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Public transport vouchers to enhance ridership: Mental accounting bias in frequent public transport users☆

Santiago Gómez Cardona [a,*], Luis A. Guzman [b], Jorge Luis Ochoa Rincón [b]

[a] Faculty of Science and Engineering, University College Maastricht, Maastricht University, Maastricht, Netherlands
[b] Departamento de Ingeniería Civil y Ambiental, Grupo de Sostenibilidad Urbana y Regional, SUR, Universidad de los Andes, Bogotá, Colombia

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ABSTRACT

The widespread adoption of smart travel cards has substantially enhanced the flexibility of pricing mechanisms in public transport. This study examines the impact of a monthly voucher on increasing the utilization of public transport services. The analysis is based on a controlled field experiment conducted within Bogotá's public transport system. We provide empirical evidence of the presence of Mental Accounting Bias (MAB) in the context of transport voucher use. Specifically, we demonstrate that the increased ridership observed among voucher recipients can be attributed not only to the voucher's monetary value but also to a behavioral response triggered by a perceived expansion of their transport budget. This finding highlights the role of MAB in explaining why this intervention was effective, whereas other demand-side subsidies, such as fare discounts, have proven less successful in this context. To establish the presence of MAB, we employ three distinct methodological approaches, each drawing on different sets of evidence collected during the experiment. They provide compelling evidence of MAB. To our knowledge, this study presents the first empirical investigation of MAB in public transport. The potential to induce MAB through transport vouchers offers valuable insights for the design of policies aimed at increasing public transport ridership.

1. Introduction

Despite the many benefits of public transport use and its role in improving quality of life (Hybel & Mulalic, 2022), many people still choose less sustainable modes. In Latin America, a key reason is the limited affordability of public transport for large segments of the population, combined with low service quality. For the poorest households, transport expenditures may exceed 25% of income in half of the region's cities (Falavigna & Hernandez, 2016; Rivas et al., 2018). This helps explain the limited access among vulnerable social groups (Guzman et al., 2018), who tend to be less mobile than wealthier groups and often live in peripheral areas (Tiznado-Aitken et al., 2023). As a result, public transport's potential to provide accessibility across the income spectrum is curtailed: low-income households underuse it due to affordability barriers. At the same time, higher-income groups favor less sustainable modes. In this context, public transport subsidies are one of the main instruments for increasing ridership and enhancing the system's attractiveness. Cities across Latin America have implemented both supply-side and demand-side subsidies, using various targeting mechanisms.

The way subsidies are provided, whether through cash transfers, vouchers, smart cards, or digital payment systems, matters for incentives, behavior, and their effectiveness. Conditional subsidies change how users engage with the program. Evidence from Bogotá's Integrated Public Transport System (Spanish acronym SITP) shows that the effect of a pro-poor subsidy—consisting of a 28% fare reduction per trip for up to 30 trips per month—declined over time, eventually becoming ineffective (Guzman & Hessel, 2022). Due to a lack of additional rigorous empirical evidence, there is no clear understanding of the reasons behind this pattern. It can be hypothesized that this may be because, despite reduced fares, the most vulnerable users must still allocate a substantial portion of their income to travel. Thus, the time, effort, or cost of accessing the subsidy can discourage use. Importantly, the delivery mechanism directly influences who benefits and how progressive

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* Corresponding author.
E-mail addresses: santiago.gomez@maastrichtuniversity.nl (S.G. Cardona), la.guzman@uniandes.edu.co (L.A. Guzman), jl.ochoa@uniandes.edu.co (J.L.O. Rincón).

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the policy is. For example, subsidies deposited directly onto public transport smart cards reduce leakage and ensure that financial support is very precisely delivered to the intended recipients (Serebrisky et al., 2009; Hörcher & Tirachini, 2021). Delivery method design is especially important in contexts where affordability constraints exclude vulnerable groups from public transport. Targeted subsidies tied to specific services can stimulate ridership among low-income populations while avoiding windfall benefits for higher-income groups that do not face affordability barriers. Furthermore, behavioral traits can cause users to react differently to subsidies depending on their delivery method, even when the monetary value is identical; this is the dimension that this paper investigates. Well-targeted, efficient and cleverly designed demand-side subsidies can achieve their goals with less fiscal pressure than broad, supply-side operator subsidies, which often disproportionately benefit wealthier users. It is not merely the provision of subsidies, but their delivery design, that determines their reach, equity, and long-term effectiveness.

To test an alternative delivery method, we conducted a controlled field experiment with 1607 frequent users of Bogotá's SITP. This intervention consisted of providing a monthly transfer to users' travel cards for four months, effectively creating a transport voucher instead of a fare discount. The voucher value lay well below the average SITP expenditure. Although prior studies attribute the intervention's success to the voucher format, finding increases in both ridership (Guzman et al., 2024) and user welfare (Guzman et al., 2025), the underlying mechanism has not been fully explained. We show that the voucher delivery method leverages users' cognitive biases, nudging them to increase their weekly trips beyond what would be expected in the absence of such framing. When users receive the voucher on their travel cards, they interact with SITP more frequently than they would if the funds were not earmarked for that purpose. Specifically, the voucher triggers a mental accounting bias (MAB) behaviour: transferring cash directly to travel cards expands the "public transport" mental account, stimulating greater spending (i.e., usage) on SITP.

This paper addresses the need for evidence on the bounded rationality of public transport users. Specifically, it shows how behavioral traits can produce departures from classical consumer behavior at the aggregate level, thereby becoming actionable policy targets. The literature has raised questions about the role of behavioral traits in general, and MAB in particular, in shaping transport choices (Garcia-Sierra et al., 2015; Metcalfe & Dolan, 2012). This study contributes to that literature by providing the first empirical support for the relevance of MAB in public transport behavior and pricing-policy design. Note that outside the tightly controlled laboratory environment, identifying MAB in real-world settings presents significant identification challenges. Specifically, researchers must demonstrate that observed behaviors are driven by mental budgeting while ruling out competing alternative explanations. We believe our study offers distinct methodological advantages over the existing literature (Feldman, 2010; Hastings & Shapiro, 2013, 2018; Milkman & Beshears, 2009) in this regard. These advantages stem from our use of experimental data (note that much of the literature relies on observational data) and the unique structure of our intervention. Specifically, the repeated delivery of vouchers to the same sample and the provision of a grocery voucher to the control group, after the main voucher intervention, allow us to more directly isolate MAB and rule out alternative explanations than previous studies. Consequently, these findings strengthen the premise that MAB persists across diverse settings and exerts detectable effects at the aggregate level.

Drawing on MAB theory, we show that: i) public transport expenditures are higher when financed through transport vouchers than when paid out of travelers' own funds; ii) the additional expenditure on public transport exceeds what would be expected if the voucher were perceived solely as an income increase; and iii) allocating a grocery voucher has no discernible effect on public transport expenditures. In the absence of MAB, the latter outcome would not hold: the impact of a grocery voucher should equal that of a transport voucher. While MAB is often viewed as a bias to be mitigated, the presence of positive externalities in public transport creates a scenario where inducing this cognitive response can facilitate reaching a higher social optimum. This unique characteristic, combined with our empirical evidence, underscores the strategic utility of MAB in this sector and provides a theoretical foundation for public policies that deliberately leverage cognitive biases to enhance social welfare.

2. Mental account bias: Background and definitions

Over the past few decades, research in behavioral economics has extensively documented systematic deviations from the principles of standard consumer behavior theory (Thaler, 2018). In a transport-related context, the additional trips taken by a traveler after receiving an income increase should be comparable to those observed when the traveler receives cash loaded onto a travel card; the issuance of a voucher should be equivalent to an increase in income (Bradford & Shaviro, 1999). However, commuters do not consistently behave as standard economic agents, owing to cognitive biases that have been widely observed across diverse scenarios. One such deviation is mental accounting, originally described by Thaler (1985).

