Finances of Bogota's Transportation System

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ABSTRACT

In this paper we study Bogotá's transportation system finances from 1994-2010. The analysis takes a systemic approach that includes from sidewalks to mass transit and highways. It analyzes revenue and expenditure trends to extract lessons regarding sustainable urban transportation finance. We exclude all vehicle capital and operating costs. We look at the revenues that accrue to the system, comparing them to expenditures and determining deficits that are covered by transfers from the city's general tax base. We then project revenue and expenditure scenarios. We find that Bogotá's transportation system finances increased significantly during the period studied, due to three main elements. First, the creation of a fuel tax, earmarked for mass transit and road construction and maintenance. Second, the city implemented a successful BRT project, Transmilenio, that has attracted additional funds, particularly from the national government. Third; the city designed and effectively collected a valorization tax associated with specific infrastructure projects located in several areas all around the city. However, despite the increase in funding, the lingering poor conditions of the road network and the lag on the development of the planed transport system shows that increases in revenue are needed to cover all the needs of the transportation system. Nonetheless, in light of the current situation these increases seem politically difficult to pass and operationally difficult to achieve. While Bogotá should try to increase revenue, we find that it should continue to emphasize the investment of scarce transportation resources in the improvement of its public transport system, specifically the Transmilenio BRT, the associated non-motorized modes network (cyclelanes and sidewalks) and the upcoming Integrated Transport System because it leads to greater financial sustainability through cost-efficiency of the investments and to long term overall transport sustainability.

INTRODUCTION

The city of Bogotá has successfully transformed its transportation system into a model project which is recognized worldwide. The changes in the transportation have been closely related with the development of an adequate road network[1] which includes sidewalks, cyclelanes, segregated bus lanes and improvements on the roads used by the conventional (non BRT) public transport modes. While the story of what happened in Bogotá has been told by several sources (*1, 2, 3, 4*), not as much has been said about the financial aspects of this transformation. The objectives of this paper are therefore; first, to examine the evolution of the financing of Bogotá's transportation system and understand Bogotá's reforms throughout the last 15 years. Second, in 2006 we carried out a similar exercise to analyze the performance of the city´s transport finance[2] and we now seek

[1] No major change in transport will be possible without the support of an adequate network and more intelligence in using it (European Comission, 2011).
[2] (Ardila-Gomez and Ortegon, 2006)

to compare our scenarios and their assumptions with the actual observed conditions to extract lessons regarding the functioning of urban transportation finance and the characteristics and time performance of some specific financing instruments. Finally, we seek to model Bogotá's future transportation system and analyze what changes need to occur in the sources of revenue, if any.

Using official information, we assembled the sources of revenue and expenditure items between 1994 and 2010 for Bogotá's transportation system. We define transportation system as the entire road network, including the infrastructure of the city's bus rapid transit system, Transmilenio which includes sidewalks, cyclelanes (when existing) and mixed traffic lanes along the corridors. We exclude all capital and operational costs for motorized vehicles that use the road network. Therefore, our focus is the infrastructure side of the entire road network in the city. In this analysis we take into account all expenditures by the city government related to investments on the road network, including construction of new infrastructure as well as maintenance and repair works. On the revenue side, we carefully examine all sources of revenue that are earmarked for the transportation system, including surtaxes and transfers, land value capture mechanisms, and a vehicle tax which is a user charge that by law is not earmarked and that goes to the general tax revenue. We then compare the revenues and the expenditures to find the deficit, which by our definition was covered with transfers from the city government. This paper is organized as follows. The next section describes Bogotá's basic mobility data to put the reader in context. The following sections concentrate on analyzing the revenues, expenditures, and deficit of the transportation system. We then conclude.

BASIC INFORMATION ON BOGOTÁ'S MOBILITY

Bogotá is the capital of Colombia. Bogotá has a population of 7.4 million inhabitants and the greater metropolitan area which includes the 20 municipalities closest to the city, the population rises to 8.5 million. In 2004 the road network had 14,485 kilometer-lane, of which 19% are deemed arterial roads, 18% intermediate roads, and 63% neighborhood streets. By 2010 the city's road network had expanded by 388 Km-lanes having now a total 14,873 Km-lane (2.7% increase) of which 19.5% are deemed arterial roads, 27.5% intermediate roads, and 53% neighborhood streets. The important changes on the distribution on the road network occurred in 2005 when nearly 1500 kilometers-lane of roads where upgraded from neighborhood streets to intermediate roads. The other changes have been more gradual and of less magnitude with nearly 200 kilometers-lane of intermediate road having changed to arterial roads in the period 2005-2010. Further, the trunk corridors of the city's Bus Rapid Transit system, Transmilenio, had in 2004 a total of 855.1 Km-lanes and had in 2010 895.4 Km-lanes which represents an increase of nearly 5% (40,5 Km-lanes) on the 5 years. This length includes busway lanes, typically two lanes per direction to allow for overtaking, and three to four lanes for mixed traffic (cars and trucks as traditional buses are not allowed on Transmilenio corridors). In 2004 only 25% of the road network as a whole was in good condition and 50% of the road network was in bad condition, while almost 100% of the roads in Transmilenio's corridors were in good condition. In 2010 37% of the whole network was in good condition and 40% remains in bad condition, while the roads in Transmilenio's corridors are 71% in good condition and 13% in bad condition. In 2004 the city had around 600,000 private cars and close to 19,000 traditional buses. In 2010 the city has nearly 1.2 million private cars and nearly 16000 buses. Transmilenio had approximately 800 articulated buses and over 350 feeder buses in 2004 *(11*) and in 2010 it had 1,241 articulated buses and 515 feeder buses.

