Evaluation of Transportation Mode Choice with the Free-Fare Bus in Sao Caetano do Sul, Brazil

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INTRODUCTION

Urban mobility is a fundamental component of the daily life in cities, considering it guarantees access to health services, employment, education and leisure. Free-Fare on Public Transport (FFPT), a policy that aims to make the public transport economically more accessible, have been implemented around the world to deal with the mobility issue. The outcomes of this policy remain a subject of ongoing scholarly debate, given its potential implications for public health (PESOLA et al., 2022; GRIMES et al., 2024), environmental sustainability (WEBSTER, 2024), and labor markets (BROUGH et al., 2025). Existing research in this field is largely situated within the context of understanding FFPT's influence on travel mode selection (BULL et al., 2021; BROUGH et al., 2022). The current research aims to contribute to the debate related to effects of FFPT on the mode choice, focusing on a high-dense environment. It investigates the city of São Caetano do Sul (SCS), in the Metropolitan Region of São Paulo, Brazil.

RESEARCH QUESTIONS

What impact has the FFPT policy had on mode choice in São Caetano do Sul?

In what ways has this policy altered the composition of transportation modes used in the city?

METHODOLOGY

To analyze the impact of the FFPT policy on travel mode choice, this research employs a discrete choice modeling framework. A Nested Logit model (McFADDEN, 1972) was specified and estimated using data from a control group comprising work and education trips

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that were not eligible for the FFPT benefit. The nesting structure differentiates between public transport trips that utilize the municipal bus system of SCS - the mode directly affected by the policy—and those that use other public transit options, such as the train and intermunicipal buses, which remained fare-based.

This estimated model serves as a counterfactual to predict the mode choices the treated group (those exposed to FFPT) would have made in the absence of the policy. The causal effect is quantified by calculating the Average Treatment Effect on the Treated (ATT), defined as the difference between the observed mode choice of the treated individuals and their model-predicted choice under the counterfactual no-treatment scenario. This approach facilitates an analysis of the policy's heterogeneous effects, enabling the identification of demographic and trip-based profiles (e.g., gender, race, income, municipality of residence, trip timing) associated with a higher propensity for mode shift.

The analysis is based on the 2023 Origin-Destination household survey database, the data collection for which coincided with the phased implementation of the FFPT policy. This survey provides a representative sample of a typical commuting day within the São Paulo Metropolitan Region. The R package R5r was used to estimate the price and duration of each trip by each mode, using the General Transit Feed Specification (GTFS) file in the case of public transport.

RESULTS

The analysis provides evidences that some the mode choice changed after the implementation of FFPT in SCS. The main decreases were in car and motorcycle travels, but also in public transport that does not use municipal bus from SCS. On the other hand, not just public transport travels using municipal buses of SCS increased, but also travels on foot.

The mode shift exhibits distinct socio-demographic patterns. The propensity to switch to the FFPT-benefited public transport was highest among lower-income populations, suggesting the policy’s effectiveness in improving mobility for economically disadvantaged groups. Furthermore, while women and non-white individuals undertook fewer total trips in the sample compared to men and white individuals, respectively, these groups demonstrated a disproportionately higher rate of migration to the fare-exempt public transport following the policy's implementation.

These findings align with prior international research on FFPT schemes, which commonly report a decline in private motor vehicle use (ŠTRAUB, 2020; CATS et al., 2017) and, in some contexts, a complementary rise in walking (BULL et al., 2021; PESOLA et al., 2022). The

present study, however, suggests that the policy's impact extends beyond a simple price elasticity effect. The behavioral response implies that travel demand elasticities are not static; they appear to differ in the pre- and post-policy environments. This is substantiated by the model's performance: a standard discrete choice model calibrated only on pre-FFPT (non-treated) trip data would have systematically underestimated the observed shift, indicating that the removal of the fare altered choice parameters beyond what a simple price variable could capture. This points to a potential "threshold effect" or behavioral adaptation where the policy not only reduces cost but may also increase the perceived utility of public transport and walk.

CONCLUSION

Following the implementation of the FFPT policy, the high-density municipality of SCS has experienced a modal shift characterized by increased usage of public transportation and active travel modes—particularly walking—alongside a concurrent decline in trips made by private automobiles and motorcycles. This policy intervention operates not merely through price mechanisms but also by reshaping urban mobility patterns, thereby fostering a more pedestrian-friendly urban environment.

Demographic analysis reveals that low-income populations, women, and racial minorities exhibited the most pronounced shifts toward public transport adoption. These findings suggest that the FFPT policy may contribute to mitigating transport-related inequities by enhancing accessibility for historically marginalized and underserved groups.

Several limitations warrant acknowledgment in the present study. First, the sample was restricted to intra-municipal trips within São Paulo and SCS, thereby excluding broader metropolitan-region travel patterns. Second, survey data collected prior to November 1, 2023, may not fully align with post-implementation travel behavior, given that the Origin–Destination (OD) survey is designed to represent a typical day in the metropolitan region rather than capturing temporal policy effects. Third, the research focus on work and education-related trips may limit generalizability to other trip purposes, such as leisure travel, where behavioral responses to fare-free policies could differ substantially.

Nevertheless, this research can provide useful insights for policy-makers in the urban mobility area and it also contributes to the debate related to the effects of FFPT.

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