THE EFFECTS OF INCOME AND FARE VARIATION ON THE DEMAND FOR BUS TRANSIT SERVICES IN BRAZIL

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ABSTRACT

The public policies on mass transit and other economic policies have been unable to avoid increasing mass transit costs and urban bus fares, which places a burden on a majority of the population depending on public transit.This study analyzes the variations in urban bus fares and households income and analyzes their effects on the demand of paying commuters in 9 large Brazilian cities between 1995 and 2008. The study shows that a gap between the rise of urban bus fares and the population's income led to a decrease of more than 30% of the paying demand between 1995 and 2003. According to the price elasticity estimated in this study, demand for bus services has exhibited elastic behavior since 2001. Since then, the gradual increase observed in population income seems to buffer against persistent fare increases. The recovery of average household per capita income since then seems to support a reversal of downward trends in the number of paying passengers and increase access to public bus services. The number of paying passengers increased about 9.5% between 2003 and 2008.The evolution of the sector's main costs complement the study, permitting an analysis of the many factors that have caused the continuous increases of bus fares in metropolitan Brazil during this period. The study concludes highlighting some public policies that could provide a better economic environment for the provision of efficient and affordable transit services.

Keywords: affordability, transit service, price elasticities, transportation costs, Brazil.

1. INTRODUCTION

The fast urbanization process in Brazil during the last 60 years has contributed to the consolidation of socio-economic inequalities in the development of urban areas. The lower classes occupy most of these segregated suburban areas in which transportation plays a central role. The public policies on mass transit and other economic policies have been unable to avoid increasing mass transit costs and urban bus fares, which places a burden on a majority of the population depending on public transit. The rise of these costs can undermine the financial management of operating companies, the quality of services and full access of poor people to these services, primarily during times when family incomes are decreasing.

The decreased purchasing power of minimum wage as compared to urban bus fares was observed between 1995 and 2003. This decrease is closely related to a decreased number of paying passengers[1] occurring in the same period when examining operating bus transit systems in 9 large Brazilian cities[2]. Despite a persistent rise in Brazilian urban bus fares during the last 15 years, available data point to a reversal of the downward trend in passenger numbers observed since the beginning of 2003. This inversion seems to be motivated by the recovery of the purchasing power of minimum wage and rising average per capita income.

This study aims to analyze the variations in urban bus fares and households income and analyze their effects on the demand of paying commuters in 9 large Brazilian cities during the last 15 years. The evolution of the sector's main costs complement the study, permitting an analysis of the many factors that have caused the continuous increases of bus fares in metropolitan Brazil during this period.

The next section of this paper analyzes the structure of urban bus fares by evaluating the influence of each component on its final price. This analysis quantifies the factors of continuous bus fare increases in metropolitan Brazil during the last 15 years.

The study also shows that a gap between the rise of urban bus fares and the population's income led to a decrease of more than 30% of the paying demand between 1995 and 2003. A closer analysis of population income also suggests that, while fare prices are still rising, recovery of the purchasing power of minimum wage and general household income since 2003 has increased the population's access to public bus services.

Considering all factors, the study suggests that the recovery of the purchasing power of minimum wage occurring since 2003 alone cannot sustain continuous growth of the number of bus passengers. A combination of many factors, such as the intensification of automobile-oriented policies (i.e., the recent reduction of automobile taxes) and the lack of policies promoting fare reduction in urban public transportation, ends up causing serious mobility problems in large Brazilian urban areas.

[1] Brazilian laws guarantee to some users the right to use public transport without paying for it. For instance, one of this law applie to people over 65 years old, who have that right written in Brazil's constitution.
[2] Belo Horizonte, Curitiba, Fortaleza, Goiânia, Porto Alegre, Recife, Rio de Janeiro, Salvador e São Paulo.

2. COST STRUCTURE OF URBAN BUS FARES

In Brazil, the costs of public bus transportation are covered exclusively by fare revenue. The bus transport system in the city of São Paulo is an exception, which covers about 20% of its costs with municipal budget resources[3]. The final calculation of bus fare is an apportionment of the total transportation system cost among paying passengers (incorporating different fare levels).[4]

In systems without subsidies, as in most Brazilian cities, market equilibrium is reached when bus fare charged to paying passengers ensures revenues equal to the total cost of the system during a given time period. This calculation is usually based on mileage, that is, the mileage cost divided by the IPK[5] of the system. Thus, the rise in any transport input costs and the fall of service demands (or IPK) can both lead to financial imbalance of the transportation system, which tends to recover by raising fares.[6]

$$Bus\_Fare = \frac{C_{km}}{IPK} = \frac{\frac{TC}{Km}}{\frac{Pp}{Km}} = \frac{TC}{Pp}$$

Where:
TC – total system cost
Pp – nº of paying passenger
C_{km} – mileage cost
IPK – Index of Passenger per Kilometer

From 1995 to 2003, the demand for urban bus transport fell over 30% in 9 major national cities. The number of paying passengers per month in these cities dropped from 445,373 million in September 1995 to 299,107 million in September 2003. Main transport input costs have also been rising since 1994, which is reflected in the persistent increase of urban bus fares in Brazil during the last 15 years. As Figure 1 shows, public bus transportation fares in Brazil have increased about 60% above inflation since 1995, as measured by INPC.[7]

[3] This percentage varies from month to month, according to the expense and receipts reports disclosed by SPTrans (www.sptrans.com.br), São Paulo agency for public transportation by bus.
[4] For a theoretical review of public transport charging in Brazil, see the study of Lima (1992).
[5] IPK is the Passenger per Kilometer Index. It is calculated as the mean number of paying passengers transported per kilometer and reflects a proxy for productivity.
[6] For a more detailed look at the diversity of regulation and remuneration models for public transportation services in some Brazilian cities, see the study by Azambuja (2002) and the study by Gomide, A. A. (2004). Economic regulation and organization of urban public transport in Brazilian cities: case studies: final report. Brasília: IPEA and the Ministry of Cities. [in Portuguese].
[7] INPC (in Portuguese) is the National Index of Consumer Prices monthly calculated by Brazilian Institute of Geography and Statistics (IBGE). It reflects price evolution in the 10 largest metropolitan areas of the country (Belém, Fortaleza, Recife, Salvador, Belo Horizonte, Rio de Janeiro, São Paulo, Curitiba, Porto Alegre, Brasília) plus the city of Goiânia.