According to the 2005 home survey, produced for the Master Mobility Plan, Bogota had approximately 9.6 million trips per day in the city, of which 62.5% were by public transit, 17.6% by non-motorized modes, 14.4% by car, and 5.5% in other modes. According to the 2011 mobility home survey the amount of trips increased to more than 12.2 million per day, of which 46% of trips are made by foot, 29% by public transport and 11% by car and the remaining 14% in other modes. In 2004 Public transportation (traditional buses and Transmilenio) accounted for 25.9% of the vehicle-Km logged, but transported 75.5% of the motorized trips. Cars logged 42.2 of the vehicle-Km, but transported only 19.6% of the motorized trips. Finally, taxis transported 4.9% of the motorized trips, but accounted for a whopping 31.9% of the vehicle-Km logged (data from *11*). In 2011 public transport accounted for 57% of the motorized trips, cars for 21%, motorcycles for 4% and taxis for 7%.

In sum, Bogota is a large city in the developing world that moves overwhelmingly by public transit and, dramatically increasingly, by walking, Although car trips present an increase in the last 7 years, they have been a minority in terms of modal share, but logged, at least in 2004, a disproportionate share of the vehicle-Km, which is a measure of actual demand on the roads. The data of Km logged by mode from the 2011 survey is not yet available, however the increase in other "individual" modes such as motorcycles and taxis. combined with the decrease in public transport vehicles and mode share suggest that the situation in terms of usage of infrastructure space might not have changed in favor of the public transport modes.

INSTITUTIONAL ARRANGEMENTS IN BOGOTÁ FOR TRANSPORTATION FINANCING

The Republic of Colombia is organized as a centralized state, in which the national government has decentralized several responsibilities to municipal governments, particularly those pertaining to land-use, infrastructure provision, education and health (*12)*. As such, the city of Bogotá is responsible for managing its entire transportation system. This includes building, operating and maintaining the road network, managing facilities for non-motorized transport, and regulating the private provision of public transportation and regulating automobile use. These responsibilities include financing the construction, operation and maintenance of the road network. The city of Bogotá collects a series of taxes, which first go to the Secretariat of Finance (SF). The SF then distributes the revenue out to the different city agencies, including the transportation related agencies (*13*). Colombian law establishes that a tax cannot be earmarked for a specific purpose (*12*). Instead, all taxes go to the city's treasury and are distributed afterwards. Levies earmarked or with specific destination are called surtaxes or fees and in theory represent the payment by the user for a service directly provided by the government.

In addition to the Secretariat of Finance, there are three other city agencies relevant for the analysis of Bogotá's transportation system's finance. First, the Instituto de Desarrollo Urbano (IDU) or Urban Development Institute, which operates in part as a road fund (*13)*. A road fund, strictly speaking, seeks to guarantee an adequate and reliable source of revenue to fund the transportation system (*9*). IDU receives two sources of revenue. The first source is the valorization surtax, which the IDU uses to finance the construction of new infrastructure or significant upgrading of existing one. In theory, the neighbors of a project experience an increase in their property values thanks to the better infrastructure brought about by the project. The valorization surtax seeks to raise revenue to fund the construction of the project by taxing the increment in property values. Bogotá, in particular, and Colombia, in general, have had a rather long history of using this surtax to finance urban infrastructure development (*14, 15*). IDU is in charge of all of the

technical and legal studies required to raise the valorization charge. IDU also has to lobby the City Council to get approved the law that regulates any valorization charge.

Second, IDU receives transfers from both the city government, through SF, and indirectly from the national government. The transfers from the city government are from a surtax on fuel, both gasoline and diesel but excluding natural gas. Colombian law establishes that the proceeds of this surtax on fuel are earmarked for the transportation system. Specifically, 50% of the revenue goes to the construction of mass transit systems, such as the Transmilenio BRT. Twenty percent is earmarked for construction and maintenance of local streets, specifically roads that provide access to neighborhoods, and another 20% is earmarked for construction and maintenance of the arterial road network. The remaining 10% of the revenue does not go to IDU, but to the 20 local governments within Bogotá (*17*). In effect, the city is divided into twenty localities, each of which has a local mayor appointed by the mayor of Bogotá, who is an elected official. Each local government also has an elected local council, while the city has a council elected at-large. By law, 10% of all revenue of the city of Bogotá is earmarked for the localities (*17*). The transfers from the national government, in turn, are earmarked to cover 75% of the construction cost of the second and third stages of the Transmilenio BRT project. The second stage opened in May 2006 for service and the third stage is started works in 2010, but has not started total operation due to delays. These transfers to IDU can also be used to purchase urban properties that need to be demolished to allow the construction of the busways. Finally, IDU can also execute projects that are funded through loans from international institutions, such as the World Bank and the Inter American Development Bank, made to the city of Bogotá (*16*).

