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IN-KIND TRANSFERS IN BRAZIL: HOUSEHOLD CONSUMPTION AND WELFARE EFFECTS

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Abstract

The Worker Food Program (Programa de Alimentação do Trabalhador - PAT) creates tax incentives for firms to provide more than 20 million Brazilian workers with in-kind transfers. They are usually distortive compared to cash transfers, but this is not clear when the latter, when paid by the employer, are subject to payroll taxes like in Brazil. Using propensity score analysis, we find evidence that the PAT increases poor households' food consumption between 15.7% and 25.0% compared to cash transfers. This result, however, may not be improving workers' nutrition, as sought by the program.

Keywords: in-kind transfers vs cash transfers, *Programa de Alimentação do Trabalhador* (PAT), propensity score analysis.
JEL codes: D11, D12, I38.

Resumo

O Programa de Alimentação do Trabalhador (PAT) cria incentivos fiscais para firmas fornecerem transferências em produto para mais de 20 milhões de trabalhadores brasileiros. Essas transferências geralmente são distorcivas quando comparadas a uma transferência monetária, mas isso não é tão claro quando esta última é paga pelo empregador, ficando sujeita à cobrança de impostos sobre a folha de pagamento. Usando escore de propensão, encontramos evidências que famílias pobres beneficiadas pelo PAT consomem de 15,7% a 25,0% mais comida do que se recebessem transferências monetárias. Entretanto, não há evidências que esse resultado esteja levando o programa a atingir seu objetivo de melhorar o estado nutricional dos trabalhadores.

Palavras-chave: transferências em produto e transferências em dinheiro, Programa de Alimentação do Trabalhador (PAT), análise via escore de propensão.
Códigos JEL: D11, D12, I38.

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1 Introduction

"In-kind transfers" are give-aways that constrain consumers' acquisition possibilities. In poor countries, they are typically food transfers, both of physical items or through vouchers and coupons. Economic theory shows there are possible distortions associated with food transfers compared to cash transfers, such as overfeeding [1].

This work sheds light on a Brazilian food transfer scheme called the Worker Food Program (*Programa de Alimentação do Trabalhador - PAT*), which benefits almost 20 million workers and around 38% of the formal workforce (Mazzon 2016). The federal government grants tax breaks for firms that provide food benefits to employees. Abatements are usually small, limited to 4% of companies' total income tax.

The program was created in 1976 after the Food and Agriculture Organization (FAO) data showed that many Brazilian workers were living with minimum acceptable calorie intake (Silva 1998). In this sense, the policy was designed to improve nutritional intake of workers. Government's tax break for 2008 is estimated between US$6.8 (R$16.1) and US$13.6 (R$32.3) million, but the program was never examined from a theoretical and empirical economic perspective using impact evaluation techniques.

Since the PAT is inserted in the labor market context, in-kind transfers are not taxed. In this case, traditional welfare superiority of cash transfers [2] is no longer obvious, because they are subject to tax deductions. Considering this specificity, we test whether the food allowance distorts consumption by comparing it with a cash transfer and calculate both effects on households' welfare. Although the PAT also allows implementation through self-management and outsourcing, our analysis is focused on food vouchers and *cestas básicas* due to a limitation of our database, which only provides data about these types of benefits.

We use propensity score analysis to control the selection bias by using the program's characteristics as observable variables. The observables that influence the program's participation are mainly regional, sectoral and socioeconomic variables. We use data from the last Brazilian Household Budget Survey (POF 2008-2009)[3]. We show that this program only distorts poor households' consumption while rich ones are not affected.

We also calculate the deadweight loss (DWL) [4] of the policy to be between US$2.8 (R$6.5) and US$3.8 (R$8.9) million, which represents 20% to 55% of government tax breaks. Further estimates show no relation between the increased food consumption and the intake of healthier food. That means the program may not be fulfilling its objectives of improved nourishment.