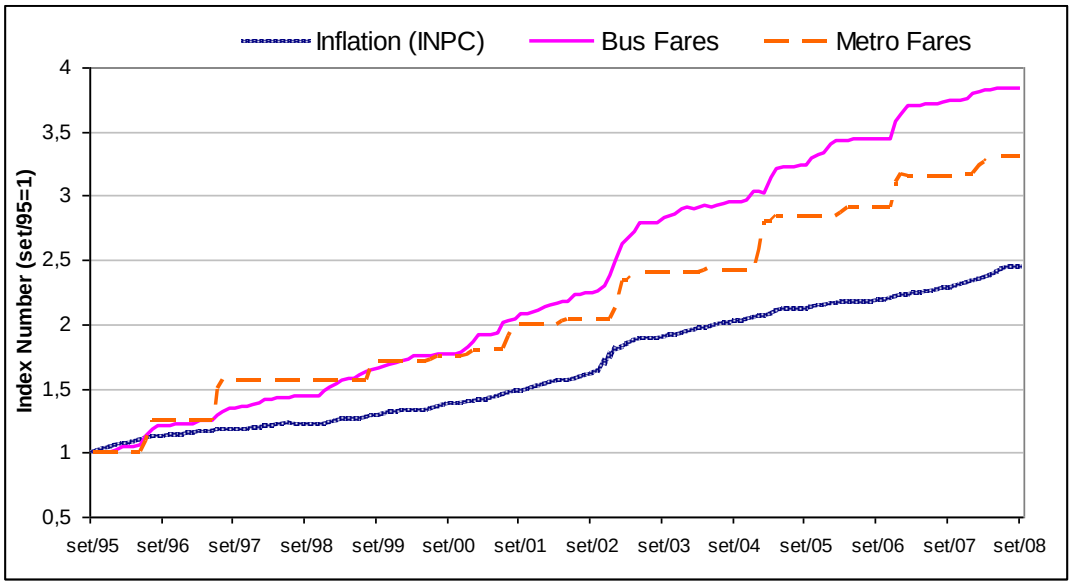


Figure 1 – Evolution of Inflation (INPC), urban buses and subway fares from 1995 to 2008 in Brazil's Metropolitan Areas[8]. Index Number.

Source: authors' elaboration with INPC data (IBGE - Brazilian Institute of Geography and Statistics).

The rise in railway system fares also overtook inflation between 1995 and 2008 but was still lower than the rise in bus fares. An explanation is that, unlike urban bus systems (which obtain remuneration exclusively through fares), the urban metropolitan railway systems are largely subsidized by the state. While government participation in the financial management of urban trains poses accounting challenges for public finances, it also ensures that these transportation systems adopt less aggressive pricing evolution. As a result, trains can gain market share more easily than bus services.

The National Secretariat for Urban Development (SEDU in Portuguese) was formerly the government agency responsible for federal urban transportation policies. SEDU recognized in 2002 that higher prices were the central problem that hindered competitiveness in public transport services as compared with informal and private transport. Despite two federal government proposals (in 2002 and 2006[9]) and pressure from other sectors of Brazilian society to reduce the tax burden on urban bus services, the persistent rise of bus fares was not addressed by any effective federal policy.

Like general market dynamics, a bus fare increase causes demand to decrease, which in turn generates new fare increases in an attempt to recover the system's revenue and cost balance. This is the vicious cycle experienced by the urban transportation sector in the last decade, compounded by heavy cost pressures from its inputs, as described below.

Table I shows the average cost structure of the major Brazilian urban bus systems. The two main components representing more than half of total service costs are fuel and labor (which

[8] In this study, we understand that 'Brazil's Metropolitan Areas' includes only the 10 most important Metropolitan Areas in the country (Belém, Fortaleza, Recife, Salvador, Belo Horizonte, Rio de Janeiro, Sao Paulo, Curitiba, Porto Alegre, Brasília).

[9] According to Gomide (2008), the official proposals for exemption of urban transport were drawn by SEDU (with a publication in 2002 called 'National Policy for Urban Transport') and by the Urban Mobility Secretariat of the current Ministry of Cities (with a publication in 2006 called ' Proposal for a cheapening of rates of urban public transport ').

includes wages, Social Security and other payroll taxes). The cost of vehicles is included in Depreciation and Compensation, which together represent about 8% of the total cost.

Table I: Average cost structure of urban bus fares. Brazil, 2008

Components cost	Portion of the bus fare (%)
Labor Force (include wages, Social Security and other payroll taxes)	40 a 50
Fuel	22 a 30
Taxes and fees	4 a 10
Administrative expenses	2 a 3
Depreciation	4 a 7
Company remuneration	3 a 4
Lubricants	2 a 3
Parts and accessories	3 a 5

Source: authors' elaboration based on data from the Ministry of Transport and National Association of Urban Bus Transport Companies (NTU in Portuguese)

The main component of bus fare pricing is the labor expense. The urban transport sector is labor-intensive and incurs a large amount of social security expenses. In a sense, these expenses make the problem worse because the contribution base for social security is the payroll, rather than the company's turnover.[10]

The second major cost component of urban bus fares is diesel fuel, which accounts for about 28% of total costs. Bus fares get even more expensive due to the high tax burdens of indirect taxes such as ICMS and CIDE, which raise diesel prices by at least 40%.[11] Direct taxes on bus services are the third largest cost component, accounting for 9% of the total fare cost. These include taxes like Pis, Cofins, and ISS[12].

2.1 Evolution of transport primary input prices

The recent price evolution of the transport sector's primary inputs gives us some insight into bus fare trends. Since opening its oil market in the late 1990s and gradually moving public subsidies to diesel, the fuel prices in Brazil's domestic market has increased 70% during the last 15 years (adjusted for inflation). In addition, trade policies in the fuel sector have more effectively contained gasoline prices since 2002 as compared to diesel prices (see Figure 2). As a result, the share of fuel expenses in the total cost of public transport rose from approximately 10% to 20%. This rise in public transportation costs restrains the mobility of the poorest populations and stimulates the use of private transportation, all while lowering the use of collective means.

