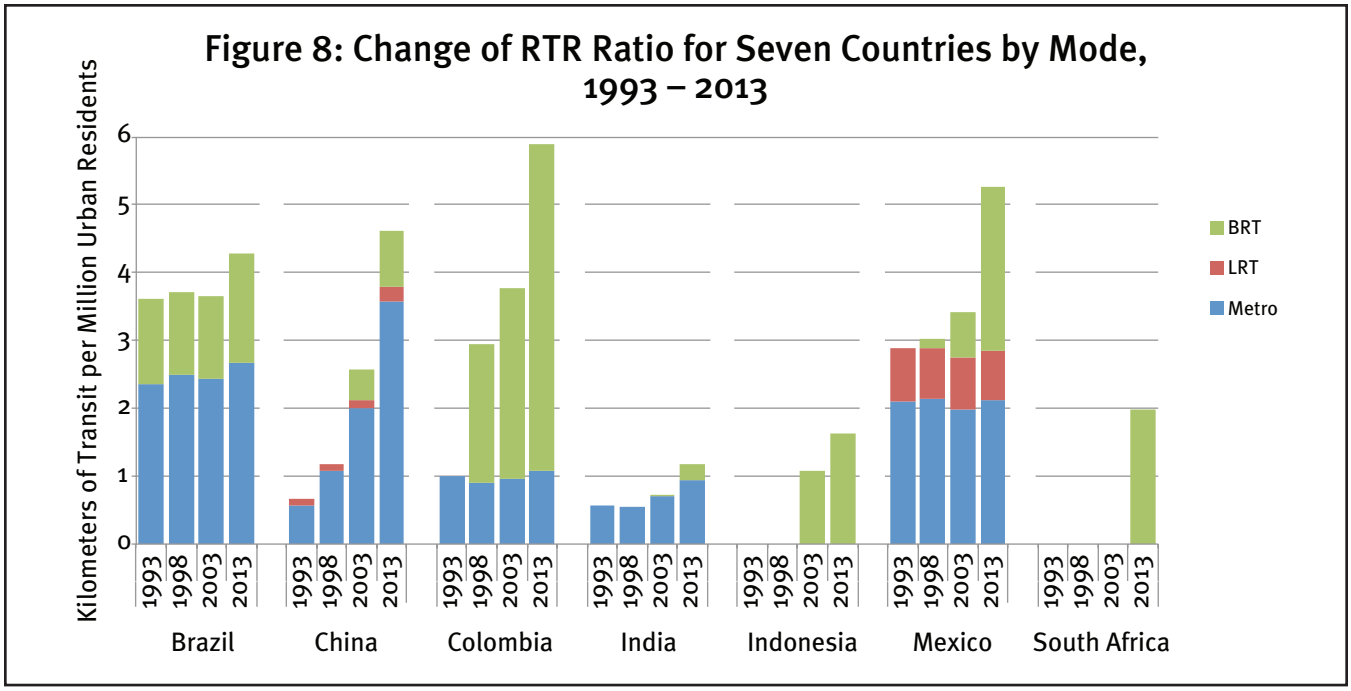
Figure 6: GDP per Capita and RTR Ratio by Country

regard to RTR ratio seems to generally follow its rank in GDP per capita—in other words, wealthier countries tend to have more transit per capita. The United States, Mexico, Brazil, China, and India all follow the same order whether they are being ranked by GDP per capita or RTR ratio. South Africa, with a GDP per capita ($11,000) similar to Brazil and Colombia, ranks far behind those two counties when it comes its RTR ratio of 2.0, which is similar to lower income countries such as India and Indonesia, which have half the GDP per capita of South Africa. Colombia, however, is ranked 85th in the world for GDP per capita ($10,700), yet its RTR ratio exceeds that of both Mexico (which has a GDP per capita that is 50 percent higher, at $15,600, and is ranked 67th) and Brazil (ranked 81st, with a GDP per capita of $11,700). Colombia's rapid expansion of mass transit proves that with investment in BRT, the growth of mass transit can exceed GDP growth, meaning that the mass rapid transit systems in developing countries can catch up to developed countries—in fact, China, Colombia, and Mexico are on course to have a higher RTR ratio than the United States within five to ten years.

Figure 7 below shows the growth in RTR ratio in five-year increments by country and by mode. However, because France's growth dwarfs that of the developing countries, Figure 8 (on page 8) shows the recent growth of the RTR ratio by mode in only the seven developing countries included in this analysis. In this chart, it becomes immediately apparent that BRT has become the main mode by which a developing country can quickly increase its RTR ratio.