2.1. A mental accounting bias definition

The Mental Accounting Bias (MAB) encompasses a wide array of behaviors explained by the notion that consumers allocate their expenses across distinct mental "accounts" (Thaler, 2008, 1999, 1985). Creating these categorical budget divisions simplifies spending decisions but overlooks the interchangeable nature of money (i.e., money fungibility), thereby resulting in inefficiencies (Heath & Soll, 1996; Henderson & Peterson, 1992; Thaler, 1999; Zhang & Sussman, 2018). Such inefficiencies emerge when decisions involve goods or services assigned to different mental accounts, often leading to excessive consumption of certain items. A typical illustration of MAB occurs when consumers receive a store voucher. A rational approach would be to use the voucher for routine purchases, thereby freeing personal funds for more desirable or profitable uses. In this sense, the value of the voucher is not confined to the store's product assortment but should be incorporated into the consumer's general budget. This implies that the use of the voucher should be equivalent to receiving the same amount in cash.

Within the context of MAB, however, vouchers are often used for additional consumption beyond usual purchases. In such cases, consumers behave as if the voucher increases the budget specific to that store, rather than their total expenditure budget. For a rational economic agent, the voucher should substitute for regular spending, while personal funds could be redirected to other purposes, eliminating the need to restrict expenditures to the store. Consequently, using vouchers exclusively for additional in-store consumption constitutes a cognitive bias.

A substantial body of literature examines the phenomenon of MAB. While the present paper focuses on MAB as it arises in the use of transport vouchers, it is important to note that MAB has implications across multiple domains. For a recent review, readers are referred to Zhang and Sussman (2018) and Silva, Lacerda and Bortolon (2023). Numerous studies have demonstrated the effects of MAB through controlled laboratory experiments, where participants are exposed to structured choice scenarios in a controlled setting. These designs allow researchers to identify variations in behavior attributable to specific conditions, thereby facilitating the detection of bias (Cherry, 2001). Beyond the laboratory, strong evidence shows that MAB also affects typical consumer behavior in real-world contexts. For example, Milkman and Beshears (2009) report results from a grocery voucher experiment that align with the findings of the present study. Other notable research includes analyses of the U.S. Food Stamp Program (Hastings & Shapiro, 2018), fuel consumption (Hastings & Shapiro, 2013), and tax rebates (Feldman, 2010). These studies consistently

demonstrate that receiving a voucher or similar instrument encourages higher-than-expected consumption of the associated goods and services. Importantly, in each case, MAB biased consumer choices, as its absence would have led individuals to select a different bundle of goods and services more consistent with their true preferences.

In contrast, limited research addresses the role of MAB in public transport. Previous studies have highlighted the potential for MAB to distort comparisons between the variable costs of private and public transport (Garcia-Sierra et al., 2015; Metcalfe & Dolan, 2012). However, these claims are based on evidence from other domains and lack direct empirical support in the transport sector. To the best of our knowledge, there has been no discussion of the potential role of transport vouchers, examined through the lens of MAB, as a tool for shaping transport policy frameworks.

2.2. Mental accounting in transportation with the presence of a voucher

The presence of Mental Accounting Bias is rooted in the cognitive processes of categorization; this implies that the formation and activation of specific budgetary categories are highly sensitive to situational and environmental cues (Henderson & Peterson, 1992). When transit authorities transition from traditional cash payments to prepaid smart travel cards, they effectively establish a highly salient "public transport" mental account (Heath & Soll, 1996). This categorization is reinforced by the fact that smart cards provide immediate feedback on costs and remaining balances. Such transparency disincentivizes the reassignment of expenditures to other budget categories, for example, by rationalizing a trip as an "entertainment" expense, thereby solidifying the public transport account as a distinct mental category.

Within this framework, a voucher issued directly to a smart card balance is likely to trigger biased decision-making. Because mental budgets are often sticky and resistant to cross-account transfers, such a voucher can create a temporary surplus that induces a period of increased consumption in travel (Heath & Soll, 1996). From this perspective, users may fail to treat these funds as fungible assets; instead of optimizing their aggregate utility, they treat the voucher as a discrete resource earmarked solely for additional transit usage. Consequently, because these funds are compartmentalized within a public transport account, travelers may revert to baseline spending patterns upon the voucher's depletion, bypassing the rational wealth-integration expected in standard consumer theory. Note, MAB likely influences how users allocate any resources saved during the weeks they are using their own money; these funds are most likely recategorized as 'pocket money' and spent within that category (Arkes et al., 1994).

Is worth noting that while the overarching budget is set monthly, as it aligns with the standard Colombian salary cycle, the psychological monitoring and execution of that budget occur at a higher frequency, driven by the visible balance of the smart card. This monthly anchor explains why the arrival of a new voucher triggers a significant change in behavior; it is viewed as an increase in the Public Transit Account for that month's cycle. While the target is monthly, our data on card recharges show that users interact with their smart cards every few days, engaging in balance-dependent consumption in which the card balance appears to be set at an expected level. As long as the smart card has a higher-than-usual balance due to the voucher, the user perceives the category as overflowing with resources that can be used specifically for that purpose.

2.3. A simple model of mental accounts

To motivate our methodological approach, we present a high-level formalization of MAB within the framework of optimal consumer behavior. This theoretical foundation serves to clarify the scope and objectives of our three methodological strategies. This formalization treats transport as another commodity within the consumption basket, as illustrated in Fig. 1. In this context, MAB can be interpreted as the

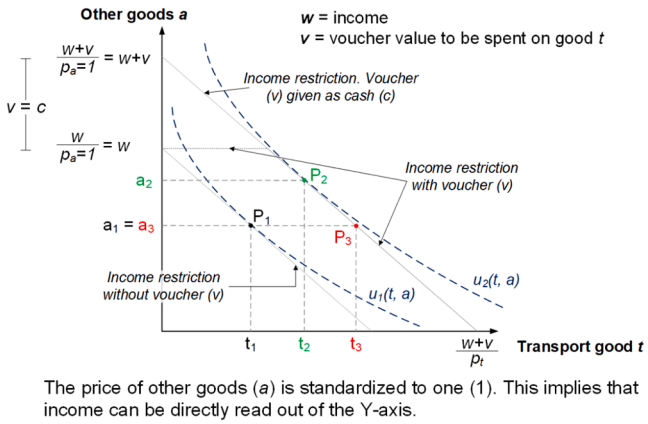


Fig. 1. Utility maximization under MAB.

consumer's selection of a goods basket that fails to maximize utility. To understand MAB and its associated implications, we adopt the structured framework proposed by Farhi and Gabaix (2020). This framework modifies the classical consumer problem of determining the optimal quantities of goods that maximize utility.

The approach begins with the classical problem of utility maximization. A consumer with a budget of w faces price p_t for good t, and price p_a for good a. The consumer's utility function follows a Cobb-Douglas parametrization $u(a,t) = a^{\alpha} \cdot t^{\gamma}$, with $\alpha + \gamma = 1$, subject to the standard budget constraint ($p_a \cdot a + p_t \cdot t \leq w$). Farhi and Gabaix (2020) introduce a parameter $\beta \in [0, 1 - \gamma]$ that characterizes the level of MAB. The consumption choice under MAB results from biased utility maximization (see Appendix 1. Supplementary Materials for further details). Fig. 1 provides a graphical representation of the problem, showing both the optimal solutions that maximize utility and the suboptimal choice under the influence of MAB.

Given the conditions in Fig. 1, the consumer chooses quantities of goods that maximize utility, represented by point P_1. This is the highest attainable utility under the budget constraint, that is, the point where the budget line is tangent to the highest reachable indifference curve (u_1). This is a standard result in consumer theory. Because of the Cobb–Douglas utility function, the consumer allocates a fixed proportion of income to each good: proportion γ to good t and proportion α to good a. This yields:

$$t_1 = \frac{\gamma \cdot w}{p_t}, \quad a_1 = \frac{\alpha \cdot w}{p_a} \tag{1}$$

In this framework, we distinguish between two categories of monetary transfers. The first involves a cash transfer, denoted as c, which is assumed not to induce MAB behavior and is therefore classified as a non-MAB-inducing transfer. The second category consists of a voucher, denoted as v, which is posited to induce MAB behavior and is thus classified as an MAB-inducing transfer.

