Income And Consumption Redistributive Effects of Passenger Transport Subsidies in Brazil.

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ABSTRACT: Brazilian households spend practically the same amount on transportation and food. It is necessary to discuss the role of public transport subsidies and the impact of this policy on household income redistribution. These effects can be captured by a Dynamic Computable General Equilibrium (CGE) model. The results indicated positive effects for the internal market of the Brazilian economy by favoring typical households in the middle and low positions of the composition of income and consumption.
Keywords: Public transport subsidies; household income redistribution.

INTRODUCTION: Urban mobility is understood as the ease of movement of goods and people in urban agglomerations and is fundamental for the development of social and economic activities. In this context, Urban Public Transport (UPT) system is essential to ensure access to opportunities, especially for the middle and low-income population. In Brazil, transport is included as a social right among other rights (e.g., education, health, food, job, housing, leisure) only in 2015 with the Proposed Constitutional Amendment nº 74, emphasizing the service as a vector of development related to productivity and to the quality of life of individuals (Erundina, 2013; Senado, 2015).

The cost of the UPT that reaches the consumer through the tariff price is often high and the quality of the transport service is low, contributing to a reduction in consumption by the population of public transport and its intermodal replacement for private transport. This contributes to the fact that, with the reduction in demand, the cost of tickets rises and the quality drops, culminating in a vicious cycle towards the unsustainability of the UPT service (Carvalho and Pereira, 2012; Oliveira Filho, 2018). An increase in urban fares for passenger transport directly affects household incomes, and may also affect the cost structure and competitiveness of passenger transport industries. The high cost of transport would end up affecting the poorest households more intensely, a situation that worsens in periods of decline in the real income of households. Between 1995 and 2003, for example, there was a drop in the volume of paying passengers, users of public transport, due to the loss of purchasing power of the minimum wage in the Brazilian economy (Carvalho and Pereira, 2012).

In recent years, a rising trajectory has been observed in final fuel prices in the Brazilian economy, raising the cost of living for society as a whole and contributing to the downturn in economic activity. In the UPT the impact of an increase in diesel oil, the sector's basic input responsible for, on average, 23% of companies' operating costs, has an effect on transport tariffs, pushing them upwards. In this activity, the

recurring price adjustments for this fuel, in 2021, further aggravated the existing crisis in the sector, which accumulated 11.75 BRL billion in losses in the period from March 2020 to February 2021, in the Covid-19 pandemic, with a drop in passenger demand and a reduction in revenues (NTU, 2021; NTUrbano, 2021). According to Pozzobon et al. (2017), changes in fuel prices generate changes in expenditures with the transport sector, influencing, in turn, the choice of consumers in the demand for travel.

Fuel taxes, in turn, make these prices (urban transport fares) even higher. An increase in urban bus fares, for example, tends to increase inequality, especially in urban areas due to household budget constraints. Among the elements that make up the final price of gasoline, diesel oil and ethanol are federal and state taxes. It appears that 40.6% of the price of gasoline and 21.4% of diesel, both sold to consumers, is due to the tax burden incurred in the operation (Petrobras, 2021). Such taxes are used by governments with the aim of restricting consumption or increasing revenues for the budget, being common in several countries. In addition, attempts are also made by governments with the purpose of containing the inflationary pressures of successive increases in fuel prices, whose oscillation has generated problems for various sectors such as road transport, food, energy and urban transport tariffs. This is what is currently happening in Brazil, especially with the policy adopted by Petrobras of changing prices according to the price of the international barrel of oil. From 2016 until recently (2023), Petrobras has adopted the Import Parity Pricing on the grounds of generating return for the company's shareholders and avoiding distortions in the Brazilian market when dealing with a commodity (NTUrbano, 2021).

In addition, in the last two decades, with regard to passenger transport policies, Brazil has prioritized transport by cars and motorcycles (private transport), particularly due to the strong policy of attracting investments from the automobile industry that began in the mid-1990s. Policies were created to stimulate private transport, such as the reduction of the tax on industrialized products, the low price of licensing and taxes on motor vehicle ownership, credit expansion for households, in addition to subsidies such as free parking on public roads. Public transport subsidies are an important option for reducing ticket prices and improving the quality of the service provided. For the specific case of public transport, the government concession aims to maintain fares at prices that are affordable by the population (Carvalho and Pereira, 2012).