We contribute to the literature in many ways. First, we present empirical evidence showing the sub-optimal result for food vouchers, when compared with cash transfers (after tax deductions). There is no consensus in the empirical literature about the distortion of in-kind transfers. Hoynes & Schanzenbach (2009) observed that vouchers lead to a small increase in food

[1] Hoynes & Schanzenbach (2009) and Ninno & Dorosh (2003).

[2] Under cash transfers, consumers face a greater set of choices than under in-kind transfers.

[3] The microdata of the Brazilian Household Budget Survey of 2017-2018 was available in April 2020, after the submission of this paper.

[4] Deadweight losses were calculated as the difference in the amount of food consumed by households receiving cash transfers and in-kind transfers, considering fixed prices.

consumption for participants of the Supplemental Nutrition Assistance Program (SNAP) in the United States. Likewise, Ninno & Dorosh (2003) reported an increase in wheat consumption for individuals in Bangladesh provided with in-kind transfers in comparison with cash transfers. Cunha (2014) and Skoufias et al. (2008), on the other hand, compared in-kind and cash transfers to the rural poor in Mexico and concluded there is no differential effect on consumption.

Second, we present the analysis of the program from an impact evaluation perspective. So far, most program assessment has consisted of analyzing firms' specific initiatives in terms of nutritional adequacy [5]. Hoffmann & Santiago (2017) tried a different approach, using Household Budget Survey data to run a linear regression model to estimate program correlation with income and possible effects on workers' body mass index (BMI). Mazzon (2016) provided an overview of the PAT along with evaluations using both qualitative research and a well performed input-output analysis. In this paper we contribute to this literature by evaluating the program impact on consumption and on welfare to, therefore, present a cost-benefit analysis.

The paper is divided into 6 sections, including this introduction. Section 2 establishes the conceptual basis of in-kind transfer analysis and how it is applied to the PAT. Section 3 explains the program assignment and identification strategy used to eliminate bias selection. Section 4 details the dataset and reports relevant descriptive statistics. Section 5 presents the estimation results in terms of food consumption and its composition. Lastly, Section 6 summarizes our findings, proposes policy measures and suggests future research avenues. There is also an Appendix which makes welfare considerations.

2 In-kind transfers

This section presents the theoretical framework of our work and is divided in two subsections. The first subsection presents the differences between cash transfers and in-kind transfers from the consumer point of view. We show cash transfers are optimal in terms of utility and that in-kind transfers distort consumer choices. In the second subsection we show how this framework can be used to analyze the Worker Food Program (PAT) in Brazil and that cash transfers are not necessarily better than in-kind transfers in this specific context.

2.1 In-kind versus cash transfers

"In-kind transfer" is a general expression attributed to give-aways that restrict the group of products that may be acquired by consumers, such as food or non-food items, through vouchers, coupons or debit cards, among others. Alternatively, cash transfers allow people to buy whatever fits their budget constraint. Thus, many researchers are interested in comparing their effects, especially on food consumption. Engel's law and consumer theory have contributed to this literature (Gentilini 2007).

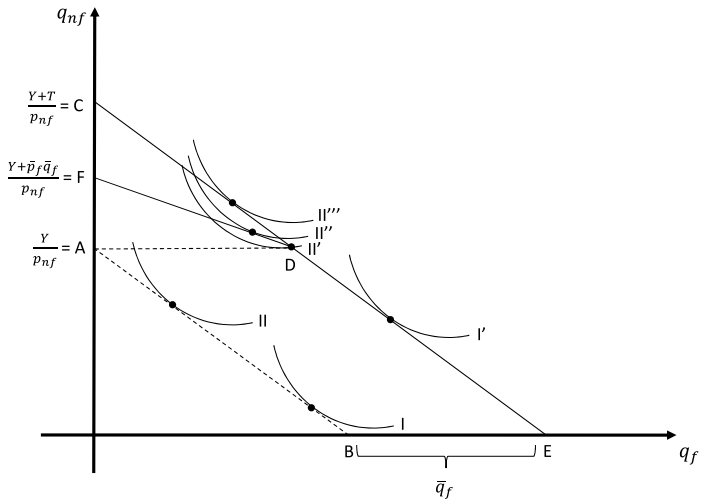
Engel's law asserts that as income rises, the proportion spent on food items decreases, even if actual expenditure on food increases. In other words, in-