2.3.1. Choice with a non-MAB-inducing transfer

First, we analyze the non-MAB-inducing transfer. Under a cash transfer of amount c, the budget constraint shifts outward and becomes $p_a \cdot a + p_t \cdot t \leq w + c$. The optimal quantities follow from Eq. (1) after substituting w with $w + c$:

$$t_2 = \frac{\gamma \cdot (w + c)}{p_t}, \quad a_2 = \frac{\alpha \cdot (w + c)}{p_a} \tag{2}$$

In Fig. 1, the new budget constraint is shown as a dashed gray line, and the new optimum is labeled P_2. With the higher budget, the consumer reaches a higher indifference (utility) curve that was unattainable in the absence of the cash transfer (voucher).

2.3.2. Choice with an MAB-inducing transfer

Next, let us examine a scenario involving a transfer that induces MAB. Introducing a voucher valued at v modifies the income restriction, shifting it from w to $w + v$. Consequently, a new basket with higher quantities of goods can be chosen. The income constraint is adjusted by including voucher v, which has the same monetary value as cash c (see Fig. 1). Within this revised context, the optimal choice of basket remains at P_2. As observed earlier Eq. (2), the exact values can be determined by adjusting the available budget to include the voucher's value:

$$t_2 = \frac{\gamma \cdot (w+v)}{p_t}, \quad a_2 = \frac{\alpha \cdot (w+v)}{p_a} \tag{3}$$

If the consumer chooses P_2 in this scenario, their utility is maximized. It is important to note that the consumer would allocate part of the voucher toward additional units of the good t. Nonetheless, this income increase is equivalent to receiving a cash transfer of the same value, as shown by Eqs. (3) and (2), which are essentially identical.

However, the selection under MAB differs. It implies an over-consumption of the good linked to the voucher (good t) and an under-consumption of the alternative (good a). This circumstance is illustrated in Fig. 1 at point P_3. In this case, the consumer increases consumption of good t while maintaining the same level of good a as before the voucher was provided. The basket represented by P_3 is defined following the framework of Farhi and Gabaix (2020) (see Supplementary Material, Model extension, for details):

$$t_3 = \frac{\gamma \cdot (w+c) + \beta \cdot v}{p_t}, \quad a_3 = \frac{\alpha \cdot (w+v) - \beta \cdot v}{p_a} \tag{4}$$

Note that if $\beta = 0$, Eq. (4) reduces to Eq. (3). In this case, no MAB bias is present. If $\beta = 1 - \gamma$, the maximum possible bias is reached, and Eq. (4) becomes[1]:

$$t_3 = \frac{\gamma \cdot w + v}{p_t}, \quad a_3 = \frac{\alpha \cdot w}{p_a} \tag{5}$$

This corresponds to point P_3. When MAB is at its maximum, the consumer uses the entire value of the voucher to purchase additional units of the good t. Since the voucher is restricted to this good, the consumer treats it as a dedicated budget. This corresponds to adjusting the pre-voucher budget for good t ($\gamma \bullet w$) by adding the voucher's value, resulting in $\gamma \bullet w + v$. In other words, the consumer establishes a new budget for good t and behaves accordingly, disregarding the opportunity to allocate part of the transfer to good a.

Intermediate values are also admissible within this framework. This occurs when $0 < \beta < 1 - \gamma$, representing cases where the consumer does not allocate the entire voucher to good t. Nevertheless, they still consume more transport (trips, good t) and less of the alternative good a than would be optimal. This is expressed in Eq. (6), though it is not illustrated in Fig. 1:

$$t_{3b} > t_2 = \frac{\gamma \cdot (w+v)}{p_t}, \quad a_{3b} < a_2 = \frac{\alpha \cdot (w+v)}{p_a} \tag{6}$$

2.3.3. Marginal propensities to consume

A useful method for representing the differences between a cash transfer that does not induce MAB and one that does is through the concept of Marginal Propensities to Consume (MPC). MPC is defined as the proportion of income spent on goods relative to the value of the transferred resources, specifically referring to the most recent income received, either in the form of cash or a voucher. In this study, our focus is exclusively on the consumption of transport good t. Determining this MPC is straightforward, as it corresponds mathematically to the derivative of transport expenditure. For the cash transfer, the cost function is expressed as follows:

$$t_2 \cdot p_t = \gamma \cdot (w + c) \tag{7}$$

The corresponding marginal propensity to consume from the cash transfer is:

$$MPC_c = \partial \frac{t_2 \cdot p_t}{\partial c} = \partial \frac{\gamma \cdot (w+c)}{\partial c} = \gamma \tag{8}$$

For the voucher, the cost function is:

$$t_3 \cdot p_t = \gamma \cdot (w + v) + \beta \cdot v \tag{9}$$

And the corresponding marginal propensity to consume from the voucher is:

$$MPC_v = \partial \frac{t_3 \cdot p_t}{\partial v} = \partial \frac{\gamma \cdot (w+v) + \beta \cdot v}{\partial v} = \gamma + \beta \tag{10}$$

The role of the β term in defining the level of MAB is evident from the difference between the two marginal propensities to consume (MPC_v and MPC_c). When $\beta = 0$, there is no MAB, and both propensities are equal: $MPC_v = MPC_c = \gamma$. When $\beta > 0$, MAB is present, and the propensity under the voucher exceeds that under the cash transfer: $MPC_v > MPC_c$.

2.3.4. Restriction condition for the equality of cash and voucher

The preceding discussion on MAB-induced transfers applies in all cases where the voucher's value is sufficiently low to allow attainment of the optimal basket; in other words, when the voucher is inframarginal. This is illustrated in Fig. 1, where the optimal basket (P_2) lies along the descending segment of the income constraint that incorporates the voucher v. This situation arises when the voucher's value is equal to or less than the cost of the optimal quantity of the good to which it is attached:

$$v \leq t_2 = \frac{\gamma \cdot (w+v)}{p_t} \tag{11}$$

Accordingly, any voucher whose value is less than or equal to the expenditure on goods before the voucher's introduction will also satisfy this condition:

$$v \leq t_1 = \frac{\gamma \cdot w}{p_t} < t_2 = \frac{\gamma \cdot (w+v)}{p_t} \tag{12}$$

This condition is particularly relevant for the vouchers used in the experimental intervention under analysis, as their values are lower than the monthly expenditures of the participants.

3. Case study and intervention design

From a public transport policy perspective, cognitive biases may serve as useful tools to enhance the attractiveness of public transport and increase ridership. Accordingly, we provide a brief description of the case study and outline the design of the field-controlled experiment.

3.1. The Bogotá's SITP

Bogotá has one of Latin America's most extensive public transport systems, with almost 4 million daily trips. The current system relies on a Bus Rapid Transit (BRT) network with dedicated lanes and stations that constitutes the backbone of the system. In addition, regular buses share road space with general traffic, and the first line of a cable car system has operated since late 2018 (Guzman et al., 2023). Together, these subsystems form Bogotá's Integrated Public Transport System (SITP), the most common motorized mode among lower- and middle-income residents.

At the time of the intervention, the SITP used a flat fare: 2950 Colombian pesos (COP; approximately USD 0.65) for the BRT

[1] Note that $(w + c)+(1-\gamma)\bullet v = \gamma\bullet w+\gamma\bullet v + v-\gamma\bullet v = \gamma\bullet w + v$. And that $\alpha\bullet(w + v)-(1-\gamma)\bullet v = \alpha\bullet w+\alpha\bullet v-v+\gamma\bullet v = \alpha\bullet w+(\alpha+\gamma)\bullet v-v = \alpha\bullet w$; with the last step due to the fact that in a Cobb-Douglas utility is $\alpha+\gamma=1$.

component and 2750 COP (USD 0.61) for the regular bus component. The SITP operates exclusively with a smart travel card that permits access to all services without separate tickets. This card is called "tullave Plus." There are two card types—personalized and anonymous. Users load funds onto the card as stored credit for use on the SITP. For each trip, the user validates the travel card; at that point, the fare is deducted from the available balance. Credit on the card is denominated in COP, cannot be converted to cash, and must be used only for SITP trips. It does not expire. A personalized travel card is required to receive transfer discounts and to access targeted subsidies such as fare discounts.