[10] In recent years, there has been some discussions inside the government about taking companies' turnover as the contribution basis for social security in order to relieve the cost of hiring staff in Brazil, which would have important benefits for the transport sector.

[11] Both in Portuguese, ICMS (Tax on Circulation of Goods and Services) and CIDE (Contribution for Intervention in the Economic Domain) are a federal and a state tax, respectively.

[12] All in Portuguese, PIS (Social Integration Program), COFINS (Contribution for Social Security Financing) and ISS (Tax over Services).

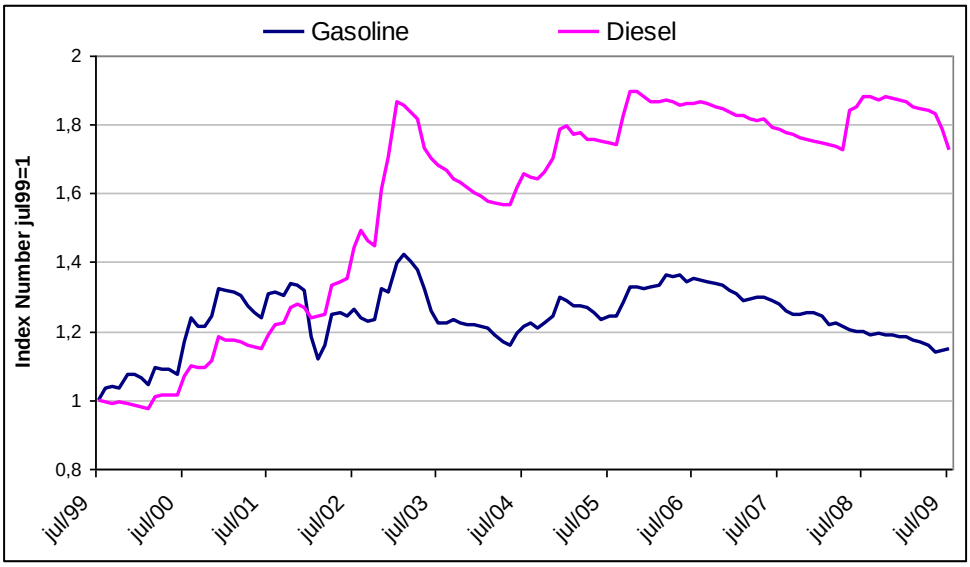


Figure 2 – Evolution of gasoline and diesel prices from 1999 to 2009 in Brazil's Metropolitan Areas. Index Number.
Source: authors' elaboration with INPC data (IBGE).

Figure 3 shows the price evolution of the major inputs in the urban bus sector, deflated by the official IPCA inflation index (broad consumer price index in Portuguese). With the exception of payroll, which remained virtually at the same level, other inputs significantly increased in price over the past 10 years. Since companies have no control over exogenous costs variations (such as fuel and vehicles), their efforts to rebalance bus system finances are based on administrating endogenous costs through controlling wages, rationalizing bus routes and managing fleet renewal rates.

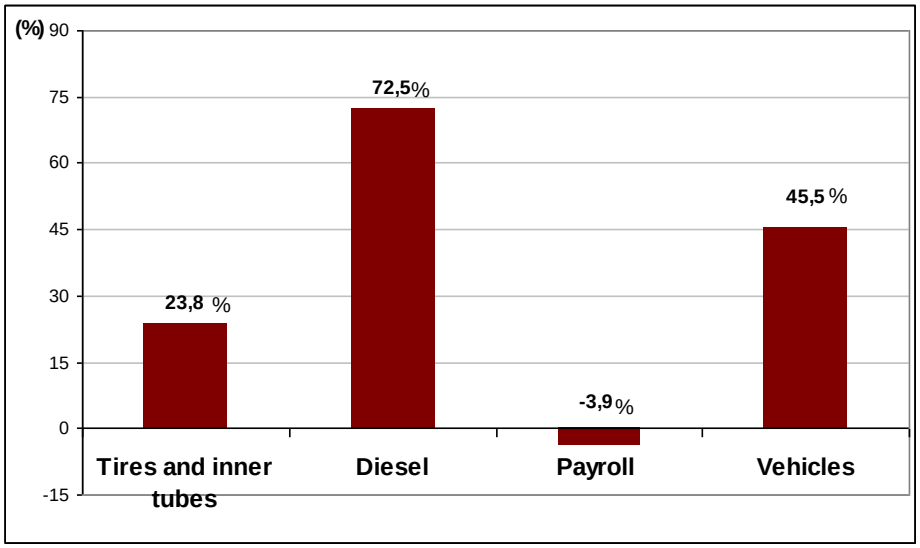


Figure 3 – Price evolution* of the urban bus sector's major inputs from 1999 to 2009 in Brazil's Metropolitan Areas.
Source: authors' elaboration with IPCA data (IBGE), Company for Transport and Transit of Belo Horizonte (BHTRANS) and newspaper reports of the fleet renewal.
* Deflated by IPCA.

Besides market factors that impact variations in vehicle prices, a portion of this rise came from technological adaptations imposed on the bus industry by new ecological and social standards. The National Council on the Environment (CONAMA in Portuguese) began

gradually imposing restrictions to pollutant emissions in 1993. In response, the bus industry introduced electronic engines (which are more expensive and pollute less) and exhaust gas aftertreatment equipment. Within the last decade, new accessibility laws have required features that make public transportation suitable for people with disabilities or reduced mobility.[13]

Although these technological adaptations contribute to society's welfare, there is no public policy encouraging the adaptation of bus fleets to offset the prices of more expensive vehicles. The price variations of these transport inputs and the sets of new technological standards have contributed to upward bus fare trends since 1995, as previously presented in Figure 1.

Another important element to consider when analysis bus fares trends is the decline in the number of paying passengers between 1995 and 2003. This decline may have caused fares to rise even more since bus fares are calculated by an apportionment of total system costs and the total number of paying passengers. Figure 4 suggests that urban bus systems in Brazil during this period experienced a vicious cycle in which rising fares reduced the number of paying passengers, in turn reducing fare revenues appreciating fare unit costs, causing further reductions in demand, and so on.