[5] Burlandy & Anjos (2001), Geraldo et al. (2008), Moura (1986), Savio et al. (2005) and Veloso & Santana (2002).

come elasticity of food lies between zero and one, being higher for poorer than richer households. Thus, cash transfers may be useful to increase low-income households' food consumption. One example is Bolsa Família, a Brazilian conditional cash transfer program that impacts approximately 14 million households or 57 million individuals (Campello & Neri 2013).

Following Cunha (2014), suppose consumers demand food (q_f) and other goods (or non-food items, q_{nf}) and they maximize a utility function $U(q_f, q_{nf})$ that is strictly increasing and concave in both arguments. Let p_f and p_{nf} be prices of those goods. The budget constraint is $p_f q_f + p_{nf} q_{nf} \leq Y$, where Y is income. Line segment $\overline{AB}$ in Figure 1 represents this restriction.

Figure 1: Impacts of in-kind and cash transfers on consumption



Source: Based on Cunha (2014), own elaboration.

Assume the existence of a cash transfer with value T which shift the budget constraint to $\overline{CE}$ and an in-kind transfer of same value $\bar{q}_f = \frac{T}{p_f}$ which creates a kink [6], depending on food resale price, $\bar{p}_f$:

$$p_f q_f + p_{nf} q_{nf} \leq \begin{cases} Y + \bar{p}_f \bar{q}_f, & if \quad q_f \leq \bar{q}_f \\ Y + p_f \bar{q}_f = Y + T, & if \quad q_f > \bar{q}_f \end{cases} \tag{1}$$

When reselling is allowed at market price ($\bar{p}_f = p_f$) then $p_f q_f + p_{nf} q_{nf} \leq Y + T$ (restriction $\overline{CE}$) which is equivalent to a cash transfer of value T. If

[6] A kink is created where $q = \bar{q}_f$, which has size $\overline{AD}$.

negotiation occurs at a fraction of full price ($\bar{p}_f \in (0, p_f)$), then $p_f q_f + p_{nf} q_{nf} \leq Y + \bar{p}_f \bar{q}_f$ (restriction $\overline{FDE}$). Finally, if trade is not permitted ($\bar{p}_f = 0$), then the restriction of interest is $\overline{ADE}$ [7].

The theoretical framework above can be used to study the Worker Food Program in Brazil, which provides in-kind transfers in the form of food for Brazilian workers. The objective of the program is to provide nutritionally adequate meals to workers in order to improve their productivity.

The PAT rules do not allow beneficiaries to resell benefits and then we should be facing the case that no benefit is traded (restriction $\overline{ADE}$). However, we are aware that there are illegal traders who charge consumers to exchange food vouchers for cash, but the exact proportion of benefits informally exchanged is unknown [8]. This beneficiaries actually face restriction $\overline{FDE}$. Below, we show that the food provided by the PAT actually distorts consumer choices, making them consume more food than they would if they received a cash transfer of the same value.

Based on Figure 1, cash transfers weakly dominate in-kind transfers since consumers face a greater set of choices. An Exception occurs when $\bar{p}_f = p_f$, since consumers face identical budget constraints. Indifference curves I and II represent two types of agents, whose choices are evaluated in order to assess possible distortions associated with in-kind transfers.

For consumer II, $\bar{q}_f$ is *extra-marginal* because it provides a greater amount of food than he would have chosen under a cash transfer. Note that under cash transfer, consumer II chooses an optimal quantity associated with II''', which is less than $\bar{q}_f$. For consumer I, the in-kind transfer is *infra-marginal* since under cash transfer he demands more food (optimal quantity associated with I') compared to $\bar{q}_f$.