Targeted pro-poor subsidies are implemented as fare discounts for individuals classified as low income under government criteria. Introduced in 2013, the program initially set fares at 60% of the regular price for individuals aged 16 or older with low-income status. The structure has evolved; currently, eligible riders pay 72% of the full fare. The program also limits use to 30 trips per month and requires meeting an income-eligibility threshold. The SITP has not yet regained its pre-pandemic ridership levels. Moreover, evidence suggests that the existing pro-poor fare discount is no longer effective in encouraging public transport use (Guzman & Hessel, 2022).

3.2. Experimental design

In 2021, we conducted a field experiment to test an alternative approach to providing transport subsidies to users of Bogotá's SITP. The intervention granted a monthly credit to a subset of frequent users for four months. We randomly selected 1607 SITP users with personalized travel cards from a population of approximately 176,000 frequent users who were not receiving any subsidy. Of these, 807 were assigned to receive a monthly voucher loaded onto their travel cards, and 801 were assigned to a control group. Voucher recipients were further divided into two arms: group A received COP 28,000 (≈ USD 7.50) per month and group B received COP 21,000 (≈ USD 5.60) per month.

Random assignment ensures the groups are statistically comparable at baseline, allowing us to attribute any subsequent differences in SITP use to the causal effect of the monthly voucher. The voucher could be used only to purchase public transport tickets; cash withdrawal was not permitted. Any unused balance remained on the recipient's travel card for future transport expenditures.

We compiled individualized travel-card transaction data for all of 2021, before, during, and after the intervention. Additional data comprised a baseline household survey, weekly follow-ups, and an endline survey. Face-to-face interviews were conducted in March, April, and November 2021. The intervention ran from May through September 2021. Control-group participants who did not receive the transport voucher were provided an alternative participation incentive at endline: a grocery voucher of COP 30,000 (≈ USD 8). We also recorded the redemption and use of all vouchers.

In this study, we show that the magnitude of the ridership increase exceeds what would be expected if, on average, users behaved as perfectly rational agents, and we attribute the difference to mental accounting bias (MAB). That is, SITP use increases more than would be predicted if participants responded only to the income effect of the voucher and treated it as fungible cash. We first provide a detailed explanation of MAB, then present three methodological approaches derived from this framework, and finally report the results with accompanying analysis and discussion.

4. Methods

Under the influence of MAB, participants who receive an MAB-inducing transfer (the transport voucher) are expected to show a larger increase in SITP usage than participants who receive a non-MAB-inducing transfer. However, our experimental design did not include a parallel cash-transfer condition that would have provided direct, head-to-head evidence on the differential impact of delivering the same monetary amount via cash versus voucher. Instead, we implemented a three-part strategy to detect MAB among regular SITP users in Bogotá. These methods were designed to identify signs of MAB in participants' post-voucher SITP expenditure patterns.

First, we examine the temporal profile of SITP expenditures in the weeks following voucher delivery. This approach analyzes short-run fluctuations in SITP usage and assesses whether the dynamics are consistent with MAB. Second, building on the premise that, under MAB, the marginal propensity to consume/spend on public transport from a voucher (MPC_v) exceeds that from additional regular income (MPC_I) (Section 2.2), we estimate the difference between MPC_v and MPC_I using data from the experiment. Third, we study responses to vouchers not earmarked for public transport. If MAB is present, an alternative voucher—such as a grocery voucher—should have a smaller effect on public transport usage than a voucher explicitly designated for transport. We test this by examining the behavior of control-group participants who received a grocery voucher at the conclusion of the experiment.

4.1. Temporal fluctuations in SITP ridership

This approach begins with the recognition that participants recharge their travel cards with sufficient funds to cover their weekly expenditures on the SITP, and that the value of the provided vouchers exceeds the average cost of one week's use. Once a voucher becomes active, individuals in the treatment group can stop adding funds to their travel cards until the voucher is exhausted, after which they revert to using their own budget. If mental accounting bias (MAB) is absent and the fungibility of money is respected, there should be no difference in resource allocation between trips financed by the voucher and those supported by the participant's budget. Vouchers are delivered monthly and are announced in advance. Consequently, participants can plan their weekly trips based on their overall financial resources, which include both personal income and the voucher.

Under these circumstances, if participants receive a transfer that does not induce MAB, they are expected to maintain consistent spending on their weekly SITP trips in the weeks following its receipt. The same pattern should also appear in their response to the voucher if they are unaffected by MAB. Essentially, this indicates that participants treat vouchers and cash as interchangeable, aligning their behavior with Eq. (3). Importantly, this mechanism allows participants to save money in the first half of the month by avoiding the use of their regular income for transport expenses. In the second half of the month, those savings enable continued SITP use. As a result, weekly ridership should remain equivalent across both halves of the month.

Conversely, when participants are subject to MAB, differences arise between trips funded by their budget and those funded by vouchers. In this case, participants first use the voucher and, once it is depleted, turn to their own funds to continue using the transport system. Under MAB, users treat these funds as temporary surpluses instead of the fungible assets they are, leading to a period of higher travel consumption that ends when the temporary surpluses are exhausted. This implies that public transport spending is higher in the initial part of the month, when participants use the voucher, than in the latter part of the month, when they rely on their income. To examine differential expenditure patterns in the weeks following voucher distribution, we estimate the following model:

$$Y_{it} = \gamma_i + \lambda_t + \sum_p \beta_p \mathbf{T}_i^p + \tau \cdot \mathbf{P}_i + \epsilon_{it} \tag{13}$$

where Y_{it} refers to the outcome variables for participant i in week t. Two outcomes are of particular interest: i) SITP expenditures through travel card use, and ii) money recharged to the travel card. γ_i are individual fixed effects, accounting for the fact that average SITP use differs across participants. λ_t are week fixed effects, capturing factors such as holidays,

weekends, and strikes, which may influence SITP usage at different points in time.

The central element of this model is the subindex p, which indicates the number of weeks elapsed since the activation of a specific voucher. In the activation week, this value is set to 1; in the following week, it increases to 2, and so on. The value resets to 1 with the activation of a new voucher for the same participant, typically the next month. Before the first voucher, the value is 0, and it remains 0 for four weeks after the last voucher. For participants in the control group, the value is always 0.

A set of dummy variables, denoted as T_i^p, indicates whether a specific week for a participant corresponds to week 1, week 2, and so forth. These variables form the basis for estimating the impact of each period, as reflected in the coefficients β_p. The dummy variable P_i marks the post-treatment period and controls for differences between the treatment and control groups after the intervention ends.

The β_p coefficients measure disparities between treatment and control groups in SITP expenditures attributable to the voucher. They also allow us to examine changes in travel card recharging patterns. This enables identification of whether variations in SITP expenditures are consistent with shifts in recharge behavior. As participants gradually deplete their travel card balance after receiving a voucher, we expect to observe corresponding changes in recharge patterns. If participants are unaffected by MAB, their public transport expenditure patterns should remain stable. However, if they are influenced by MAB, the weeks following voucher activation should display increased expenditures alongside reduced recharge activity.

4.2. The marginal propensity to consume public transport

The approach presented in the previous section does not entirely preclude the possibility that the increase in SITP trips is driven solely by income effects coupled with high time discounting, which would cause the voucher's impact to dissipate rapidly. Were this the case, further empirical evidence would be required to isolate the behavioral mechanism. The analysis in this section provides such evidence by demonstrating that, over the course of a full month, SITP expenditures under the voucher format significantly exceed the marginal increases expected from a simple income effect.