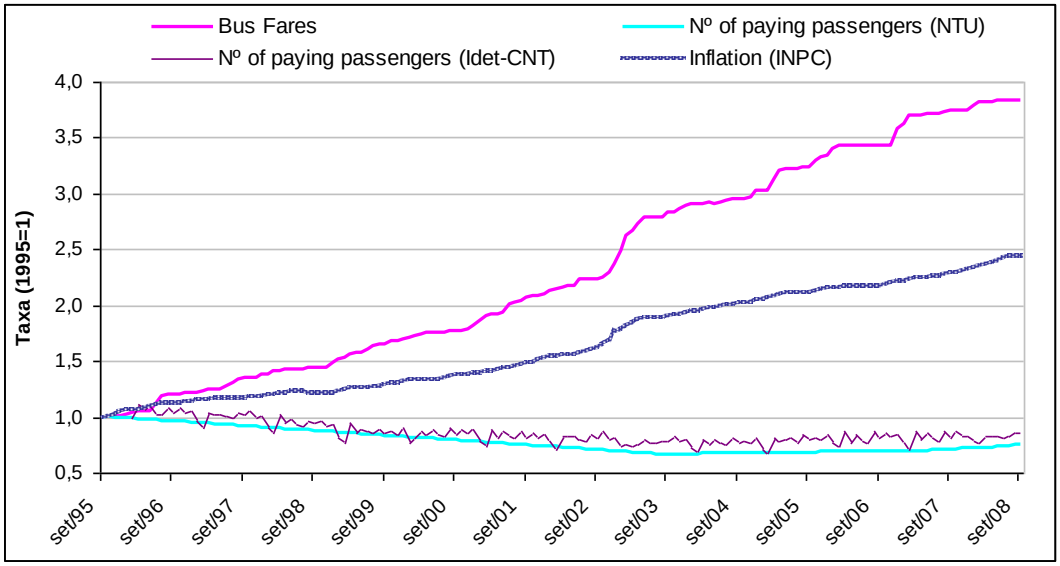


Figure 4 – Evolution of Inflation (INPC), urban buses fares and number of paying passengers[14] from 1995 to 2008 in Brazil's Metropolitan Areas. Index Number.
Source: authors' elaboration with INPC data (IBGE), 2008 Statistical Yearbook (NTU) and Index of Economic Performance of Transport (IDET-CNT/FIPE).

[13] The laws number 10.048/2000 and number 5.296/2004 (also known as 'Accessibility Acts') establish general standards for transportation services and infrastructure so as to promote urban accessibility for elderly and disabled persons.
[14] Available data on the number of paying passengers capture only the passengers transported in the 9 largest Brazilian cities of those 10 metropolitan areas.

3. THE EVOLUTION OF BUS FARES AND POPULATION INCOME BETWEEN 1995 AND 2008

It is widely accepted in Brazil that the pricing policy of public transport services must cover their costs and be efficiency-oriented. Nevertheless, it is also important to consider the affordability of fares when establishing prices (SANT´ANNA, 1991; LIMA, 1992; VIVIER, 1999; GOMIDE et al., 2004; CARRUTHERS et al., 2005; MITRIC et al., 2005; ESTUPIÑÁN, et al., 2007).

Carruthers et al. (2005, p.2) define the notion of affordability broadly as "[…] the ability to undertake transport movements without significantly constraining the ability to undertake other activities of importance." In more objective terms, this ability reflects the level of financial accessibility that people have to urban transportation services.

Affordability measures commonly have two methods of calculation. In the first method, household affordability is measured by the proportion of household spending on transportation within total household income. In the second method, the proportion of household spending on transportation is considered within total household expenditures. However, these methods require information about expenditure profiles that is only available through household expenditure surveys. When such data is missing, it is common to estimate these expenditures by making certain assumptions about family transport demands, such as an estimated of number of trips per month (MITRIC et al., 2005).

In order to avoid fragile assumptions, this paper analyzes the historic evolution of urban bus fares and household per capita income rather than using an affordability index. The study nonetheless draws on the concept of affordability, which is implicit in the analysis of the purchasing power of household income with regard to public transport.

It is especially important to remember the affordability concept with countries such as Brazil, where public transport services are used primarily by the lower and middle classes. In such cases, the pricing policy of bus fares may be useful in combating social exclusion and facilitating urban mobility. This observation is supported by the fact that variation in the number of paying passengers in Brazilian urban bus systems is highly influenced by income level changes.

Figure 5 shows that bus fare increases that occured simultaneously with decreases in family income during 1995-2003 were preceded by a significant decline in the number of paying passengers. However, the recovery of average per capita income since 2003 has appeared to deaden the effects of fare increases on the demand for urban bus services. This recovery in population income appears to support a reversal of the downward trend passenger numbers and leads to increasing access to public bus services. The number of paying passengers has increased about 9.5% since 2003.