The two additional agencies relevant for the analysis of the finances of the transportation sector in Bogotá are the Secretariat of Transit and Transportation (STT), which in 2005 was restructured and renamed as the Secretariat of Mobility (SM) and Transmilenio Co. SM is in charge of regulating the provision of public transport, enforcing the national traffic laws, and engineering traffic measures to improve traffic flow. SM [3]oversees the traditional transit system and perform as the head of the sector being above, in political terms, of Transmilenio Co and IDU. SM can use those funds to cover its own operation expenditures and carry out some projects, such as upgrading the agency's software and facilities. Additionally, SM receives transfers via SF from the city treasury to cover other operating and investment costs. Transmilenio Co., in turn, is responsible for the Transmilenio BRT system and will be responsible for Bogota's Integrated Transport System, (BITS) which aims at optimizing and modernizing the conventional public transport service to integrate it with the existing BRT services through a unified electronic payment system. This responsibility entails planning the expansion of the network, planning daily service, and supervising the private concessionaires that own and operate the articulated and feeder buses that provide service in the system, as well as the BITS 12 private concessionaries which will be in charge of providing fleet and operating services in whole operational area. The contract with the concessionaires establishes that approximately 4% of the farebox—i.e. gross revenue—goes directly to Transmilenio Co. This agency uses these funds to cover its operating costs as well as part of the costs of operating the system. However, these funds are usually insufficient and SF also transfers funds to Transmilenio Co (*11*).

[3] When the STT was still in operation all the revenue from tickets issued to drivers when to a trust fund, FONDATT, which belonged to STT. FONDATT was cancelled on 2006 and the management of the revenue from the tickets was directed to the SF.

THE EVOLUTION OF THE REVENUES OF THE TRANSPORTATION SYSTEM: 1994-2005

As seen in the previous section, Bogotá's financing structure has several sources of revenue that are earmarked for the transportation system. In this section, we analyze the period 1994 to 2010 by looking at the situation at the beginning and end of the period, and then by looking at the evolution in between. Note that we exclude the vehicle tax, because as a tax, it is not earmarked. In 1994 Bogotá just emerged from an important tax reform that changed the face of the city's finances. Between 1993 and 1994 total tax revenue in the city increased by 77% and by 1996 total tax revenue had doubled with respect to 1993 (*18*). All figures that follow are expressed in constant Colombian pesos of 2010. Occasionally we convert to US dollars by using an exchange rate of one dollar equal to 1,868 pesos. This figure was the value of the exchange rate on December 31st 2010 (*19*).

Regarding the finances of the transport sector, in 1994 total revenue was Col$ 198,000 million (US$ 105.9 million). In this year, the main sources of revenue were (Table 1) the valorization tax, followed by administrative fees paid by vehicle owners, and capital resources, for example from IDU's investments or from the privatization of city-owned enterprises done by the Mayor. The gasoline surtax, instituted that year, raised a minimal amount. By 2005 total revenue had grown to Col$ 768,000 million (US$ 411 million), which represents an annual average increase of 25.2% in real terms and in 2010 the total revenue was 1,440,000 of millions (US$ 770 million). While this is an impressive change, there was an equally important change in the composition of the funds raised. In 2005, the main sources of revenue were the gasoline surcharge and the transfers from the national government earmarked for the Transmilenio BRT project. In 1994 there was no equivalent project in terms of quality and impact and hence there were no transfers from the national government. The main source in 1994 was the valorization tax accounting for 38.7% of the total revenue. In 2005, the two main sources accounted for 76.6% of the total revenue. Most of the other sources of revenue lost importance, particularly the valorization tax. The drop in the valorization charge is particularly important because it reflects the lack of support for repeated attempts by several mayors to pass new charges in the City Council. In effect, only after a long hiatus, the City Council approved a valorization charge in 2005, which started to raise revenue in 2006 and accounted for 27.1% of the revenue in 2008. In 2010 Capital gains, Gasoline surcharge and Transfers from the national government are the three main sources of revenue, accounting for 36%, 21.8% and 14.7% of the total revenue, respectively.

Table 1. Revenue Sources by item: 1994, 2005 and 2010

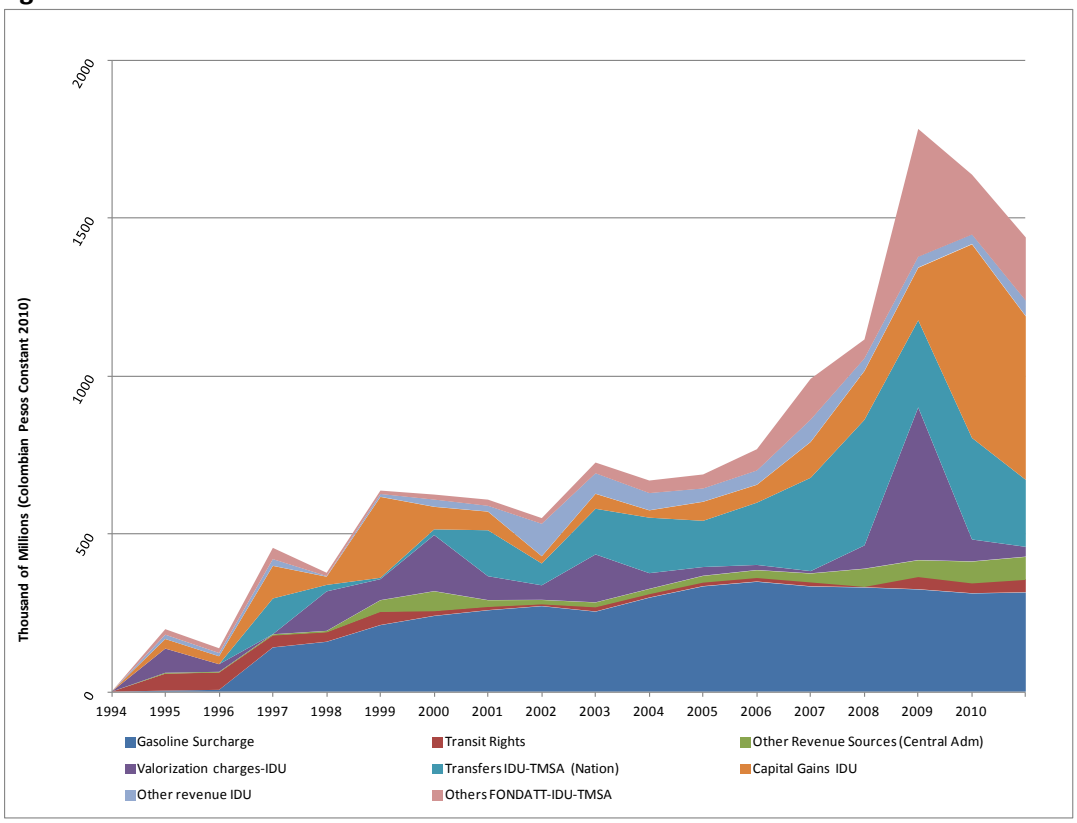
	1994	2005	2010
Gasoline Surcharge	1.70%	45.23%	21.79%
Transit Rights	27.04%	1.79%	2.89%
Other Revenue Sources (Central Adm)	1.56%	3.21%	5.07%
Valorization charges-IDU	38.68%	2.07%	2.15%
Transfers IDU-TMSA (Nation)	0.00%	25.67%	14.74%
Capital Resources IDU	15.24%	7.35%	35.99%
Other revenue IDU	6.95%	5.89%	3.43%
Others FONDATT-IDU-TMSA	8.83%	8.80%	13.94%