Note that, the preceding methodological approach relies on identifying expenditure patterns over time. In contrast, the present approach focuses on the share of the voucher that participants allocate to additional trips. As noted previously, because of MAB, participants may not devote the entire voucher value to additional trips. Importantly, with MAB in place, expenditures on these additional trips exceed those made when an equivalent cash amount is provided. This discrepancy can be quantified through the Marginal Propensity to Consume (MPC) of public transport. Under MAB, we have:

$$\mathrm{MPC}_c = \gamma \ < \gamma + \beta = \mathrm{MPC}_v \tag{14}$$

Based on the results, our primary objective is to empirically demonstrate that the marginal propensity to consumer out of the voucher ($\mathrm{MPC_v}$) exceeds the marginal propensity to consume out of cash ($\mathrm{MPC_c}$). In our experiment, $\mathrm{MPC_v}$ is directly observable by comparing the additional travel expenditures of treated participants with the voucher's value. Conversely, $\mathrm{MPC_c}$ is not directly observable because the intervention did not include cash transfers. To address this, we use an analytical strategy centered on Average Propensities to Consume (APC), defined as total expenditure on trips relative to the total available budget (regular income plus the voucher, when present).

Fig. 2 illustrates how a divergence in marginal propensities ($MPC_v > MPC_c$) translates into a disparity in the corresponding observed average propensities ($APC_v > APC_c$). We adopt this alternative because, although $\mathrm{MPC_c}$ is unobserved, the experimental data allow us to compare $\mathrm{APC_v}$ with $\mathrm{APC_c}$. Existing evidence suggests that public transport expenditures in Bogotá do not exhibit a constant MPC across income levels (Guzman & Oviedo, 2018). As income rises, public transport spending initially increases, albeit at a diminishing rate, and subsequently declines as higher-income individuals shift to other transport modes. This pattern indicates that the share of income allocated to public transport falls with rising income (Graham et al., 2009; Rivas et al., 2018). Both MPC and APC[2] decrease consistently as income increases.

Fig. 2 schematics clarify this relationship. The left panel depicts the MPC for public transport for six individuals with six income levels (level 1 is the lowest income). All individuals' income derives from regular earnings, and the sixth individual additionally receives a transfer. The right panel displays the APC across the same income levels. APC can be viewed as an aggregation of $\mathrm{MPC_s}$ up to a given income level.

Consider the sixth income level. If this individual receives a non-MAB-inducing transfer (cash), the new MPC_c corresponds to the solid black bar in the left panel. If the transfer is MAB-inducing (a voucher), the new MPC_v corresponds to the hatched bar in the same panel. The presence of MAB raises MPC. We can directly observe MPC_v under a voucher, but we cannot directly observe MPC_c under a non-MAB-inducing transfer.

Shifting from MPC to APC (right panel), APC for the sixth individual averages the new MPC with all preceding MPCs (individuals one through five). As before, with a non-MAB-inducing transfer (cash), the new APC_c is the solid black bar; with a MAB-inducing transfer (voucher), the APC_v is the hatched bar. Because the first five $\mathrm{MPC_s}$ are identical across scenarios, the cash-versus-voucher ranking persists, yielding $APC_v > APC_c$, though the difference is smaller than in the MPC comparison. Note that it is feasible to estimate both $\mathrm{APC_v}$ and $\mathrm{APC_c}$: $\mathrm{APC_v}$ is directly estimable from the data, while $\mathrm{APC_c}$ can be approximated by using as a control an individual whose income equals that of a treated individual once the voucher is added.

Ideally, we would compare a participant with income w_x who receives a voucher v to another participant with the same income w_x who receives cash c, such that $w_x + v = w_x + c$. In the absence of a cash transfer, we compare a participant with income w_x who receives a voucher to a participant with income w_y such that $w_x + v = w_y$. Because cash is non-MAB-inducing, the APC of a cash recipient and that of an individual who already has the higher income level are equivalent.

Given the small effect we aim to detect (APCv - APCc << MPCv - MPCc) and the non-linear relationship between income and transport expenditures, a precise characterization of this relationship is essential. Without a sufficiently accurate model, there is a risk of miscalculating the relevant income effect, particularly as the voucher represents only a small fraction of a user's total income. Hence, to accurately estimate the average propensity to consume public transport as a function of income, we employ a polynomial specification to capture the necessary nuances of this relationship. We then test whether APC is higher for voucher recipients using the following model:

$$\mathrm{Y}_{it} = \lambda_t + \beta_T \cdot \mathbf{T}_{it} + \sum_{\mu} \beta_\mu \mathbf{I}_i^\mu + \ \mathbf{X_i} \cdot \beta_\mathrm{X} + \epsilon_{it} \tag{15}$$

Here, T_{it} is an indicator equal to 1 if participant i is treated in week t, and 0 otherwise. We include week fixed effects λ_t and no individual fixed effects, because income is (by design) constant for each participant over the treatment period. We control for socioeconomic covariates X_i. Random assignment of treatment avoids estimation bias; the controls improve statistical efficiency. Y_{it} is the share of income spent on public transport in week t, computed from weekly public transport use and reported income. I_i^μ denotes the polynomial terms in individual i's income, based on reported household income; for treated participants, income is augmented by the voucher value during the offer period, while

[2] We employ the term Average Propensity to Consume (APC) to maintain consistency with the MPC framework. It should be noted that the APC, as defined in this study, represents the expenditure share of transportation relative to total income.

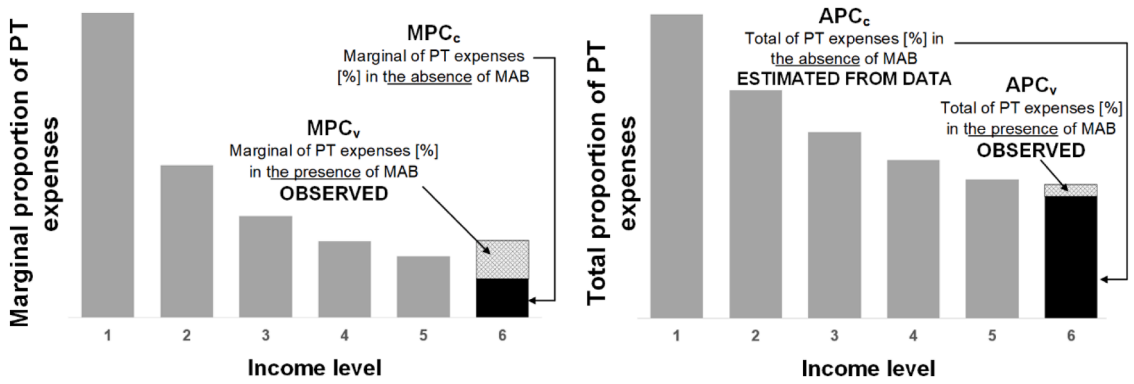


Fig. 2. Schematic representation of comparison measures to identify the presence of MAB.

income remains constant for control participants. Under this specification, β_T captures induced changes in public transport spending not explained by income. Income effects are captured by the β_μ terms. If MAB increases expenditure, β_T should be statistically greater than zero.

4.3. The response to no public transport vouchers

As previously noted, if an additional treatment group had been allocated a voucher-equivalent value transferred directly to their bank accounts or provided in cash, we could have directly assessed the unique impact of receiving the monetary transfer in voucher form. Unfortunately, this treatment modality was not implemented. Nevertheless, as described in the case study, participants in the control group were issued vouchers redeemable at grocery stores as an incentive for their participation. Assuming that participants in the treatment group reverted to their pre-treatment behaviors once the intervention concluded, which has been demonstrated (Guzman et al., 2025), this scenario can be used to gather further evidence regarding the existence of MAB in public transport usage.

The value of the grocery voucher exceeded that of the transport voucher by 7% (USD 8.0 vs. USD 7.5). It is important to note that the grocery voucher's value is below the average weekly household grocery expenditure reported for Bogotá; like the transport voucher, the grocery voucher is also inframarginal. Following the framework presented earlier, this is equivalent to a cash transfer. Consequently, in the absence of MAB, both the transport voucher (provided to treatment participants) and the grocery voucher (allocated to control participants) should function as cash-equivalent increases in total available resources. Therefore, in this context, and absent MAB, any changes in public transport expenditures among grocery voucher recipients should mirror those observed among transport voucher recipients. Conversely, if MAB is present, a disparity in public transport expenditures between the two voucher types should emerge.