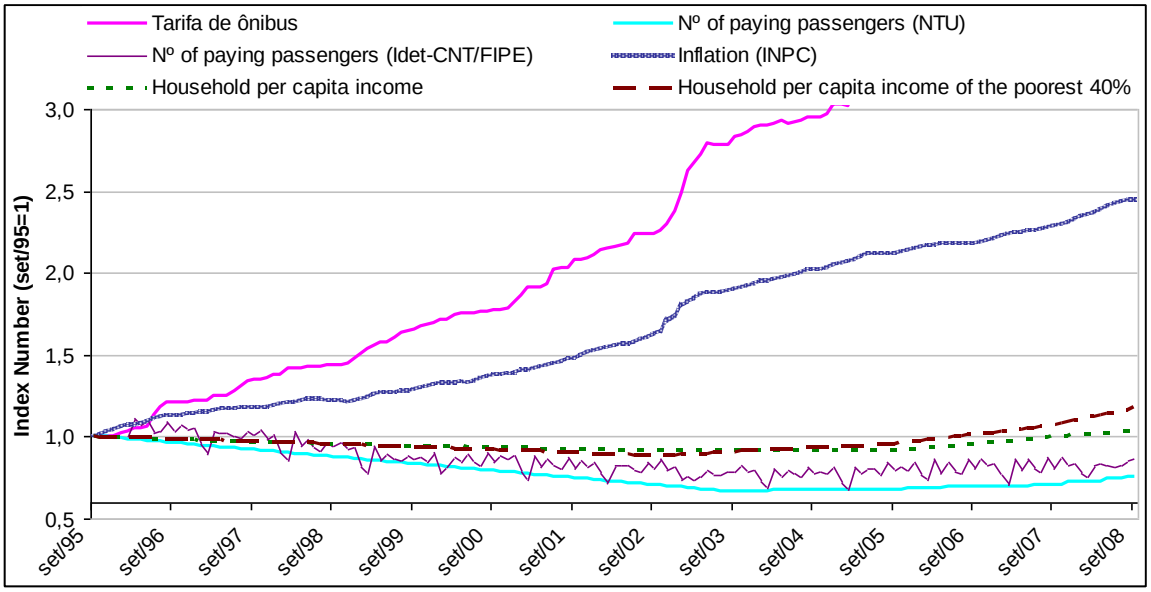


Figure 5 – Evolution of Inflation (INPC), urban buses fares, number of paying passengers, household per capita income and household per capita income of the poorest 40% from 1995 to 2008 in Brazil's Metropolitan Areas. Index Number.
Source: authors' elaboration with INPC data (IBGE), 2008 Statistical Yearbook (NTU), Index of Economic Performance of Transport (IDET-CNT/FIPE) and National Household Survey (PNAD/IBGE).

The trend reversal supported by the recovery of purchasing power relative to public transport can also be observed using the number of bus fares that can be purchased by minimum wage. The ascending portion of the curve (visualized in Figure 6) shows that minimum wage increases clearly surpassed bus fare increases from 2003 and onwards. Thereafter, minimum wage was able to purchase an increasing number of fares. The same relationship can be seen when considering household per capita income in the poorest 40% of the population, with some temporal lag behind the general population.

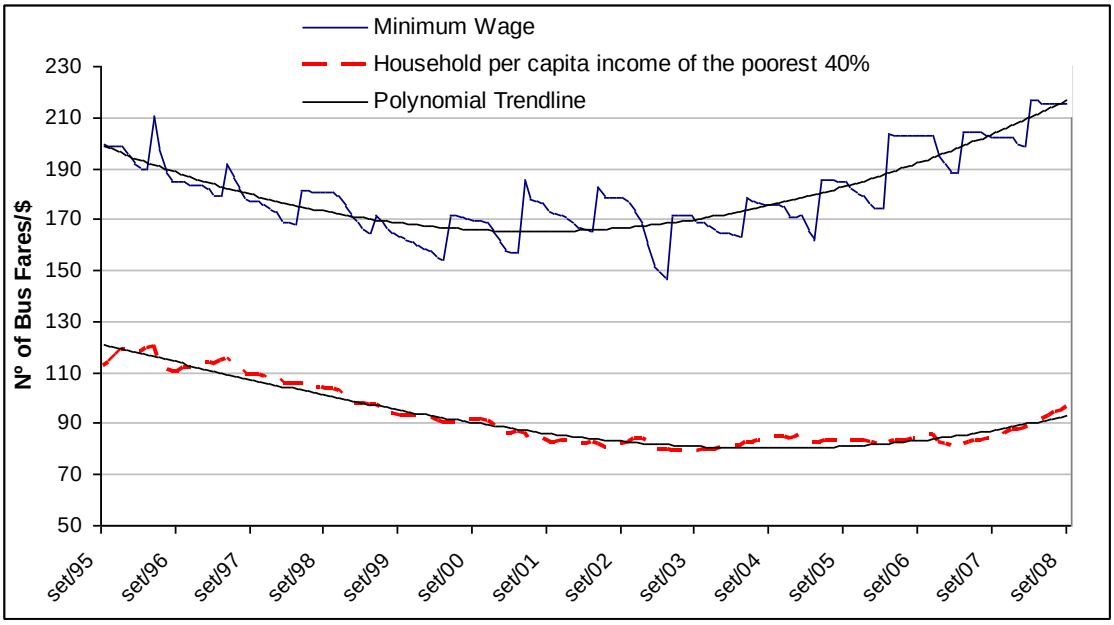


Figure 6 - Number of Bus Fares that can be purchased by the minimum wage and by the household per capita income of the poorest 40% from 1995 to 2008 in Brazil's Metropolitan Areas.
Source: authors' elaboration with INPC data (IBGE) and National Household Survey (PNAD/IBGE).

The rising costs of primary inputs for urban buses have pushed firms to consistently increase fares in order to balance revenues and costs. Data shows the importance of income growth, especially for the poorest 40%, as an inducement of downward trend reversal in the number of paying passengers since 2003 despite persistent fare increases. It is likely that these fare increases during the last 6 years are being supported by general rises in income and employment levels in the country. This should alert public agents to a possible discontinuity in urban bus demands when facing a possible reversal of the current national economic environment.

New federal laws enacted during the 1980s[15] created the Vale-transporte (VT in Portuguese), a type of transit voucher that could make worker demands for urban public transport less sensitive to fare changes. The VT is a worker's right, according to which an employer must cover all monthly commute expenditures (traveling to and from work only) that exceed 6% of a worker's salary. For all practical purposes, the VT is a direct subsidy that employers are required to pay to their workers (GOMIDE et al., 2004).

It is noteworthy, however, that this benefit is not guaranteed to a large part of Brazilian population because they either work in the informal labor market or are unemployed. According to Brazilian National Household Survey (PNAD), more then 57% of the economically-active population (EAP) living in the 10 largest metropolitan areas during 2008 were either informally employed or unemployed.

Although the portion of EAP receiving any kind of transportation voucher (in which VT is included) has been growing since 1992, this ratio has never exceeded 41% (as shown in Table II). It should also be emphasized that VT only applies to commute to and from work. Other trips are not covered.

Table II – Economically active population that received any kind of transportation voucher (VT included). Brazil's Metropolitan Areas, 1992 to 2008.