[1] World Economic Outlook Database, April 2014, International Monetary Fund. Database updated on 8 April 2014. Accessed on 10 April 2014.



Comparing RTR Ratio Growth and Investment Costs of Different Mass Rapid Transit Choices

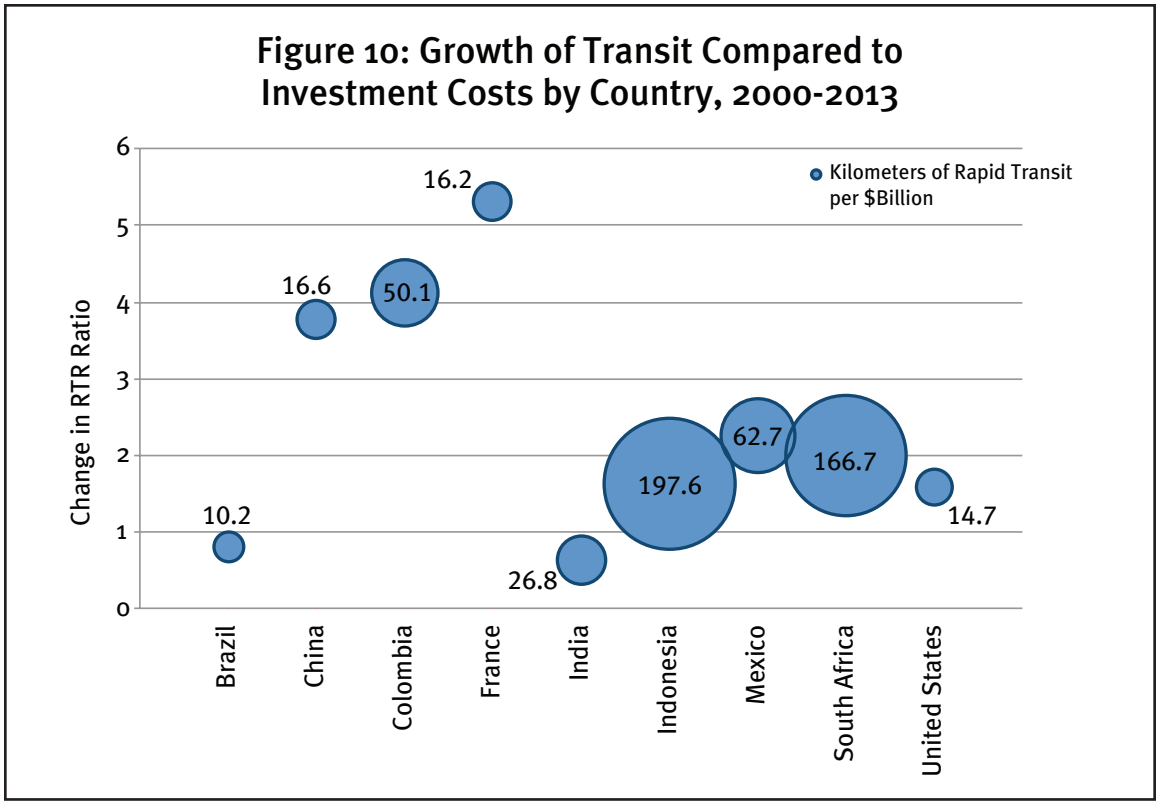
	Brazil	China	Colombia	France	India	Indonesia	Mexico	South Africa	USA
Δ RTR 2000-2010	1.34	2.69	3.50	2.92	0.53	1.43	0.68	1.52	1.62
Rapid Transport Investment, 2000-2010 (billions USD)	$42	$114	$3	$24	$8	$0.8	$0.9	.288	$25
Urban Residents (millions)	153	555	31	51	333	104	85	28	238
Investment per Urban Resident ($USD)	$274	$207	$102	$483	$24	$8	$11	10	$107
Avg Cost per Km of RT (millions USD)	$205	$77	$29	$166	$46	$6	$16	7	$66

Figure 9: A Comparison of Changes in RTR Ratio and Costs by Country from 2000 to 2010

The figure above compares each country's change in RTR ratio between 2000 and 2010, and the cost of that change in absolute value, per urban capita, and per kilometer of mass rapid transit. Costs were estimated based on the average cost per kilometer from a sample of projects of that mode in that country, so they reflect an average of local costs.