By comparing the behavior of participants receiving grocery vouchers with those who did not, it becomes possible to determine whether receiving a grocery voucher produces an effect on public transport expenditures comparable to that identified for transport vouchers. Specifically, because we have information on the dates when transport vouchers were redeemed, we will, mirroring our initial approach, reconstruct the temporal behavioral patterns of participants following redemption of the grocery voucher. We propose the following model:

$$Y_{it} = \gamma_i + \lambda_t + \sum_p \beta_p \mathbf{T}_i^p + \sum_s \beta_s \mathbf{T}_i^g + \epsilon_{it} \tag{16}$$

This specification modifies Eq. (13) by incorporating a set of coefficients to capture the behavior of control group participants who received and redeemed grocery vouchers. The subindex s denotes time, measured in weeks from the moment the grocery voucher is redeemed. The outcomes in this model are the same as those in the earlier regression Eq. (13), specifically additional SITP expenditures and travel card recharge patterns.

If MAB influences the grocery budget category, the values of β_s would tend toward zero or be indistinguishable from it. Such a result would suggest that participants allocate most or all of the additional income from the grocery voucher to grocery purchases, leaving little or none for additional public transport trips. Conversely, if MAB is not present in the grocery category, β_s could be positive, although they should be smaller than β_p if the transport voucher induces MAB. If neither voucher produces MAB under any circumstances, the coefficients would be identical. Table A2 in the Supplementary Material provides a visualization of these scenarios.

5. Results

Before delving into the outcomes of the methodologies described

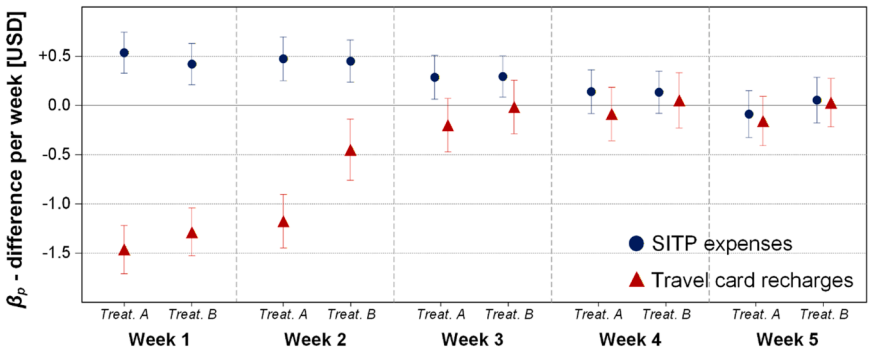


Fig. 3. Changes in SITP expenses and travel card recharge between participants who received the transport voucher (treatment) and those who did not (control). This corresponds to the βp coefficients of the regression 13 on both outcomes respectively.

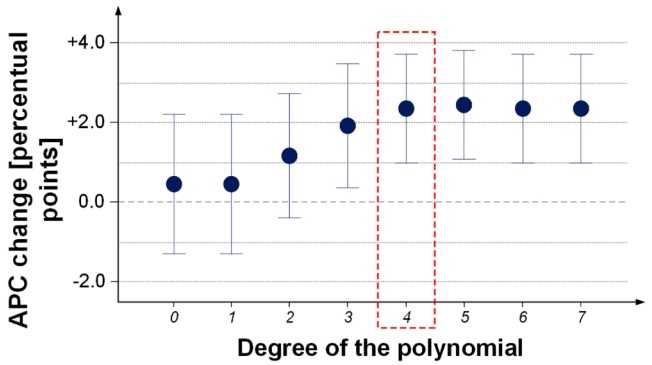


Fig. 4. Coefficients corresponding to the differential in the APC on public transport between treatment and control for different levels of a polynomial fit to the income per week. Our preferred model (4th degree polynomal) is highlighte with a dash-line red box.

above, we first highlight the key findings of the field experiment. Providing subsidies in the form of vouchers increased their average use of the SITP. On average, voucher recipients raised their SITP spending (travel-card use) by 8.4% over the intervention period. The increase was larger in treatment A (8.73%) than in treatment B (8.04%) (Guzman et al., 2024). This additional spending indicates that participants used 35% of the voucher value to fund additional trips and saved the remainder, 39% in treatment A and 31% in treatment B.

5.1. SITP use patterns

Fig. 3 presents the set of β_p coefficients estimated using the model in Eq. (13). These coefficients, shown as dots, represent the average weekly changes in SITP expenditures (travel card usage in USD) for participants in treatment groups A and B as a result of transport vouchers. The figure is divided into five panels by vertical dotted lines, with each panel corresponding to a different week (week 1 marks the transfer and activation of the voucher).

There is a statistically significant increase in travel card usage (expenditures), particularly during the first two weeks. By week 3, the increase remains but is smaller, as reflected in the decline of the coefficients (from 0.45/0.48 to 0.29/0.28; see Fig. 3, weeks 2 and 3, respectively). However, by weeks 4 and 5, this increase is no longer statistically significant. As explained in Section 4.1, this observed pattern diverges from what would typically be expected under rational economic behavior, where the voucher's value is perceived as equivalent to an increase in income. In the absence of MAB, it would be expected that expenditures would consistently increase across all weeks in which vouchers were distributed. Fig. 3 results demonstrate that this is not the case.

During week 1 following voucher distribution, SITP expenditures increased by approximately +11.7% (+0.42 USD) for treatment group B and +14.9% (+0.53 USD) for treatment group A. By week 3, the increases had fallen to +8.2% (+0.29 USD) and +7.1% (+0.28 USD), respectively. By week 4, no statistically significant increase in expenditures was observed. It is important to emphasize that these values represent average responses. Furthermore, our results are based on the intention-to-treat approach, which includes both participants who redeemed their vouchers and those who did not. Additionally, Wald tests comparing the coefficients for both treatment groups confirm this general trend. We find no statistically significant difference between weeks 1 and 2 (Treatment A: p-value: 0.507; Treatment B: p-value: 0.543). However, significant differences emerge when comparing week 1 against week 3 (Treatment A: p-value $<$ 0.01; Treatment B: p-value: 0.051), week 4 (Treatments A and B: p-value: $<$ 0.01), and week 5 (Treatments A and B: p-value $<$ 0.01). A full report of these statistical tests is provided in the Appendix A.1.

This trend, characterized by higher SITP expenditures relative to the control group during the first three weeks after voucher delivery, closely mirrors participants' travel card recharging patterns. This relationship is evident when examining recharges following voucher activation, represented in Fig. 3 by triangles. In week 1, there was a sharp decline in the weekly amount participants loaded onto their travel cards. This decline continued in week 2, though less markedly, with a stronger effect for treatment group A. By week 3, weekly recharges aligned with those of the control group. At this point, participants who received vouchers spent the same amount on SITP trips as those who did not, and their recharge amounts also converged. In terms of both expenditures and recharges, participants in the treatment groups became indistinguishable from the control group during the latter part of each month.

Furthermore, there is no evidence of learning effects associated with the treatment, at least across the four iterations of the voucher. An alternative specification (see Appendix Figure A.1) differentiating the four treatment waves reveals the pattern is consistently seen in all: heightened SITP utilization during the initial two weeks, followed by a decline that results in a negligible impact by the fourth and fifth weeks.

Additional trips primarily occurred during weeks when participants did not recharge their travel cards with personal funds but instead relied on vouchers. This behavior is consistent with the concept of MAB. With the introduction of a voucher that increased their available travel budget, participants expanded their use of the SITP. However, once they had to rely on their own resources, they reverted to previous travel patterns, even if they still had greater liquidity from voucher savings. Thus, the presence of MAB led to increased SITP expenditures only when participants perceived that their trips were financed by vouchers rather than by their own money.

5.2. The marginal propensity to consume public transport

It is noteworthy that the marginal propensity to consume (MPC) SITP trips through the provided voucher reached 35%. By contrast, the average propensity to consume (APC) observed in our dataset is 20% of per capita income. If participants were to use the voucher in the same way as their regular income, we would expect, on average, that no $>$20% of their income would be spent on additional trips. This observation suggests a potential overspending phenomenon within the SITP among participants, consistent with the presence of MAB. A detailed investigation of this potential overspending was proposed in the methodology described in Section 4.2.