Transport has become a typical consumption item in the Brazilian household budget, reaching a higher share than that spent on food. The most recent household budget surveys for 2017-2018 by the Brazilian Institute of Geography and Statistics show evidence that Brazilian households commit 17.5% to food expenses, while transportation expenses occupied 18.1% (IBGE, 2018). Despite the data, the burden of transport is higher for high-income households. According to the survey, while the poorest (the first three income strata) committed 9.58% of their expenses with transport, this percentage was much higher (23.09%) in the budget of households with higher income (10° more rich) (IBGE, 2018). However, low-income Brazilian households are the greatest demanders of public transport and the ones who waste more time commuting home-to-work-to-home, as they live on the outskirts of urban areas, far from their workplaces. In 2013, for example, travels by the poorest took 20% longer than those of the richest (Pero and Mihessen, 2013).

Since households have spending and income links from different sources with other economic institutions (government, firms, rest of the world), the economic

consequences of policies in passenger transport services are also transmitted directly and indirectly in the production system from the country. Thus, the present paper aims to analyze and project the economic effects of subsidies granted to passenger transport activities on the Brazilian economy, as well as the redistributive effects on consumption and income of typical households. Recent studies have applied computable general equilibrium modeling (CGE) to address tax policy issues and policy implications. Most studies focus on the increase or decrease in world fuel prices and oil subsidies (see, for example, O´Ryan et al., 2005; Arndt et al., 2008; Yusuf and Resosudarmo, 2008; Henseler and Maisonnave, 2018; Alshehabi, 2012). However, there is a lack of empirical studies for the Brazilian economy that carry out analyzes related to passenger transport subsidies using CGE models and, therefore, this research in particular directs attention to these pertinent policy issues. The subsidy policy for the provision of passenger transport services can lead to a substitution between public and private transport, affecting the Brazilian productive system. With the aim of reconciling applied economic theory and relevant empirical studies for policy makers, we use the CGE models as a methodology for the analysis.

DIAGNOSIS, PROPOSITIONS AND RESULTS. Table 1 provides the accumulated deviations on the growth rates of the selected macroeconomic variables, namely: GDP, imports, exports, household consumption, investments, capital stock, real wage, national employment, nominal tax revenue, deflator and terms of trade. The analysis of the results of the subsidy policy on macroeconomic variables aims to assess the impact of the policy on the economy in general.

Table 1 – Macroeconomic effects of policies related to public transport subsidies (Var.%)

| Variables	Short term	Medium term	Long term
	2021-2025	2021-2030	2021-2040
GDP	0.03	0.07	0.35
Import	0.26	0.61	1.07
Export	-0.29	-0.74	-1.10
Household consumption	0.18	0.39	0.90
Investments	0.24	0.86	1.24
Capital Stock	0.00	0.13	0.77
Actual Salary	0.17	0.47	1.32
National Employment	0.07	0.11	0.12
Nominal income from taxes	-0.40	-0.78	-1.40
Deflator	0.39	0.95	1.14
Terms of trade	0.28	0.71	1.04

Source: Search results.

According to Table 1, an increase in the GDP growth rate of 0.03% in the short term, 0.07% in the medium term and 0.35% in the long term can be observed. The observed changes in GDP can be explained by an increase in household consumption, investment and a reduction in the trade balance. With regard to household consumption, it can be seen that this grew by 0.18% in the short term, 0.39% in the medium term and 0.90% in the long term. This result contributes positively to the value of GDP, since this component is a demand absorption factor in the economy's total expenditure and a result of the domestic market via an increase in real household consumption. The term of trade variable represents the relationship between the price of exports and the price of imports of a country, and aims to evaluate the performance of a country vis-à-vis abroad in terms of trade relations.

Higher terms of trade values mean that the price of exports is valued in relation to imports from a country. It is observed that there is an increase in the variable in the long term, going from 0.28% in 2025 to 1.04% in 2040.

To assess the expansion of economic activity, Graph 1 shows the breakdown of GDP components from the perspective of expenditure and income. It can thus be seen that, on the expenditure side, the positive impact on GDP is mainly due to gains in investment and household consumption, which offset the negative effects on the trade balance – exports minus imports. The government spending component is exogenous and therefore does not change over the period. On the income side, GDP growth is related to remuneration for work and capital, as well as indirect taxes.