Received any kind of transportation voucher (VT included) ?	**1992**		**1997**		**2005**		**2008**	
Yes	6.253.984	**30,2%**	6.924.940	**34,9%**	10.875.270	**35,9%**	12.767.879	**40,7%**
No	14.420.560	**69,8%**	12.904.717	**65,1%**	19.388.173	**64,1%**	18.580.722	**59,3%**
Total EAP	**20.674.544**	**100%**	**19.829.657**	**100%**	**30.263.443**	**100%**	**31.348.601**	**100%**

Source: authors' elaboration with PNAD microdata (IBGE) 1992, 1997, 2002, 2005 e 2008.

Variations in bus fares tend to play an important role for most people in their decisions regarding transportation mode. For these people, expensive bus fares may lead to suppression of trips or enforced mode changes to walking or cycling, even though these transport modes are inappropriate for large distance travel. In such cases, the high cost of bus fares clearly acts as an additional barrier to accessing urban public transport. According to the 2007 Origin/Destination Survey of São Paulo Metropolitan Area, about 635,000 trips

[15] The laws number 7.418/1985 and number 7.619/1987.

per day during a typical workday were accomplished by walking mode because transit fares were considered expensive.

At the same time, it may be argued that the persistent rise of urban bus fares, combined with the improvement in general income conditions (particularly in the last 8 years), also stimulates the substitution of individual modes of transportation. This effect is known in economic theory as the substitution effect, as we are reminded by Lima (1992). Detailed analyses can gauge this substitution effect and its impact on traffic conditions but will depend on further Consumer Expenditure Surveys and Origin/Destination Surveys.

It is evident that some of these effects are already noticeable. For example, cars and motorcycle sales have grown at average annual rates of 9% and 20%, respectively, driven mainly by sales of popular cars and easy access to credit. Certainly, public policies that exempted federal taxes helped the automotive sector to hit record new car sales during 2008-2009.

4. FARE AND INCOME ELASTICITIES OF DEMAND FOR BUS TRANSIT SERVICE

Many factors influence how prices affect consumer decisions. The decision to catch a bus, for example, is influenced not only by the fare, but also by the person's social class, features of the trip (e.g., period of the day, distance, etc.), service quality, cost of a related service (e.g., other transport modes), traffic conditions and weather conditions. These are among the factors that affect elasticity of demand for transit services (LITMAN, 2007).

The present study focus on the effects of household income and bus fare variations on the demand for bus transit services in Brazil. Income and price are the traditional variables used in elasticity analyses, and both variables have shown considerable variation since 1995. In order to assess the impact of income and bus fares variation on the number of paying bus passengers, price elasticities and income elasticities for urban bus transportation were calculated based on a demand function adjusted by linear regression, considering all other factors constant. Average bus fares and average per capita income of the population living in 9 large Brazilian cities[16] were taken as independent variables (constant prices, base=Sept/2009). The number of paying passengers in these areas was taken as dependent variable.

Demand function estimated: $q = 404 + 0{,}43r - 205p$

Where:

q = Number of monthly paying passengers (millions)

r = Average household per capita income (constant prices, base=Sept/2009)

p = Average bus fare (constant prices, base=Sept/2009)

Adherence Test: R2 = 0,94; F = 1391,5; P value ≈0 — F test indicates a good fit of the model to the data

[16] Belo Horizonte, Curitiba, Fortaleza, Goiânia, Porto Alegre, Recife, Rio de Janeiro, Salvador e São Paulo.

$$Price\_elasticity = \frac{p}{q} x \frac{\partial q}{\partial p} = -\frac{205p}{q} \qquad Income\_elasticity = \frac{r}{q} x \frac{\partial q}{\partial r} = \frac{0{,}43r}{q}$$

Considering this function, it was possible to estimate the elasticity values corresponding to each combination of bus fare and income level during the last 15 years, as presented in Figures 7 and 8.

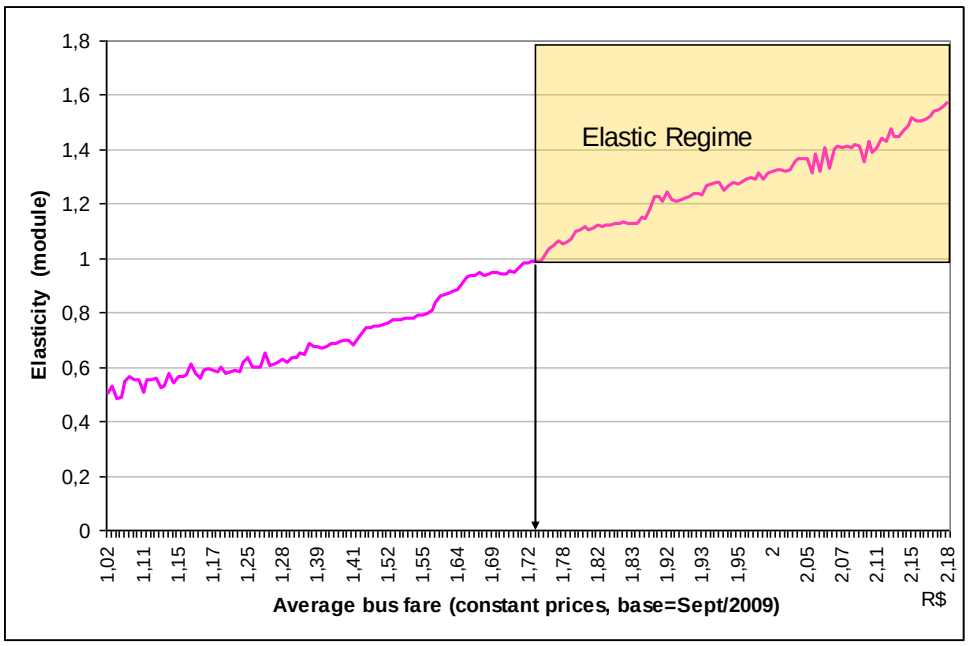
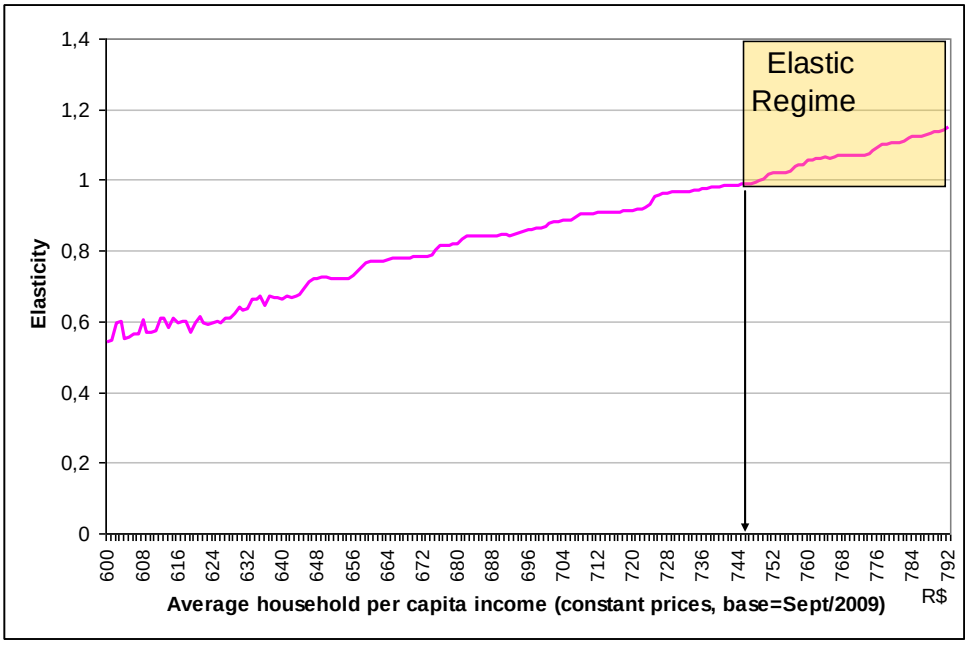