Source: authors' calculations based on (*20*) and SF data.

The evolution of the finances between 1994 and 2010 (Figure 1) shows that while the revenue raised from most sources increased in real terms, there are important variations in the amounts raised from year to year. The highest variations are in the transfers from the national government, the valorization surtax and the capital gains. The transfers from the national government experience important variations because they are contingent on the city having a sound project the national government is interested in funding. In the case of Bogotá this project is the Transmilenio BRT system, which has managed to attract funds. In turn, the valorization charge is highly variable because it depends on the city council passing laws to create the charge and on the calendar for collecting the levy set is those laws. Once the city council passes a law authorizing a valorization charge, it is fairly reluctant to approve new valorization charges until the current one is over.

The gasoline surtax is the source with the clearest tendency of increase year after year, albeit at different rates, and with the most stable revenue. The changes observed in the rate of growth of the gasoline surcharge during the first 10 years are associated with changes in the rate of the surtax. Specifically, in 1997 the rate changed in Bogotá from 15% to 20% of the price at the pump. In 1999 the national Congress unified the rate at 20% in all of the country, to prevent drivers from driving to fill up their tanks in municipalities with lower rates. In 2003 Congress raised the rate to 25%. Finally, it is worth mentioning the revenue source "capital gains," because it has an important peak in the late 1990s. This peak is associated with the partial privatization of the power company, which gave additional funds to the city government. The city used some of these funds for financing the construction of the Transmilenio BRT project (*1*).

Figure 1. Evolution of Revenues: 1994-2010



Source: authors' calculations based on (*20*) and SF data.

Notice an important pattern that took place in Bogotá. The introduction of the gasoline surtax allowed the city to raise important resources to invest in the transportation system. These resources then facilitated in part the implementation of an important and successful project, Transmilenio. The Transmilenio project, in turn, was able to attract additional funds from other sources, such as national government or global fund sources[4], and thus creating a virtuous cycle to fund the system. A counter example is illustrative. In 1988-92 the city implemented a busway project that included the segregation of bus flow from mixed traffic flow (*1*). Because busways are just one element of bus rapid transit but are not BRT as such, the busway project did not deliver a high-quality service. Further, at the time there was no gasoline surtax. The result was a low-cost, low-quality project that did not manage to attract additional revenue to the system. Therefore, when the transportation system is able to raise funds *and* there is a successful transportation project in terms of achieving sustainable transport objectives such as economic efficiency, social equity or environmental and human protection, the system will attract additional financial resources from different levels (local, national, global) so that further benefits of the type can be obtained. This situation seems particularly true in light of the increasing concern about climate change and the need to take a global approach for defining strategies to reduce green house gases emissions.