Graph 1 – Effects of public transport subsidies on GDP aggregates
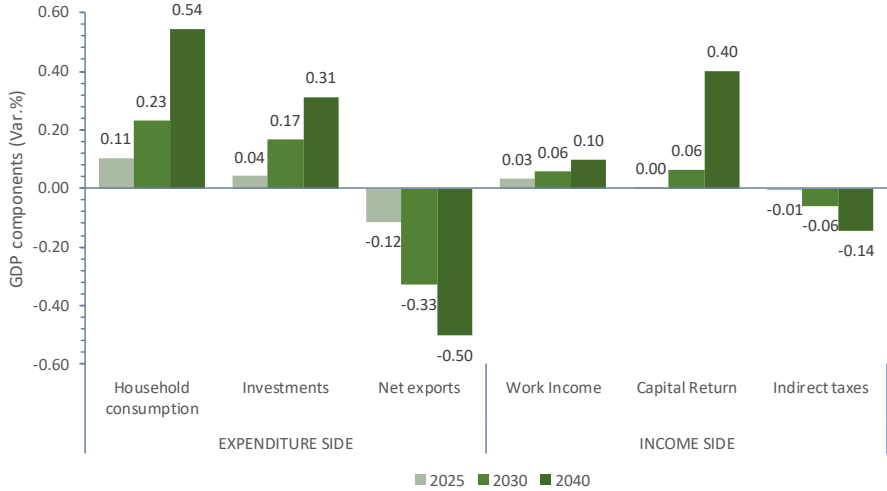
Source: Search results

In this scenario, the subsidy policy for public passenger transport contributes to stimulating the country's economic activity, as it favors the reduction of costs passed on to the final consumer in the form of fares, encouraging greater consumption by individuals and households of transport, which leads to greater consumption of inputs throughout the public transport production chain. In addition, the reduction of the impact of transport on the income of individuals and households contributes to the redistribution of income in the consumption of other goods, mainly those related to food and services. The GDP deflator that measures the average change in prices in the period compared to the previous period in an economy shows a variation of 0.39% in the short term, 0.95% in the medium term and 1.14% in the long term. This result is consistent with expectations, since with the policy, it would cause an increase in the market for goods and services, increasing the demand for primary factors and consequently generating a rise in product prices.

With the subsidy policy for public passenger transport, there is a reduction in prices and a consequent increase in demand for transport services. This impacts the demand for primary factors present in the production chain. Demand pressure raises capital income, which contributes to an increase in the percentage change in the prevailing rate of return. Consequently, investments increase. In the following period, when investments become operational, there is an expansion of the capital stock. Thus, there is an increase in the capital stock, especially in 2040, when it reaches 0.77%. In the labor market, subsidy policy contributes to national employment growth that affects real wages. However, there are no constraints on the model for the labor market, since the demand for labor is elastic. It is noted that with the policy, there is

an increase in real wages, from 0.17% in 2025, to 0.47% in 2030, followed by 1.32% in 2040. National employment, on the other hand, shows a growth of 0 .07%, 0.11% and 0.12% in the same periods. Regarding the nominal tax revenue, it is observed that this is negative, going from -0.40% in 2025 to -1.40% in 2040. The nominal tax revenue is negative since the policy was not enough to offset values.

To assess the distributive effects of subsidies on passenger transport in the Brazilian economy on households, the heterogeneity of five representative families presents in the BIG TP model, differentiated by income strata, was used. In this case, there was a disaggregation of households by monetary income in number of minimum wages (IBGE, 2010), where H_1 represents households that have up to three minimum wages of monthly income, H_2 represents those that have between four and six, H_3 refers to those that have between seven and ten, H_4 are households with incomes between eleven and twenty and, finally, H_5 represents households that have more than twenty minimum wages as monthly income. For the analysis of the impact of the policy on households, real disposable income and utility were evaluated in the period 2021-2025 as short term, 2021-2030 as medium term and 2021-2040 as long term. Table 2 presents the results of the impacts of subsidies on real income by groups of households.