Figure 7: Price elasticity of demand for public transport by bus.

Source: authors' elaboration with INPC data (IBGE), 2008 Statistical Yearbook (NTU) and National Household Survey (PNAD/IBGE).



Figures 8: Income elasticity of demand for public transport by bus.

Source: authors' elaboration with INPC data (IBGE), 2008 Statistical Yearbook (NTU) and National Household Survey (PNAD/IBGE).

Figures 7 and 8 indicate that, all other factors constant, the demand for bus services has displayed elastic behavior since 2001, when bus fares exceeded R$1.75 (constant prices, base=Sept/2009). Considering this context with constant income, any increase in bus fares leads to a more than proportional reduction in bus service demand, which means that revenues fell despite fare increases.

An analysis of the curve that would maximize revenue could bring us to the same conclusion by deriving the revenue function and estimating the maximum points on the curve, considering household per capita income observations.

$$v = pq = p(404 + 0{,}43r - 205\,p) = -205\,p^2 + 404\,p + 0{,}43rp$$

$$\frac{\partial v}{\partial p} = -410\,p + 404 + 0{,}43r = 0 \Rightarrow p\max = \frac{404 + 0{,}43r}{410}$$

Where:

p*max* = fare that would maximize revenue at a specific level of household per capita income

v = bus transit system revenue = p x q

$\frac{\partial v}{\partial p}$ = derived revenue

As Figure 9 shows, the average fare charged by the bus systems was lower than the optimal price for maximizing revenues until 2001. During that period, companies could raise bus fares in order to increase profits. However, this scenario has changed, and fares charged since then are higher than the optimal revenue-maximizing price, partially because of pressure from transportation inputs and an inertial inflation of bus fares.

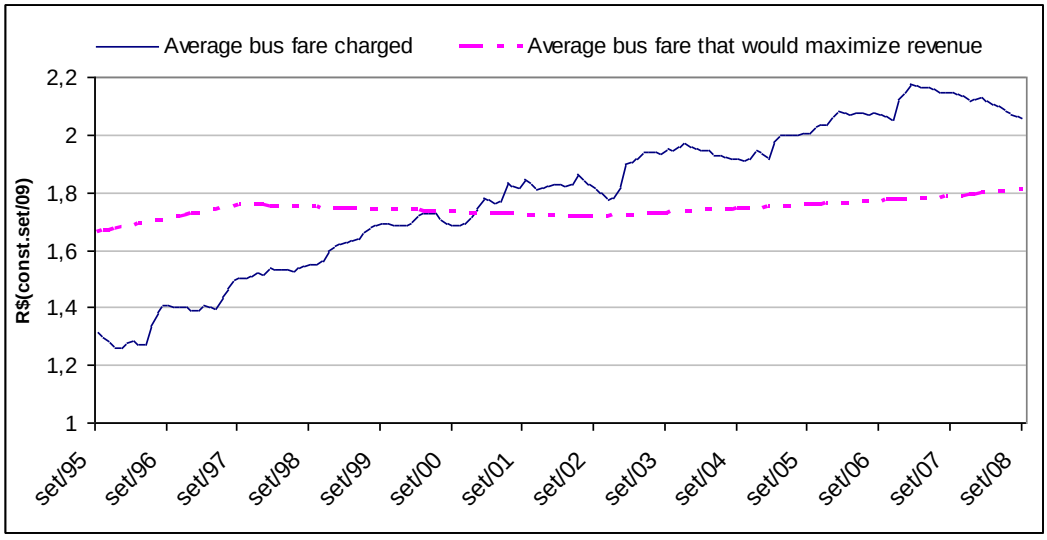


Figure 9: Average bus fare that would maximize revenue compared with the average fare charged in 9 large Brazilian cities*, 1995-2008.

Source: authors' elaboration with INPC data (IBGE), 2008 Statistical Yearbook (NTU) and National Household Survey (PNAD/IBGE).

***** Cities included: Belo Horizonte, Curitiba, Fortaleza, Goiânia, Porto Alegre, Recife, Rio de Janeiro, Salvador e São Paulo

It is noteworthy that revenue maximization does not necessarily lead to profit maximization. In situations where transit systems operate at full capacity, an eventual raise in service demand due to fare decreases may imply a cost increase that exceeds a proportional revenue increase. In any case, it seems clear that bus transit companies have not had many options in avoiding revenue decreases while reducing fares since 2001. A tough decision to be made without the basis of a strong policy that supports costs reduction. As discussed, this situation may lead to the suppression of trips or enforced mode changes to walking or cycling (for lower income populations) and stimulate the substitution of mass transit options for individual transportation modes (for higher income populations).