That is to say, only *extra-marginal* transfers distort consumer choices. Individual II receives more food than desired (optimal quantities associated with II' or II'') when his best interest is achieved at II'''. Consumer I, on the other hand, is indifferent between the two transfer schemes. The distortion caused by *extra-marginal* transfers is measured as:

$$EM_f(\bar{q}_f) = \begin{cases} \bar{q}_f - q_f^{Cash}, & if \quad q_f^{Cash} < \bar{q}_f \\ 0, & otherwise \end{cases} \tag{2}$$

An in-kind transfer is classified as *binding* when the consumer demands more food than was transferred. That is the case of an individual I who demands the optimal quantity associated with I' but only receives $\bar{q}_f$. For consumer II, the transfer is considered *non-binding* since demands associated with II'' and II''' are both smaller than $\bar{q}_f$. In this case, only *non-binding* transfers distort consumer choices and can be measured by:

$$NB_f(\bar{q}_f) = \begin{cases} \bar{q}_f - q_f^{In-kind}, & if \quad q_f^{In-kind} < \bar{q}_f \\ 0, & otherwise \end{cases} \tag{3}$$

Note the main difference between these concepts is the comparison base. When evaluating an in-kind transfer in terms of extra-marginality, $\bar{q}_f$ is com-

[7] This is the same as giving someone a prepared meal to be immediately consumed.

[8] For anecdotal evidence of this fact, see Romani (2019).

pared with consumer choice under cash transfer. However, to define *binding* transfers, comparison occurs with choice under in-kind transfer.

Hence, the total distortion associated with an in-kind transfer of size $\bar{q}_f$ can be seen as the amount consumed above the case of a cash transfer. In terms of the previous definitions:

$$D_f(\bar{q}_f) = EM_f(\bar{q}_f) - NB_f(\bar{q}_f) = q_f^{In-kind} - q_f^{Cash} \tag{4}$$

Intuitively, $D_f(\bar{q}_f)$ evaluates food quantities received above the cash transfer optimum (which is bad for the consumer), but discounted from non-binding transfers, which improve his welfare since he receives an extra amount of food. In other words, extra-marginal transfers move consumers away from optimality but this effect is partially compensated by a surplus in provision, which actually improves well-being.

However, it is hard to empirically measure $D_f(\bar{q}_f)$ since individuals cannot be observed under both transfer schemes. According to Cunha (2014), distorting effects of in-kind transfers and their magnitude have fundamental importance for policymakers. A lack of empirical evidence exists, since counterfactual behavior can never be observed. In our case, propensity score matching will be used to address the problem of estimating eventual PAT distortions in terms of food consumption. Further details are provided in Section 3.

From the discussion above, cash transfers weakly dominate in-kind since there may be a distortion associated with the latter. In the next section we use this framework to analyze potential distortions associated with, the Worker Food Program (*Programa de Alimentação do Trabalhador* - PAT).

2.2 Brazilian program: PAT

The Worker Food Program (PAT) is a voluntary [9] Brazilian food program created in 1976 whose objective is to provide nutritionally adequate meals, especially for low income workers, to increase their productivity. In 2016 the program reached more than 20 million workers and approximately 38% of the formal labor force in the country (Mazzon 2016). The federal government grants tax breaks to firms that provide food benefits to their employees on a monthly basis. This is beneficial for the government because it grants additional purchasing power to workers that is not included in the calculation of social benefits after retirement. For workers and companies, the main advantage of such benefits is that regular payroll and income taxes do not apply.

Benefits may be supplied in two different types: self-management and/or outsourcing. Self-management applies to firms which provide cooked or non-cooked meals for their workers. It may involve *in natura* food supply, staple food baskets, as well as in-house restaurants. Outsourcing occurs when companies delegate this task to a specialized firm and/or provide debit cards (vouchers) or coupons restricted to food purchase, at restaurants or markets. Companies are free to provide benefits in more than one modality. For example, a firm can have an in-house canteen and also provide workers with meal vouchers.