With regard to the impact of subsidies on households, increases in real disposable income are observed for all income strata. This result is consistent with what was expected, since the presence of subsidies in passenger transport generates a positive impact on household income, by contributing to the reduction of fares and the reduction of the price of urban public transport in general. It is important to point out that a higher percentage growth is observed in the income of the poorest households, mainly for the group between four and six, and between seven and ten minimum wages, given that the poorest groups are those that demand greater public transport. The direct and indirect effects on the income of typical households could contribute to an increase in purchasing power and, consequently, in the real consumption of households.

Table 2 – Effects on real household disposable income (Var.%)

	Households	2021-2025	2021-2030	2021-2040
H1	Até 3 sm	0.16	0.37	0.84
H2	4 a 6 sm	0.23	0.50	1.08
H3	7 a 10 sm	0.22	0.47	1.02
H4	11 a 20 sm	0.16	0.37	0.84
H5	Acima de 20 sm	0.12	0.29	0.73

Source: Search results.

Note: sm (minimum wages).

With regard to utility, this can be considered as a function of the variation in household consumption that is above the subsistence portion and is a hypothesis of the impact on the economic welfare of households (Proque et al., 2022). The public transport subsidy policy induces an increase in welfare by contributing to the price of fares being below the cost of providing services. Table 3 presents the impact of the policy on the utility of household groups. It is observed that all income strata show utility gains for the three scenarios. The classes that are at the beginning of the distributive structure show the greatest gains, with a focus again on groups of four to six and seven to ten minimum wages. The group with income above twenty minimum wages presents the lowest utility gains in the three periods, since this group

comprises the largest share of spending on luxury goods. As individuals/households show utility gains with an increase in the consumption basket, this scenario contributes to an increase in the welfare of households. The subsidy policy for public transport activities contributes to the reduction of the fare price and, consequently, the increase in demand for these sectors. Tables 4 and 5 presents, respectively, the demand for public transport and the demand for private transport by groups of households. For all income strata, increases in demand for public transport are again to be seen, mainly by households in the lower strata, who are the ones who consume the most this category of service. In relation to the demand for private transport, it shows an increase in the three periods, but in a more discreet way. In this case, it is the households with the highest income strata that have the greatest gain in demand, since they are the ones that most demand private transport, such as cars.

Table 3 – Effects on household utility (Var.%)

	Households	2021-2025	2021-2030	2021-2040
H1	Até 3 sm	0.35	0.81	1.66
H2	4 a 6 sm	0.51	1.12	2.21
H3	7 a 10 sm	0.48	1.04	2.03
H4	11 a 20 sm	0.36	0.79	1.64
H5	Acima de 20 sm	0.27	0.62	1.40

Source: Search results.

Note: sm (minimum wages).

Table 4 – Demand for public transport by household group (Var.%)

	Households	2021-2025	2021-2030	2021-2040
H1	Até 3 sm	0.65	1.28	2.15
H2	4 a 6 sm	1.21	2.34	3.90
H3	7 a 10 sm	1.13	2.16	3.47
H4	11 a 20 sm	0.98	1.85	2.85
H5	Acima de 20 sm	0.80	1.51	2.23

Source: Search results.

Note: sm (minimum wages).

Table 5 – Demand for private transport by household group (Var.%)

|	Households	2021-2025	2021-2030	2021-2040
H1	Até 3 sm	0.00	0.01	0.02
H2	4 a 6 sm	0.02	0.04	0.10
H3	7 a 10 sm	0.02	0.05	0.13
H4	11 a 20 sm	0.03	0.07	0.17
H5	Acima de 20 sm	0.03	0.07	0.20

Source: Search results.

Note: sm (minimum wages).

So far, the impacts of subsidies on passenger transport activities at the macroeconomic level and the consequences on typical households' groups have been evaluated. In this section, the impacts on the sectors of the economy will also be evaluated. Graph 2, in turn, presents the impacts of sectorial production and investment. Eight sectors are recognized in the model in the short-, medium- and long-term periods, namely: agriculture, extractive industry, food, consumer goods, consumption of durables, intermediate goods, capital goods and services.