5. CONCLUSIONS

Recently analyzed data indicate that people's capacity to afford transit services was somewhat compromised by a combination of two factors between 1995 and 2003: a marked rise in urban bus fares and a general decline in population income, especially in the poorest populations. The study also showed that the gap between rising fares and income led to a decrease of more than 30% of paying demand in 9 large Brazilian cities during that period.

As we have seen, however, the recovery of average household per capita income since 2003 seems to support a reversal of downward trends in the number of paying passengers and increase access to public bus services. The number of paying passengers increased about 9.5% between 2003 and 2008.

According to the price elasticity estimated in this study, demand for bus services has exhibited elastic behavior since 2001. Since then, the gradual increase observed in population income seems to buffer against persistent fare increases. It is possible that with ongoing upward income trends, a strong policy supporting bus fare reduction could trigger greater demand for transit services, leading to a virtuous cycle.

For all intents and purposes, it is important to highlight the fragility of urban mobility conditions in major Brazilian metropolitan areas due to the persistent fare increases. In a scenario where this trajectory continues, a possible worsening of current economic conditions (e.g., a decrease in family income) could seriously compromise the basis for a sustainable raise in transit services demand.

Given this possibility, it may be appropriate to review public policies that could provide a better economic environment for the provision of transit services. This could lead to more affordable services and more efficient services, which are financially attractive to companies. Some of these possible policies are highlighted below.

Promoting fare integration, for instance, can facilitate access to transit services because this integration enables users to perform a greater number of trips with less expenditure. Other studies also advocate tax reductions and the formation of alternative funding (not linked to fare charging) in order to recover the costs of non-paying passengers and drive the reduction of transit fares (ANTP, 2006; NTU, 2009; GOMIDE et al. 2004; MCIDADES, 2004).

As discussed, public subsidies can play important role in access to transit services. According to Cropper & Bhattacharya (2007), unsubsidized urban bus fare in Mubai (India) would have to rise almost 30% to cover the costs of these services. As an objection to this

kind of policy, the authors agree with the argument of Estupiñán et al. (2007) that most these subsidies benefit middle and high-income classes. A similar objection was noted by Gomide (2003) with respect to transportation vouchers in Brazil. Mitric et al. (2005) also highlight that, unless these subsidies have a reliable and sustainable source of funding, the negative impact of subsidies on a service operator can more than offset the benefits derived from low-income passengers.

Regarding Bill nº 1.687/2007 (known as Urban Mobility Bill), Gomide (2008) also stresses some proposals for a regulatory reform in mass transit services. Among these are proposals for annual fare adjustments based on inflation and productivity factors and proposals to disengage bus fares from operating costs.

Another policy that could help reduce bus fares has been discussed inside the government is a proposal that would establish transit company turnover as the contribution basis for Social Security. Because the largest transit cost is labor expenses, this policy will likely have a positive effect in fare pricing.

These are some of the possible policies that could be adopted to make mass transit services more affordable and accessible. It is important to note that these policies are complementary. Thus, the application of only one of those policies alone may result in a compromise in effectiveness. Either way, the combination of these policies requires a thorough study of their possible impact on urban mobility conditions and the urban economy as a whole.

REFERENCES

ANTP Associação Nacional de Transportes Públicos (2006). Panorama da Mobilidade Urbana no Brasil: Tendências e Desafios. São Paulo.

Carruthers, R.; M. Dick and A. Saurkar (2005). Affordability of Public Transport in Developing Countries. World Bank Group Transport Sector Board. January. Washington DC: World Bank Publications.

CNT/FIPE Índice de Desempenho Econômico do Transporte (IDET-CNT/FIPE); www.cnt.org.br.

Cotta, J. L. (2005). Elasticidade - Demanda e Preço; Monografia apresentada ao Curso de Especialização em Matemática/UFMG. Belo Horizonte.

Cropper, M. and S. Bhattacharya (2007). Public Transport Subsidies and Affordability in Mumbai, India. Policy Research Working Paper 4395. The World Bank.

Gomide, A. A. (2003) Transporte urbano e inclusão social: elementos para políticas públicas. Texto para Discussão, nº. 960. Brasília: Ipea.

Gomide, A. A. (2008). Agenda governamental e o processo de políticas públicas: o projeto de lei de diretrizes da política nacional de mobilidade urbana. Texto para discussão nº 1334. Brasília: Ipea.

Gomide, A. A.; S. Leite and J. Rebelo (2004). Public Transport and Urban Poverty: A Synthetic Index of Adequate Service. Washington DC: World Bank Publications.

IBGE Instituto Brasileiro de Geografia e Estatística; Banco de Dados Sidra/IBGE; www.ibge.gov.br

ITRANS Instituto de Desenvolvimento e Informação em Transporte (2004). Mobilidade e Pobreza: relatório final. Brasília: Itrans.

Lima, I. M. de O. (1992) Transporte urbano de passageiros: a tarifa como fonte de recursos. IPEA. Texto para discussão nº 273. Brasília: Ipea.

Litman, T. (2007). Transit Price Elasticities and Cross-Elasticities. Victoria Transport Policy Institute.

MCIDADES Ministério das Cidades. (2004). Cadernos Mcidades Mobilidade Urbana nº 6 Política nacional de mobilidade urbana. sustentável. Brasília: MCidades/ Governo Federal.

MT/GEIPOT (1996). Cálculo das Tarifas de Transportes de ônibus Urbanos; MT, 1996.

NTU Associação Nacional das Empresas de Transportes Urbanos (2005). Novas tendências em política tarifária. Brasília.

NTU Associação Nacional das Empresas de Transportes Urbanos (2009). Anuário da NTU 2008/2009. Brasília.

Sant´Anna, J. A. (1991). Reordenamento Urbano pelo Transporte. Texto para Discussão nº 225. Brasília: Ipea.

Vivier, J. (1999). Urban Transport Pricing. Public Transport International, 5.

Vuchic, V. R. (2005). Urban Transit Operations, Planning and Economics; John Wiley & Sons.