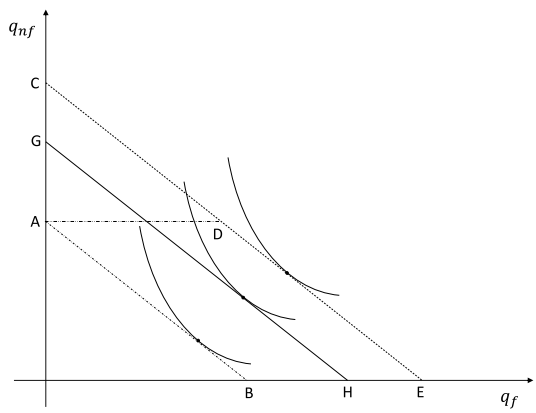
[9] Firms choose whether or not to participate.

In order to maintain eligibility, firms must keep all employees' situation strictly inside the law. Any sign of violation of labor rights results in total removal of the tax benefits.

We now show the superiority of cash transfers are no longer obvious in the PAT context. In the labor market, any cash transfers are considered salary and are taxed accordingly, resulting in a discounted transfer $T' = (1-\tau)T$. Discount factors (τ) are payroll taxes applied on labor income in Brazil. For each additional R$1.00 payment companies spend, on average, another R$1.48 and workers receive minus 8.0% to 22.2%, depending on income level. This changes traditional analysis so that it is not obvious that T' is preferable to an equivalent in-kind transfer.

To see this, consider the following consumer preferences represented by the indifference curves in Figures 2, 3 and 4. $\overline{AB}$, $\overline{CE}$ and $\overline{ADE}$ represent same budget restrictions of Figure 1. The only difference among figures is restriction $\overline{GH}$, which represents a monetary transfer $T' = (1-\tau)T < T$. Such transfer may be higher (Figure 3) or lower (Figures 2 and 4) than an in-kind transfer, depending on individuals' preferences.

Figure 2: $q(Y+T,\mathbf{p}) \sim q(Y+p_f\bar{q}_f,\mathbf{p}) \succ q(Y+T',\mathbf{p})$



In other words, considering firms would not increase their spending when deciding to provide in-kind transfers or cash transfers [10], it is not trivial to infer whether or not their workers would be better off in terms of consumption.

For simplification purposes, our analysis sticks to the case where benefits are not traded (ADE restriction). As mentioned in former subsection, the PAT rules do not allow beneficiaries to resell benefits, but it is known that illegal traders buy the vouchers at a discount, although there are legal restrictions to this practice.

We evaluate the potential distortions in food consumption (in terms of equation (4)) for program beneficiaries. If we conclude that PAT transfers are not distortional compared to a discounted cash transfer, it means the program

[10] Or they could shift consumers' budget constraint back to an equal valued cash transfer.

Figure 3: $q(Y+T,\mathbf{p}) \succ q(Y+T',\mathbf{p}) \succ q(Y+p_f\bar{q}_f,\mathbf{p})$

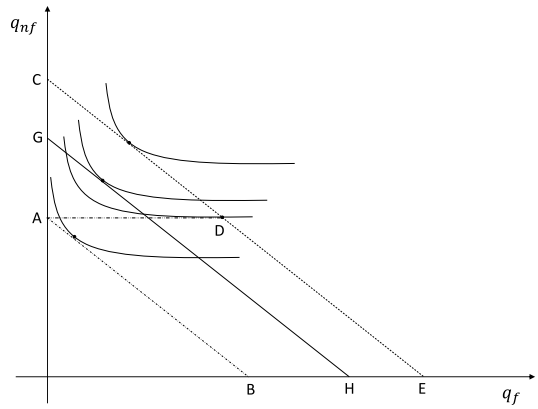
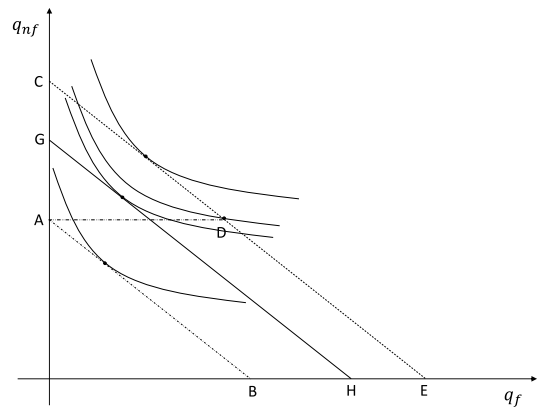