Between 2000 and 2010, China increased its RTR ratio by 2.69, at a cost of $207 per urban resident. Colombia's RTR ratio increase, 3.50, was 30 percent higher than that of China. However, because Colombia invested primarily in BRT and China invested primarily in metro, Colombia spent less than half as much as China per capita, and over 60 percent less per kilometer of mass rapid transit built on average. China spent just over $77 million on average per kilometer of mass rapid transit to build 1,460 kilometers of metro and 420 kilometers of BRT, while Colombia spent an average of $29 million per kilometer to build ten kilometers of metro (at an average cost of $96 million per kilometer) and 123 kilometers of BRT (at an average cost of $17.8 million per kilometer). Differences in costs per kilometer for various modes depend on construction and material costs in the country and on the capacity of the systems built. Colombia's BRTs have some of the highest capacities in the world, while several of the Chinese systems were lower-cost, lower-capacity systems.

The vertical axis in Figure 10 shows the change in RTR ratio from 2000 to 2013. The size of the circles represents the number of kilometers of mass rapid transit that each country



built per billion USD spent (the bigger the circle, the more transit built per dollar). Indonesia and South Africa far surpass all other countries with regard to building more rapid transit per dollar because they built mostly or only BRT. The results for Indonesia, however, must be tempered by the fact that the BRT built was of fairly low quality. Colombia and Mexico also have strong value, because they invested more heavily in BRT.

Another way of understanding these trends is to look at a country's investments in mass rapid transit over time as a portfolio. The mass rapid transit investment portfolio can be analyzed according to cost, length of system, and capacity (for which data is not currently not available). Figures 11 and 12 show how much bus rapid transit (BRT), light rail transit (LRT), and metro were built as a percentage of total mass transit kilometers and then how that relates to the spending by mode as a percentage of total spending on mass rapid transit.

A common trend among all the pie charts is that metro takes up a much larger portion of the spending pie than it does of the pie that shows length of transit by mode. This is especially evident in the two pie charts from China and Brazil, where there were higher levels of investment in metro. LRT performs slightly better than metro, as evident in the France charts. Relative to metro and LRT, even small investments in BRT result in large expansions of kilometers of mass rapid transit. Again, the China example is illustrative: BRT garnered only 1 percent of mass rapid transit spending from 2000 to 2010, yet it accounted for 22 percent of the kilometers of mass rapid transit built over the same period. A similar trend can be seen in India, where BRT made up 2 percent of spending, but 24 percent of mass rapid transit length on the ground.

Figure 12 shows that Mexico and Colombia had the highest levels of investment in BRT, which explains why these two countries also had the lowest costs per kilometer of mass rapid transit, as shown in Figure 10, above.