THE EVOLUTION OF EXPENDITURES OF THE TRANSPORTATION SYSTEM: 1994-2005

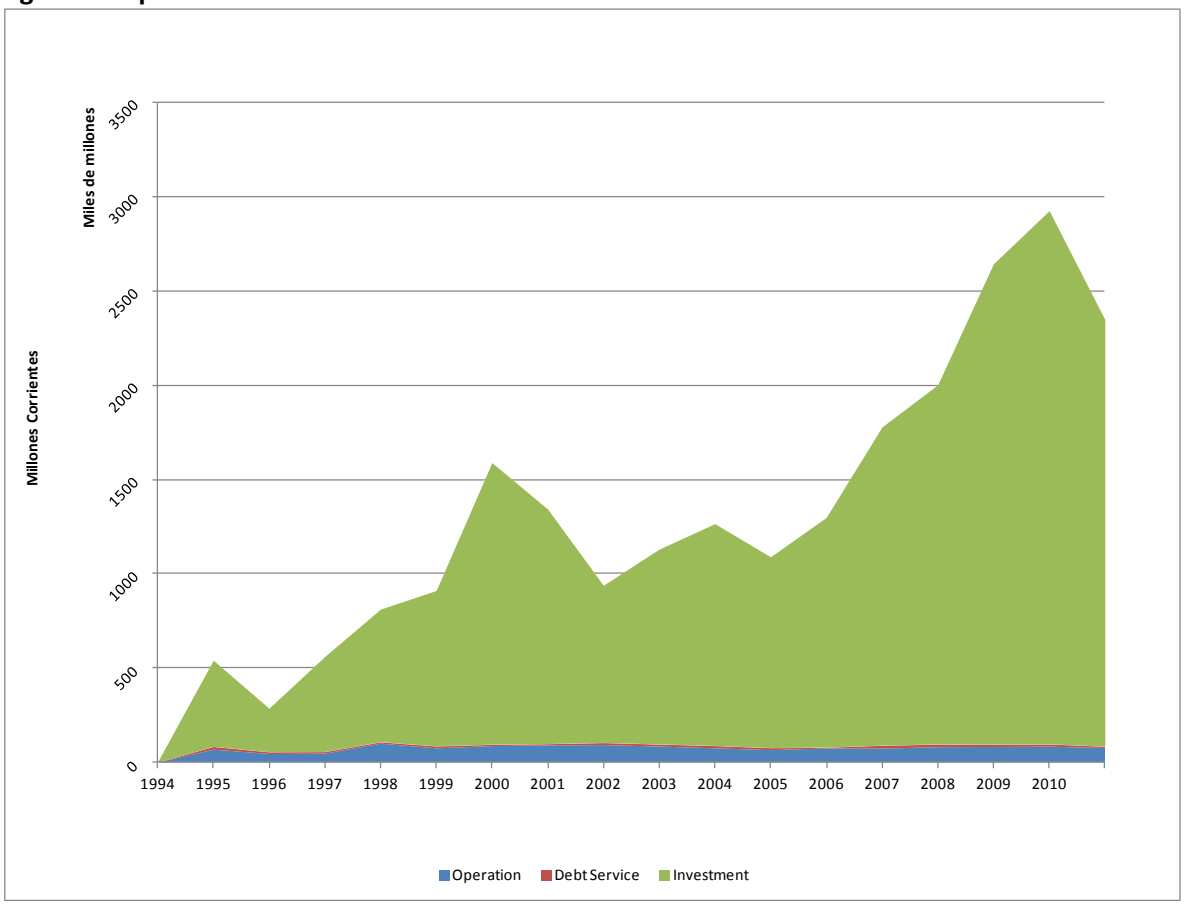
Expenditures in the transport sector in Bogota consist of investment, debt service, and agency administration. Investment refers to expenditures in construction and maintenance of infrastructure. Debt service refers to paying back loans the city obtained for the sector, and expenditures in administration cover the routine operations of the agencies that administer and manage the sector: IDU, Transmilenio Co., and SM. Expenditures in 1994 totaled Col$ 539,000 million (US$ 288.6 million), in 2005 Col$1,296,000 of millions (US$ 693,6 million) and by 2010 they reached Col$2,344,000 of millions (US$ 1254,8 million) which was by far the point with higher expenses in the studied period. The previous peak observed in the period was Col$ 1,590,000 of millions (US$ 848,9 million) in 1999 (Figure 2), at the height of construction of the first stage of the Transmilenio Project. This stage included 424 Km-lanes of exclusive lanes for buses, refurbishing the mixed traffic lanes, and building 53 stations, plus several pedestrian overpasses at the station. The total cost of this first stage of the project was US$ 240 million, including infrastructure and rolling stock (*21*). The level of expenditure observed in 2010 can be associated with an overall increase of the road network of 388 km-lanes and the upgrade of 1272 km-lanes of neighborhood street to intermediate roads and the upgraded of approximately 200 km-lanes of intermediate road to arterial roads. These periods also accrues for the construction of 40 Km-lane of the BRT segregated roads.

In 1994 the expenditure in agency functioning was 12.8% of total expenditure in transportation. By 2005 this figure had dropped to 5.7%, despite a real increase in the amount spent. In 2010 this expenditure item further dropped to 3.31%. A similar pattern occurred with debt service. The result was that the amount devoted to investment went up from 84.7% in 1994

[4] Bogota's Transmilenio scheme is one of the two transport related Clean Development Mechanisms (CDM) approved projects. The CDM funding represent 10% of the total infrastructure cost. The Transmilenio project also received funding from the Climate Trust Fund (Sakamoto, 2011).

to 93.9% in 2005 and 96,4% in 2010 of total expenditures. This increase represents an important gain in organizational efficiency, particularly at IDU, which reduced the administration costs per unit of investment.

Figure 2. Expenditures: 1994-2010



Source: authors' calculations based on (*20*) and SF data.