Fig. 4 illustrates the β_T coefficients derived from the model presented in Eq. (15), applied to polynomials of varying degrees. Figure A1 in the Supplementary Material shows how a polynomial function approximates the average relationship between income and APC for the participants in the experiment. As shown in Fig. 4, as the degree of the polynomial used to model income effects increases, the estimated difference in APC between the treatment and control groups shifts upward. This shift becomes evident beginning with a polynomial of degree 4 and stabilizes around degree 7. To identify the optimal specification, we conducted an analysis of the Akaike and Bayesian Information Criteria (AIC and BIC). Both criteria indicate increases in explanatory power up to the fourth-degree polynomial, beyond which no further improvements are detected. Based on this analysis, the fourth-degree polynomial was selected as our primary model to derive the most robust estimate of the APC difference between the treatment and control groups. These results suggest that the relationship between public transport expenditures and income is effectively captured by a polynomial of degree 3 or higher. This allows for a comparison between APC_c and APC_v. The estimated difference is 2.4 percentage points, corresponding to an increase of $>$10% relative to the average value of 20% of per capita

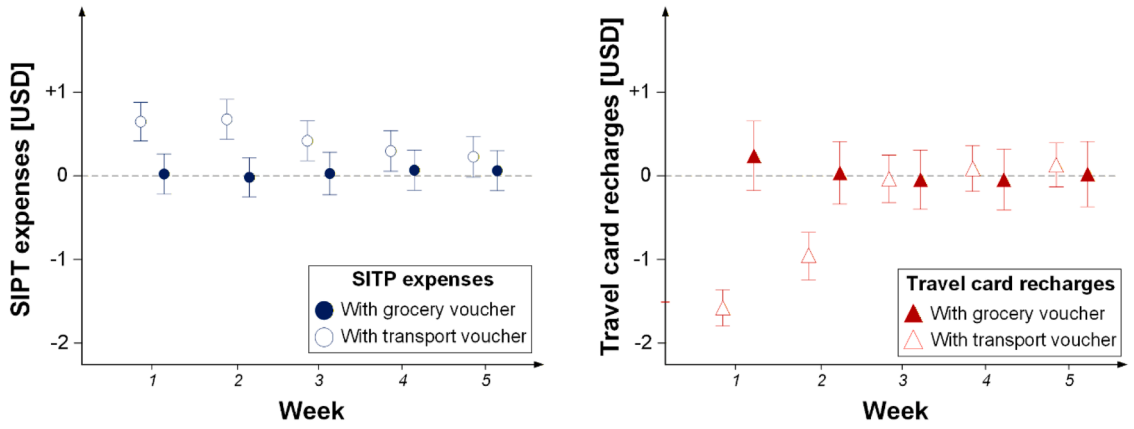


Fig. 5. Change in SITP expenditures (left graph), and weekly recharge to travel cards (right graph) due to the reception and use of a grocery voucher.

income.[3]

These findings suggest that participants who received the voucher experienced a higher APC than those in the control group. Importantly, this increase persists even after accounting for the additional income introduced by the voucher. This effect cannot be fully explained by the increase in resources alone. If participants had treated the voucher as equivalent to cash—without the influence of MAB—there should be no significant difference between the treatment and control groups in the model specified in Eq. (15). The presence of such a difference therefore implies an additional impact of the voucher itself on APC, consistent with the expected behavior of participants influenced by MAB.

5.3. *The response to no-public-transport vouchers*

The third and final approach provides insights into how SITP expenditures respond to an increase in income resulting from the provision of a grocery voucher. Although the grocery voucher has a specific purpose, it is considered equivalent to any other form of income-enhancing transfer. In other words, in the absence of MAB influence, a participant's response in terms of SITP expenditures should be consistent, regardless of whether the transfer is provided in cash, as a transport voucher, or as a grocery voucher.

Fig. 5 illustrates the outcomes of the model in Eq. (16), which evaluates participants' responses to receiving a grocery voucher. In the left panel of Fig. 5, the graph shows the variations in SITP expenditures induced by the grocery voucher (point estimates and 95% CIs of the β_s coefficients, represented by dark dots) and by the transport voucher (point estimates and 95% CIs of the β_p coefficients, represented by dotted lines). These changes are presented as variations in SITP expenditures across the weeks following voucher distribution. As previously shown, the response pattern to the transport voucher is characterized by a strong initial reaction in the first two weeks, followed by a diminishing effect in subsequent weeks (higher β_p values in weeks 1 and 2). By contrast, the β_s estimates indicate no discernible change in SITP expenditures after the redemption of a grocery voucher in week 1 or in subsequent weeks (weeks 2–5).

The right panel of Fig. 5 depicts shifts in weekly recharges to travel cards. In this graph, the point estimates and 95% CIs of the β_s (grocery voucher) are shown as dark triangles, while those of the β_p (transport voucher) are shown as dotted lines. Importantly, if participants were allocating part of the grocery voucher's monetary value to increase SITP expenditures, we would expect to observe a rise in travel card recharges. However, this does not occur, as the β_s estimates are consistently statistically indistinguishable from zero across all weeks following voucher redemption. Both panels of Fig. 5 therefore demonstrate that participants' SITP expenditures remain unaffected upon receiving a grocery voucher.

Wald tests regarding the differences between coefficients confirm the patterns discernible in Fig. 5. With respect to SITP expenditures, the effects of the grocery vouchers are not only indistinguishable from zero (as evidenced in the figure), but are also statistically different from the transport voucher coefficients for weeks 1 and 2 (p-value < 0.01) and week 3 (p-vallue: 0.02). Conversely, these effects are indistinguishable from those of transport vouchers during weeks 4 and 5 (p-value: 0.438, and p-value: 0.902, respectively). Regarding travel card recharges, grocery vouchers are statistically different from transport vouchers during weeks 1 and 2 (p-vallue < 0.01), while no statistically significant differences are observed for weeks 3, 4, and 5 (p-value: 0.737, p-value: 0.825, and p-value: 0.842, respectively).

Referring to Table A1 in the Supplementary Material, in the absence of MAB influence, we would expect the coefficients estimated for responses to both grocery and transport vouchers to be equivalent in terms of SITP expenditures. However, this is not the observed outcome. Instead, the coefficients for the transport voucher are significantly larger than those for the grocery voucher ($\beta_p > \beta_s = 0$; 0.59 vs. 0.016). This suggests that we are in one of the three scenarios outlined in Table A1, where MAB influence exists either in both categories (SITP and grocery expenditures) or in one of them.

6. Discussion

In this study, three distinct approaches are presented, each consistently providing evidence that aligns with the presence of Mental Accounting Bias (MAB) among public transport users induced by the use of vouchers. Notably, each methodological approach relies on different data sources to conduct its respective analysis. The first approach examines weekly variations in SITP usage, beginning from the moment the voucher is distributed. The second approach moves away from this week-by-week perspective and instead analyzes the average use of travel cards over the treatment period, incorporating income information. The third approach, also week-by-week, focuses on the grocery vouchers provided to control group participants.

The first approach reveals that participants take additional public transport trips when using the voucher rather than their regular income. The second approach demonstrates that this additional travel card usage, averaged over the treatment period, exceeds what would be expected if the voucher were perceived simply as an increase in the commuter's budget. The third approach shows that providing an equivalent amount of money in the form of a grocery voucher, representing additional income, does not alter public transport expenditures. The convergence of our three primary findings provides robust evidence that the observed increase in SITP travel is driven by Mental Accounting

[3] An alternative analysis using splines instead of polynomials for the income variable, provides nearly identical results

Bias (MAB). We further validate this hypothesis by evaluating it against several competing explanations.