It is observed that with the policy there is an increase in production and investment in the sectors of the economy in both policy scenarios, with the exception of the agricultural and extractive industry sectors. This can be explained by the fact that both sectors are representative in the composition of Brazilian exports and, according to Table 1, there is a reduction in the country's exports in the three periods. There is an increase in production and investment in the sectors of consumer goods, consumer durables, food and services. The increase in household income contributes to an increase in the production of those sectors that are more related to household consumption, mainly due to the consumption profile of households in lower income strata. Graph 3 presents the production of the sectors in the three periods. It can be noted that the sectors that showed the greatest growth are consumption of durable goods and services, reaching 0.55% and 0.58% in the long term.

Graph 2 – Sectoral effects of subsidy policy from the perspective of production and employment and investment (Var.%)
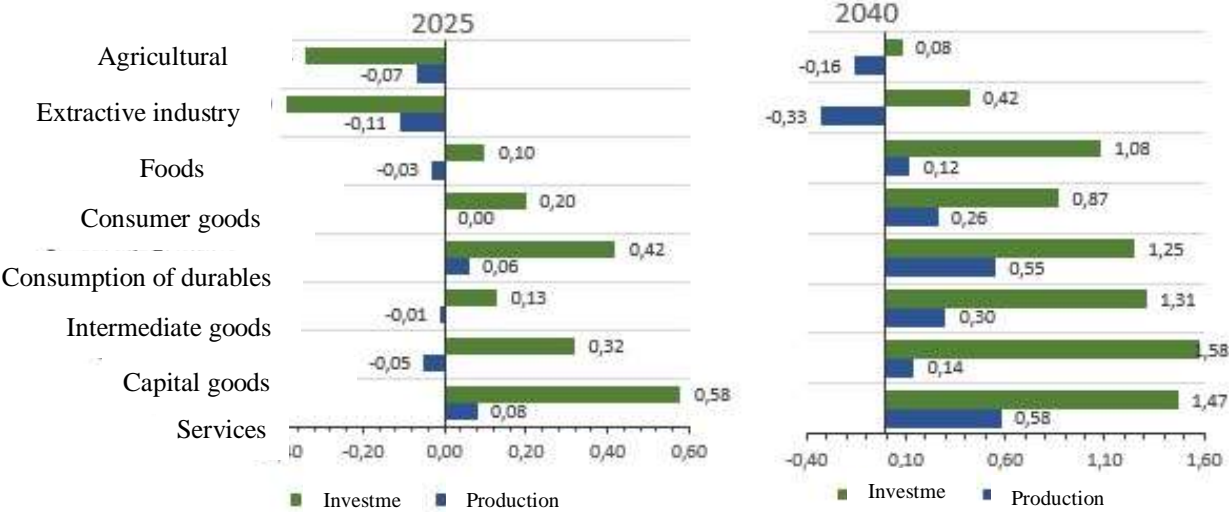
Source: Search results.

Graph 3 – Sectoral effects of the subsidy policy from the perspective of production (Var.%)
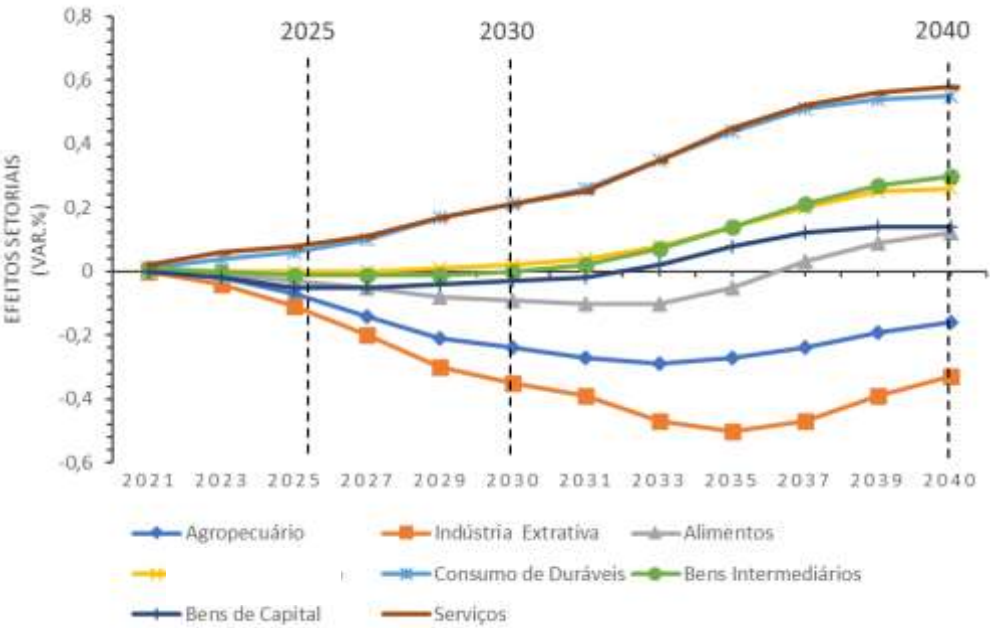
CONCLUSION AND POLICY IMPLICATIONS: Household budget surveys by the Brazilian Institute of Geography and Statistics (IBGE) show evidence that Brazilian households already spend practically the same amount on transport and food, and in some metropolitan regions there are indications that spending on transport exceeds food. In the latest edition of this survey, spending on transportation exceeded spending on food. Thus, changes in the price of urban public transport (UPT) fares directly affect the cost of living and the household budget. Despite the importance of urban public transport as a guarantee of accessibility and mobility for a large part of the population, it has become increasingly expensive for users, with fare increases and quality reductions, which reduces the demand for the service on the part of citizens. users, reduced ability to pay the minimum wage and compromised access to public transport services, especially for the poorest households. Public policies such as the Urban Mobility Law are unable to contain the effects of rising public transport costs.