THE EVOLUTION OF DEFICITS OF THE TRANSPORTATION SYSTEM: 1994-2005

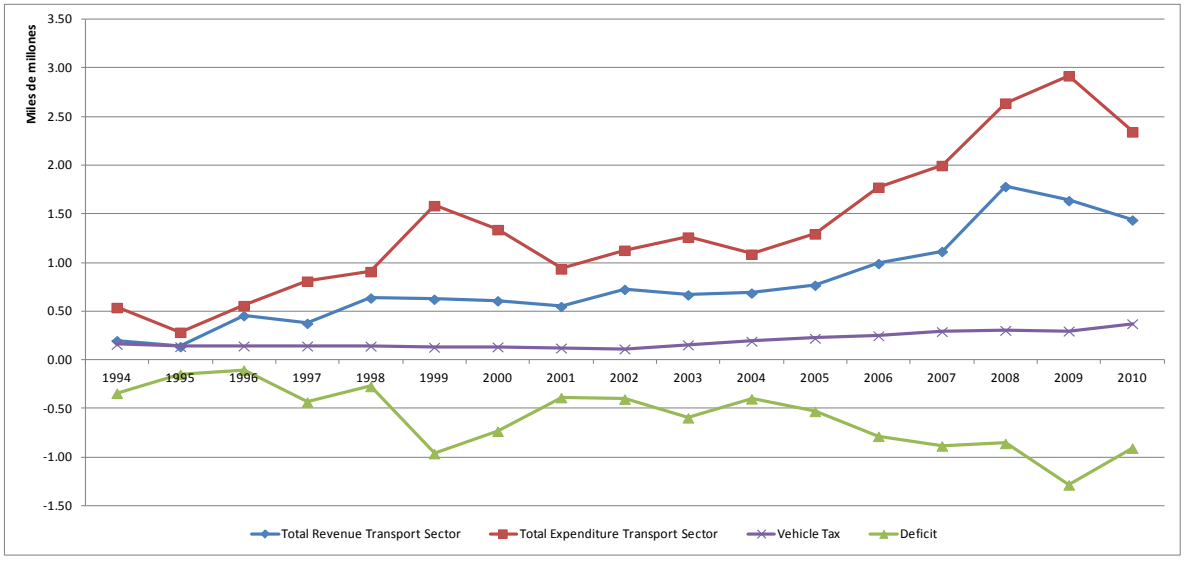
Because the expenditures are higher than the revenue generated by the transportation system, there is a recurrent and increasing deficit in the period we studied. Figure 3 shows total revenue, total expenditures, and the resulting deficit. Every year has a deficit, i.e. the difference between revenue and expenditures, which was covered with transfers from the City Treasury. Notice then that our methodology by definition equals the transfers from the city government to the deficit. This approach is necessary because the Mayor's office publishes the revenues and expenditures, but not the actual transfers. These transfers come from the general tax revenue pool that has no pre-specified destination.

Figure 3 also shows the revenue raised from the vehicle tax. As said, because it is a tax, it is not earmarked. Nonetheless, it is a charge to cars and presumably part of this revenue ends up covering the expenditures in the transportation system. Only in 1996, 97 and 98 the administration transferred funds to the transportation system for less than the amount raised by the vehicle tax. In 1999, however, there is a breaking point. The breaking point is the

implementation of the first stage of the Transmilenio BRT project. This project attracted additional funds, including capital gains and transfers from the city government's general tax revenue. Ever since, the transfers have surpassed the revenue from the vehicle tax, with peaks coinciding with peaks in the construction of Transmilenio's stages 1 and 2 and the start of Transmilenio's phase 3 in the beginning of 2010.

This pattern in which the system attracts funding beyond its sources, including in this case the vehicle tax for analytical purposes, reinforces our point that when the transportation system has good projects and a reliable source of dedicated revenue—the fuel surtax—then it is able to attract additional funding. Notice, moreover, that in Bogotá's case this funding is directed predominantly for mass transit and not for private transport.

Figure 3. Deficit, revenue, expenditures and vehicle tax: 1994-2010



Source: authors' calculations based on (*20*) and SF data.

In sum, Bogotá's strategy for funding its transportation system has been to use an earmarked revenue source, the gasoline surtax, to fund in part a sound public transit project, Transmilenio. In turn, the Transmilenio project managed to attract additional funding initially from the city government—transfers and capital gains—and later on transfers from the national government. In effect, thanks to Transmilenio Bogotá finally received transfers for transit from the national government. Before, lacking a sound project, the national government had transferred substantial amounts to Medellín, the only city with a metro in Colombia but not to Bogotá (*22*).

EXPLORING ALTERNATIVES TO COVER FINANCIAL NEEDS

In our first version of this paper from 2006, in order to project the future of the system and explore the required financial resources we took the revenue and expending sources of the period 1994- 2005 and projected them over a 10-year period. Our objective was to see if in the future the transportation system could be financed with increases in the revenue sources and/or sources that are earmarked, including transfers from the national government but not from the city government. That is, we wanted to see if the system could generate enough resources so that the city treasury does not have to transfer general tax revenue.

For creating the future scenarios, first we projected the fuel taxes revenue using growth rates in accordance with their historical behavior. Then we adjusted those rates to generate high and low revenue scenarios. For other revenue sources, such as the valorization charge and transfers from the national government, the projections correspond to yearly values established in several official documents that reflect the compromises acquired by the national and city governments. The historical values of the remaining revenue sources presented a high variability, which made it difficult to project a growth rate. For the projection of these sources, therefore, we took the historical average value.

We then projected the expenditure sources. For the ten years in the projection we kept constant the government agencies' operation expenditures and the debt service expenditures as a share of total expenditure. Notice, however, that in the past these items have decreased as a share of total expenditures. Finally, based on the condition of the road network and the requirements of new infrastructure defined on the city's Master Urban Development Plan (*23*) we projected the required investment expenditure. Then we defined two possible maintenance policies: "good" and "acceptable". The "good" maintenance policy aims to take the complete road network to a good condition. To accomplish the "good" policy goals the city must stop the deterioration process, reconstructing as soon as possible all the kilometers in poor condition and rehabilitate all those in regular condition. In addition, the scenario assumes the city has ten years to build the new infrastructure contemplated in the Master Development Plan. Consequently, all the roads must be intervened continuously to prevent further deterioration to keep the good condition. The criteria used to define the proper intervention moments comes from local studies on pavement deterioration curves.