First, one could argue that the spike in trips during the first two weeks reflects a standard income effect (increased resources) paired with a high discount rate (a preference for immediate consumption). However, such an explanation would typically predict a steady, week-by-week decline in extra trips as resources are smoothed over the period. It does not align with our data, which shows a sustained, higher level of expenditure during the first two weeks that disappears once the voucher is exhausted. Crucially, an income effect cannot explain why an economically equivalent grocery voucher produces no change in travel behavior. Because both vouchers are inframarginal, as they are valued well below typical monthly expenditures, a rational, utility-maximizing agent should treat them as perfectly fungible. The savings from a grocery voucher should 'liberate' pocket money to be spent on any category, including transit. The fact that the behavioral response is label-specific rather than income-specific directly contradicts the principle of fungibility and supports a category-based budgeting model.

Second, a salience-based explanation might suggest that the voucher simply reminds users of the value of mobility, temporarily shifting their preferences. This would explain why the effect is specific to the transit voucher. However, the salience model struggles to explain the temporal pattern of exhaustion. If the voucher fundamentally shifted a user's preference for mobility, we would expect that preference to persist throughout the month, funded by the cash 'freed up' by the voucher earlier in the period. Instead, we see a reversion to baseline when the voucher balance is depleted. Furthermore, the absence of learning effects, as we see identical patterns repeating from the first month to the fourth, suggests this is not a shift in the perceived utility of transit, but rather a rigid adherence to a transit-specific mental budget that feels 'flush' only when the specific voucher is present. Additionally, because the timing of the voucher was predictable, a salience or expectation-based model would predict 'pre-loading' effects or trips appearing before the voucher's arrival as the experiment progressed; we observe no such pattern.

Third, one might argue for a liquidity or cash-constraint explanation, where users lack the weekly liquid cash to reach their 'target' level of mobility. In this view, the voucher simply provides the liquidity needed to travel. However, if users were truly liquidity-constrained the grocery voucher would have provided identical relief by freeing up cash for transit use. The lack of cross-category reallocation supports the idea that the constraint is not financial, but psychological.

Finally, we consider the 'pain of paying' (Prelec & Loewenstein, 1998) as a potential mechanism. Under this framework, the trip increase occurs because the voucher renders transit 'psychologically free' at the point of use. The user avoids the immediate pain of parting with physical cash or, more specifically, the pain of reloading the card balance. When the voucher is depleted and users must once again use their own pocket money to add balance, the marginal psychological cost of a trip rises, suppressing demand. Evidence from the grocery voucher suggests either a similar process is occurring within that category, or there is another mechanism 'fencing' those resources out of transit expenditures. Regardless, the result is a violation of fungibility, as resources provided in voucher form increase expenditures specifically within the labeled category. We cannot definitively determine whether the 'pain of paying' is the primary driver, a contributing factor, or if the observed behavior stems exclusively from the cognitive categories mentioned in Section 2.2. Nonetheless, for policy purposes, these mechanisms are effectively indistinguishable: both imply that the form and label of a subsidy are more influential than its raw economic value.

One final, significant aspect of our findings is that they do not rely on unanticipated windfalls. Very commonly in the existing literature (e.g., Feldman, 2010; Hastings & Shapiro, 2013; Milkman & Beshears, 2009), MAB is identified using windfalls or price shocks. In our setting, participants were fully aware of the timing and value of the vouchers, particularly as the experiment moved into later waves. Our evidence supports the idea that MAB is a persistent feature of consumer budgeting that does not require the element of surprise to override the principle of fungibility, reinforcing the idea that MAB is an adequate explanation.

Classical economic theory posits that cash transfers to *tullave plus* travel cards are equivalent to cash transfers, implying that the transport voucher represents an income increase. However, this study suggests that participants behave as rationally bounded agents; they exhibit a behavioral bias, specifically a Mental Accounting Bias. This bias is induced by changes in the perceived size of a budget category and does not arise when fare prices change. Consequently, subsidies delivered as price reductions (fare discounts) versus vouchers have distinct effects on travel behavior and ridership. When subsidies are credited to travel cards (transport vouchers), individuals tend to use public transport more than they would if the same amount were not earmarked for that specific purpose.

6.1. Policy implications

Our findings underscore the importance of how public transport subsidies are delivered. Directly transferring funds to *tullave plus* travel cards reinforces the “public transport” mental spending account and encourages increased use of SITP. Thus, providing purpose-specific funds, such as transport vouchers, prompts individuals to spend more on SITP than they would if the funds were unrestricted. These findings have practical implications for transport authorities considering strategies to incentivize public transport use.

MAB can be leveraged to increase ridership by altering how subsidies are presented. For example, subsidies could be provided as a recurring lump sum (e.g., a monthly or weekly credit) rather than on a per-fare basis. This would encourage users to view the subsidy as a total transport budget rather than as individual fare discounts. Such an approach capitalizes on budget framing to stimulate greater use of the subsidy for transport. This experience can also serve as a valuable reference for other cities with similar pricing and technology policies, offering substantial potential for replication.

It is important to underscore that the estimated effect of the intervention is likely to be context-dependent, as it depends on both the delivery mechanism and the population reached. In Bogotá’s SITP, the voucher was loaded onto an existing personalized smart-card system. Because the stored value is visible and effectively restricted to SITP use, users can more easily treat the credit as a dedicated transport budget. This feature may encourage additional spending relative to an equivalent non-earmarked transfer. On the other hand, the study population consists of frequent users with personalized cards. For this group, repeated interactions with the card and regular recharge cycles may increase the salience of the SITP balance. Effects may therefore be smaller or more heterogeneous among infrequent users, who are less likely to maintain a stable mental budget for public transport. However, we cannot know this for sure, as infrequent users were not part of the experiment.

In cities without an integrated smart-card system or a comparable mechanism that ring-fences funds and keeps balances visible, the same mechanism will be difficult to implement. Leveraging the existing SITP payment system is therefore central to the program’s effectiveness. And maybe, among populations facing severe budget constraints, effects may increase if the voucher covers necessary trips (e.g., greater value). However, impacts may attenuate if structural barriers limit access to the subsidy. Note that under severe budget constraints the voucher can cease to be inframarginal and the extra trips (above normal use) that can be paid with the voucher cannot be consider to represent fungible resources. External validity thus depends on whether the program exists in the context of a salient public transport balance and whether it reaches users for whom fare affordability is the binding constraint.

7. Conclusions

Mental Accounting Bias offers individuals a simplified way to frame their expenditures but limits their ability to make optimal choices. The implications of this bias must be considered from a policy standpoint. In some cases, where the policy objective is to stimulate consumption, it may be intentionally induced. In most contexts where MAB has been documented (e.g., social programs, fuel consumption, or tax rebates), policy intervention appears limited. In these cases, MAB distorts decision-making, reducing overall utility. When intervention is possible, strategies generally aim to mitigate or eliminate the bias, often by manipulating information or reframing expenditure options.

Public transport presents a contrasting case: increased use is desirable because users often fail to account for its positive externalities, such as congestion reduction and improved air quality. This leads to demand falling below socially optimal levels. Given these dynamics, transport policies can be designed to harness MAB to promote greater public transport use. For example, an income tax that is fully refunded in the form of a transport voucher could influence users' choices, encouraging ridership without altering total budgets or restricting consumer options. Within this framework, equality considerations can be addressed by targeting subsidies to low-income users while maintaining the voucher component.

Emerging technologies such as smart travel cards, bank cards, and mobile apps offer opportunities to revisit pricing and subsidy design. In particular, demand-side subsidies allow for significant innovation in delivery mechanisms. While much of the discussion has focused on targeting efficiency, this study highlights the critical importance of subsidy format, vouchers versus fare discounts. Our findings show that recognizing and accounting for cognitive biases among public transport users is essential for designing more effective instruments to stimulate ridership. By documenting the presence of MAB in a developing-country context, this study not only provides initial empirical evidence of its effect on public transport but also establishes proof of concept for a mechanism policymakers can harness.

CRediT authorship contribution statement

Santiago Gómez Cardona: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Luis A. Guzman:** Writing – review & editing, Writing – original draft, Project administration, Funding acquisition, Conceptualization. **Jorge Luis Ochoa Rincón:** Methodology, Data curation.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.socec.2026.102595.

Data availability

Data will be made available on request.

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