This scenario opens the discussion on the role of subsidies for urban public passenger transport, as an important option for reducing ticket prices and improving the quality of the service provided. For the specific case of public transport, the government concession aims to maintain tariffs at prices that are accessible to the population. In addition, it is necessary to evaluate the impact of the subsidy policy on the redistribution of household income, taking into account the peculiarities of different groups by income level. Thus, the present paper aimed to analyze and project the economic effects of subsidies granted to passenger transport activities on the Brazilian economy, as well as the redistributive effects on consumption and income of typical households. To fulfill the objective, the BIG-TP model was used, which is a Computable General Equilibrium (CGE) model that presents flexibility for the creation of scenarios based on economic fundamentals for the Brazilian economy. Within the innovations proposed by the model, the present paper contributes to filling gaps in the analysis of the redistributive effects of income with the introduction of subsidies to the transport.

The macroeconomic results show that the subsidy policy for public passenger transport generates effects on the growth of the Brazilian GDP and contributes to the increase in the flow of expenditure and income, generating positive impacts for the Brazilian economy. This positive effect is mainly due to the increase in household consumption and investments and the reduction in the trade balance. Regarding the results observed by groups of households, it can be concluded that the analyzed policy generally benefits all income strata, but mainly the poorest households, which have greater percentage gains in real income, utility and consumption. There is a greater demand for public transport mainly by the poorest households and a more expressive increase in the demand for private transport by the richest households. Regarding the sectoral impacts, the increase in household income contributes to an increase in the production of those sectors that are more related to household consumption, mainly due to the consumption profile of households from lower income strata, contributing to the increase in sectoral production and investment. In sectors such as agriculture and extractive industry, however, there are difficulties in expanding production in the short and medium term. These projections are in line with the reflections and proposals of the National Association of Urban Transport Companies (NTU) and the National Transport Confederation (CNT), which seek ways for sectors such as public passenger transport, essential services that benefit from these policies. specific for inputs such as diesel and which, on the other hand,

suffer from recurrent crises resulting from the loss of demand, high tariffs, the absence of economic subsidies, the current sector financing model, among others.

In a final assessment, there is no doubt that any movement towards a search for improvements in the public passenger transport sector that includes tax exemptions and/or economic subsidies, in principle, is beneficial for Brazil. And the search for segments of society, beneficiaries of public transport, that can contribute to its financing, without safeguards, will bring gains to the Brazilian economy, although with greater incentives for specific groups, such as the poorest households. Such incentives should favor the greatest demanders of public transport, since the access of these users to the service is costly due to the higher tariffs. In other countries (e.g., United Kingdom, France) funding for the sector is already a reality, whose subsidies account for almost half of the resources allocated to finance the operation of these services. The sector's tariff regulation model and the government's private interests constitute the greatest obstacle to public transport financing in Brazil.

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