On the other hand, the "acceptable" maintenance policy aims to let some parts of the network remain in poor condition, some in regular condition and some in good condition, so that in average the road network would be in acceptable condition. To achieve this policy the city must invest on the roads before they pass from regular to poor condition based on the pavement deterioration curves (*20*). This means the city postpones the necessary investments in maintenance as long as possible by letting the roads deteriorate to such level that the only possible intervention is reconstruction. In addition, the city has ten years to build the entire new infrastructure and five years to rebuild the kilometers that are currently in poor condition.

In sum, we have two revenue scenarios, high and low, and two expenditure scenarios derived from the maintenance policies, good and acceptable. The combinations of those scenarios allow us to generate the following final scenarios:

- Scenario 1: High Revenue- Acceptable maintenance policy.
- Scenario 2: Low Revenue- Acceptable maintenance policy.
- Scenario 3: High Revenue- Good maintenance policy.

- Scenario 4: Low Revenue- Good maintenance policy.

Our interest was to see if the projected revenue equaled or exceeded the projected expenditures. Table 2 presents the resulting deficits—there is no year with a surplus—for the 10 year projection. The table also shows the net present value (NPV) of the deficits, and the equivalent annual value (EAV) using a discount rate of 12%. One outstanding aspect from the scenarios comparison is that, for the same maintenance policy, the difference between the deficits for high and low revenue scenarios is very small. This is a consequence of the limited growth potential of the fuel taxes, the only revenue sources that we can vary. This result implies that the deficit level depends directly on the expenditure level and not on the revenue generated. Notice that the Net Present Value of the deficit almost doubles from the acceptable maintenance policy to the good maintenance one. From this analysis we conclude that the limitations of the existing sources to raise the revenue make it rather difficult for the city of Bogotá to respond adequately to the road network needs. Therefore the city has to search for new revenue sources.

Table 2. Projected Deficit by Scenario (millions of pesos of 2005)

Deficit per Scenario	Scenario 1	Scenario 2	Scenario 3	Scenario 4
	High Revenue-Acceptable Maintenance	*Low Revenue-Acceptable Maintenance*	*High Revenue-Good Maintenance*	*Low Revenue-Good Maintenance*
2006	-960,190	-969,085	-5,179,256	-5,188,151
2007	-926,900	-951,491	-316,562	-344,196
2008	-958,822	-1,000,273	-1,654,854	-1,703,332
2009	-1,055,060	-1,114,612	-350,076	-414,616
2010	-2,992,553	-3,071,529	-1,740,532	-1,830,926
2011	-403,402	-503,216	-403,957	-503,216
2012	-2,880,064	-3,002,224	-6,273,706	-6,393,848
2013	-276,038	-422,153	-441,969	-588,727
2014	-250,912	-422,701	-6,241,988	-6,415,061
2015	-403,327	-602,623	-589,404	-789,986
NPV (12%)	$ -6,486,266	$ -6,916,935	$ -12,926,457	$ -13,374,143
EAV (12%)	$ -1,147,966	$ -1,224,188	$ -2,287,778	$ -2,367,012

Source: calculations by authors.

NEW SOURCES TO COVER THE DEFICIT

To analyze the potential and limitations of possible new revenue sources we designed a simple model that allows to combine revenue sources to achieve zero deficits, for given projected expenditure levels and under certain conditions. The model also allows us to find suitable values for gasoline and diesel surtaxes, a toll for entering the Central Business District in Bogotá, and the vehicle tax, which we assume becomes earmarked for the transportation system. The last two are new sources of revenue. The toll is a user charge that can raise revenue for entering the most congested area of the city. As such, is also serves the purpose of alleviating congestion. The vehicle tax we assume becomes a user charge that is therefore earmarked. The model targets a zero deficit—i.e. zero transfers from the City government from the general tax pool—given the following set of restrictions valid for the acceptable maintenance policy:

- gasoline surtax ≤ 50%
- diesel surtax ≤ 50%
- Toll for entering downtown ≤ $Col 8,000
- Vehicle surtax ≤ $Col 250,000 per vehicle

Table 3 shows one set of possible results, because the model does not have a single feasible solution but a set. Nonetheless, the results are illustrative and show that the projected revenues can equal the projected expenditures with most variables at the maximum levels. These levels are already politically difficult to reach, but we estimate can be feasible if a mayor builds enough support. Notice, however, that these results are for the acceptable maintenance policy

.

We now relax the restrictions in search for a feasible set of values for the good maintenance policy, which demands more expenditures than the acceptable maintenance policy. Table 3 shows the results. As seen, for Bogotá to achieve a good quality road network, it has to raise significantly the fuel surtaxes and the vehicle surtax, and impose a significant charge for entering downtown. We deem these changes politically infeasible.

Table 3. Model Results
Source: calculations by authors.