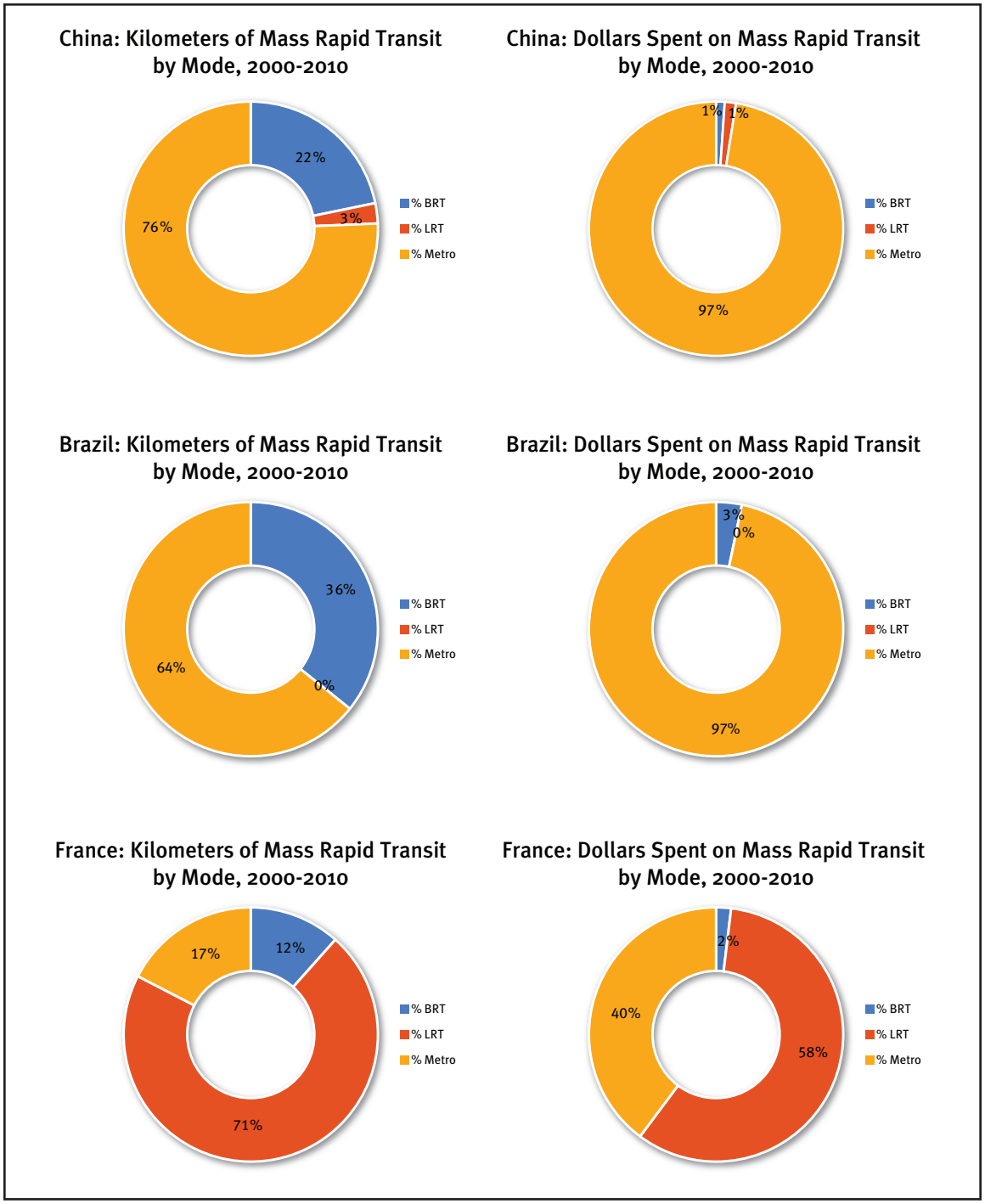


Figure 11: Spending Compared to Length for Mass Rapid Transit by Mode for China, Brazil, and France