REVENUE SOURCE	Current Level	Optimal Values for	
		Acceptable Maintenance Policy	Good Maintenance Policy
Gasoline Surcharge	25% ($ 1,495/gallon)	50% ($ 2,392/gallon)	75% ($ 3,588/gallon)
Diesel Surcharge	6% ($ 276/gallon)	46.31% ($ 2,009/gallon)	63.82% ($ 2,768/gallon)
Toll	0	$ 8,000 per trip to downtown	$ 16,000 per trip to downtown
Average Vehicle Tax	$ 249,347/per car	$ 249,347/per car	$ 500,000/per car

Our model suggests that with an important effort to introduced new sources of revenue Bogotá will be able, at best, to approach an acceptable condition in the transportation infrastructure system, but not a good one. However, the analysis of the real revenues and expenditure for the studied period show an increase in deficit (measured in constant 2010 pesos) that suggests how the sustainability path requires not only increases in revenue through more and better sources (such as the valorization charge) but also "wise investments," that is on sustainable transport projects such as the BRT network. Hence, Bogota faces a very critical situation in which both the existing road network (used by conventional public transport and by the future Integrated Transport System) and the planned infrastructure for the BRT are underfinanced. This situation further emphasizes the need to invest the scarce resources strategically to achieve an eventual reduction in the financial gap. Nonetheless, it is important to highlight the effort by Bogota to improve the overall condition of the road network, which of course is economically and politically sensible. Seen differently, investing in mass transit has benefits not only for the functioning of the city but to attract sources of finances to the system. Urban highways, on the other hand, generate some benefits for the functioning of the city but do not raise any revenue or attract outside sources of financing—unless cars have to pay tolls.

CONCLUSIONS

In this article we showed the evolution of urban transportation system finances in Bogotá. During the period studied, 1994 to 2010, the system's revenues increased significantly. We argue that this was due to two main elements. First, the establishment of a fuel tax earmarked for mass transit construction, Transmilenio, and road construction and maintenance. The fuel surtax is a dynamic source of revenue, but that nonetheless needs to be reinforced periodically by increasing the surtax rate.

With the revenue from the fuel surtaxes, Bogotá has financed not only road maintenance but more importantly a successful mass transit system, Transmilenio. This BRT project is precisely the second element that explains the significant increase in the revenue that accrues to the city's transportation system. Transmilenio is a successful mass transit system that is able to carry more than to 1.8 million passengers per day on an 87 Km network, with peaks of up to 46,000 passengers per hour per direction (*21*). This success has translated into financial support from the national government, which allocates part of its tax revenue for the purpose of financing the construction of new lines in the network. In short, our argument is that the finances of an urban transportation system improve when the system is able to generate resources, earmarked for use in the system itself, *and* when there are successful transportation projects that attract more funding and promote sustainable travel patterns that relatively reduce the future investment needs. This creates a virtuous cycle. In the absence of a minimal source of revenue for the system, implementing a successful project such as Transmilenio becomes more difficult, and hence the appearance of the virtuous cycle is less likely.

Despite this successful side of the story, our results suggest the entire transportation system is under financed. Historically this has been the case, and even the city government acknowledges it needs close to $3.2 billion dollars to maintain or upgraded the existing system to an acceptable condition (*16*). Moreover, some other $ 4 billion dollars will be needed to develop the road infrastructure projects that are defined in the Master Urban Plan. Our findings, however, suggest that this situation is structural. Our simulation of future scenarios indicated that not even increasing significantly the fuel surtaxes and even adding a toll for entering downtown and changing the vehicle tax to an earmarked surtax will ensure enough revenue to take the road network to an acceptable condition. These results are also consistent with the observed situation on the defined period. Despite the limitation, to increase the system efficiency, we still recommend that Bogotá consider increasing the revenue directly generated by the system, for example by raising the rate of the fuel surtax, by increasing the rate for the vehicle tax and turning it into an earmarked source, and further, when the public transport system has the capacity to manage demand shifts, by charging a toll for entering downtown. Yet our results indicate that even then the system will not raise enough revenue. The city government will have to continue to transfer funds to cover part of the deficit.

The question that remains is up to what point is justifiable for the city of Bogotá to entirely cover the deficit of the transportation system. In the end, these transfers from the city government from the general tax revenue are in fact a subsidy to car users. As seen car trips are a minority of the total trips and yet generate a disproportionate part of the vehicle-Km logged. We find this measure to be socially unfair. If the minority of car users wants better roads in Bogotá then it should pay more. That is, better roads for the car should come thanks to increased revenue from fuel surtaxes, an earmarked vehicle tax, and hopefully tolls.

At the same time, our analysis indicates that Bogotá , up to 2005, was following a clear sustainable transportation strategy, precisely because it used its scarce resources to improve conditions for the majority that use public transit. Urban transportation sustainability should not be understood as having a road network in good or perfect condition. Instead, we argue,

sustainability refers to maximizing the benefit of scarce resources with an eye on allowing future generations to blossom. Bogotá's strategy pointed precisely in that direction by emphasizing the construction and expansion of the Transmilenio BRT system. Nonetheless, the fact that from 2005 to 2010 the BRT network only expanded in 40 km-lane, and that the quality of the conventional transport, that uses the other overall, road network has not improved, makes difficult to judge whether the city is still on the sustainability path. This approach that focuses on the majority renders more benefits than biasing resource allocation in favor of the minority that use the car. This same rationale can be extended to the consideration of new transport modes. Sustainability has to do with both the initial investment in infrastructure and the recurrent expenses it generate. Finally, Bogotá has to consider seriously the need to increase the revenue its transport system generates, precisely because these additional sources coupled to a successful project attract even more resources to the system and reduce the overall deficit.

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