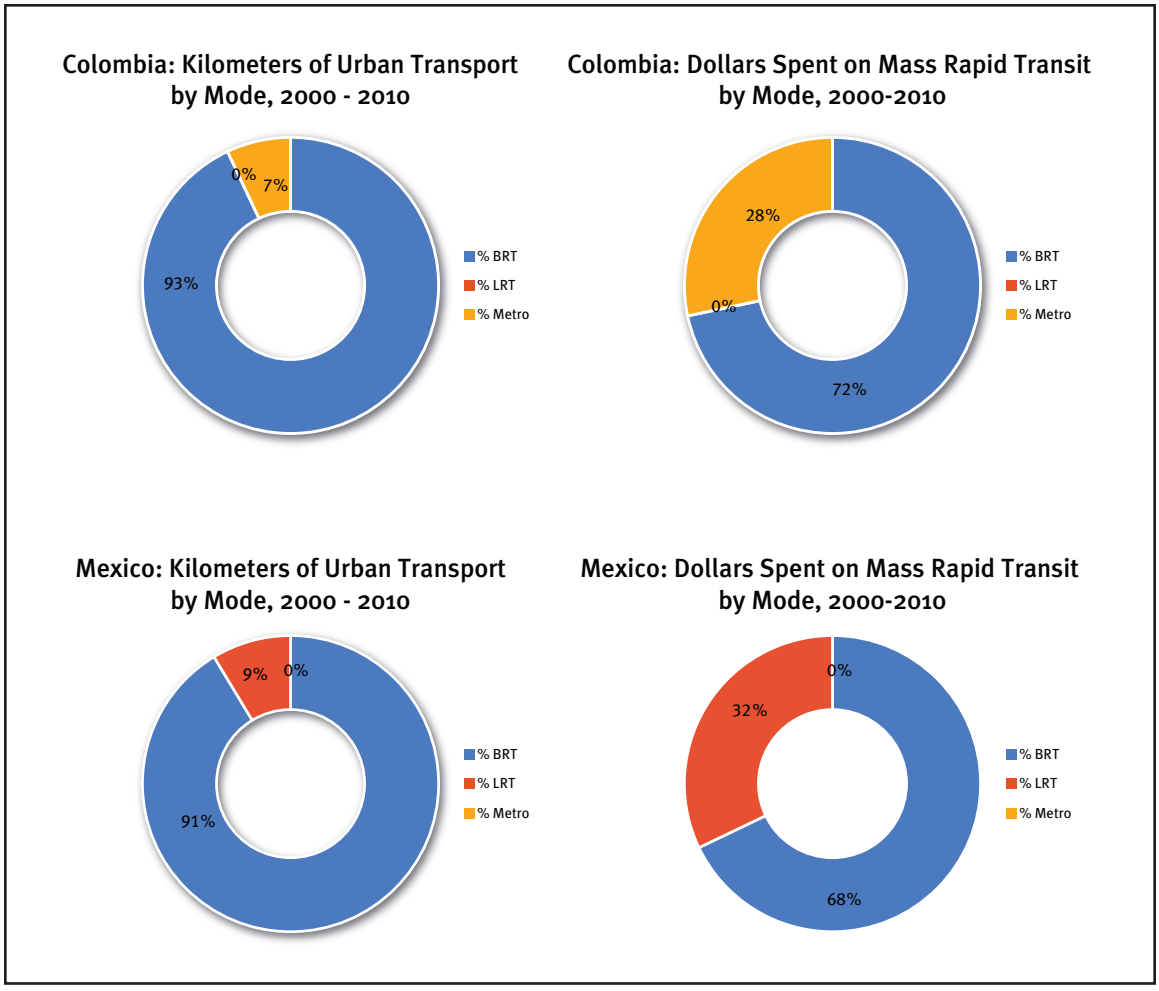


Figure 12: Spending Compared to Length for Mass Rapid Transit by Mode for Colombia and Mexico

Conclusion

As the twin engines of urbanization and economic growth accelerate in the developing world, cities there will need to build mass rapid transit at even faster rates, or face terrible congestion, poor health and quality of life, and the effects of catastrophic climate change. The RTR ratio allows for a simple, normalized comparison of the provision of mass rapid transit both over time, as a country urbanizes, and in comparison with other countries of different sizes.

An analysis of the RTR ratios in countries around the world reveals a staggering asymmetry in the provision of mass rapid transit to urban residents: the developing countries studied here have anywhere from just one-fourth to one-thirtieth the amount of mass rapid transit that a transit-rich country like France has, underscoring the acute need for growth in rapid transit investment. Developing countries will not only need sustained investment to develop mass rapid transit to remain competitive and improve urban quality of life, but they will have to invest wisely in cost-effective modes of mass rapid transit. Cities and countries will need to focus on rapidly expanding the scale of their transit networks. The level of change needed requires implementing many kilometers of mass rapid transit rapidly; building ten corridors of BRT for the same cost as ten kilometers of metro can truly allow a city to shift its transport economy to a more sustainable path and help a country keep pace with the requirements of rapid urbanization.

The quality of mass transit investment also matters. The BRT investment to be equivalent in performance to rail-based alternatives, needs to be bronze-standard or better using *The BRT Standard* and silver-standard or better to inspire expansion and replication.

And while the gap in mass rapid transit per urban capita between countries like India and France seems daunting, this analysis also shows that it can be narrowed quickly and without a great deal of capital. Colombia's RTR growth occurred at 0.4 kilometers per million urban residents per year from 2000 to 2013. Mexico grew by 0.75 kilometers per million urban residents per year in 2011 and 2012, and between 2014 and 2016, Brazil is expected to grow at one kilometer per million urban residents per year. At that rate of growth, India could have ten times the mass rapid transit it has now—and almost 50 percent more than the United States—in just a decade's time.

Colombia's growth in RTR ratio over the last decade, Mexico's over the last couple years, and the expected growth in Brazil all are encouraging signs that cities will be able to build mass rapid transport fast enough in the future. But this will only come to pass if best practices are followed to catalyze new projects, invest resources efficiently, and develop financial resources necessary to spark and sustain such growth.

The next report in this series will examine how transport infrastructure is funded and financed in each of these countries by analyzing a sample of projects. The third report will then look at national policies that relate to urban transport in each country and the impact of those policies on growing the RTR rate, as well as project selection, regulation, and financing.

ITDP | Institute for Transportation & Development Policy

9 East 19th Street, 7th Floor, New York, NY 10003 USA
Tel: +1-212-629-8001 • Fax: +1-646-380-2360 • Email: mobility@itpd.org
www.itdp.org

Promoting sustainable and equitable transportation worldwide