Figure 4: $q(Y+T,\mathbf{p}) \succ q(Y+p_f\bar{q}_f,\mathbf{p}) \succ q(Y+T',\mathbf{p})$



reaches a first-best situation, equalizing full cash transfers (Figure 2). Now, in case the program actually distorts food consumption, the scenario presents two options: (i) cash transfers may be preferable (Figure 3); or (ii) in-kind transfers may be preferable (Figure 4). These are both second-best situations where the results ultimately depend on consumer preferences.

The next section discusses the empirical strategy to estimate possible distortions in Brazilian provision of in-kind transfers for different types of consumers.

3 Empirical Strategy

We cannot observe the difference in food consumption of a unit i when receiving in-kind transfers from the PAT ($D_i = 1$) or when receiving cash transfer ($D_i = 0$) benefits ($q^f_{D_i=1} - q^f_{D_i=0}$) to infer causality. In this sense, we propose estimating a counterfactual for observed units that receive PAT benefits. The counterfactual would consider the unit that receives additional cash instead of an in-kind transfer (equation (4)). Once units are balanced, and the selection of the groups is controlled for, we can compute the average impact of the PAT, or the Average Treatment Effect on Treated (ATT):

$$E[q^f_{1i} - q^f_{0i}|D_i = 1] = E(q^f_{1i}|D_i = 1) - E(q^f_{0i}|D_i = 1) \tag{5}$$

Treated units are those households where at least one individual, of age between 16 and 65 and not working in the public sector, receives food vouchers or *cestas básicas* [11]. Accordingly, non-beneficiaries (the control group) are formal employees of working age in the private sector who do not receive any type of food assistance.

Understanding benefit assignment is crucial for eliminating potential bias selection. First, joining the PAT is voluntary, but there are three main reasons to participate: (i) tax incentives; (ii) labor union pressure; and (iii) desire to raise workers' productivity. Second, benefits can influence choices regarding job offers, leading those who prefer the food allowance to only accept job offers of companies that participate. Such mechanisms are further discussed in Section 5.

Therefore, PAT assignment suggests regional, sectoral and socioeconomic variables are related to participation. Therefore, a vector X of covariates intended to eliminate selection bias should consider such factors. Once X is adequately specified, equation (5) may be rewritten as:

$$E[q^f_{1i} - q^f_{0i}|D_i = 1, X] = E(q^f_{1i}|D_i = 1, X) - E(q^f_{0i}|D_i = 1, X) \tag{6}$$

In other words, even if q^f_{1i} and q^f_{0i} are correlated with D_i, they become independent given the observables that explain participation X_i, or $q^f_{1i}, q^f_{0i} \perp\!\!\!\perp D_i|X_i, \forall i$. As shown by Rosenbaum & Rubin (1983), X can be merged into a propensity score, $P(X)$, and equation (6) remains valid with the following change:

[11] A *cesta básica* is a food basket containing staple food items such as rice, beans, milk, flour, oil, coffee and sugar, among others. Quantities in the basket can vary by company and region where it is distributed, and items may be substituted with similar ones.

$$E[q_{1i}^f - q_{0i}^f | D_i = 1, P(X)] = E(q_{1i}^f | D_i = 1, P(X)) - E(q_{0i}^f | D_i = 1, P(X)) \quad (7)$$

Equation (7) is valid under the common support or overlap assumption (CSA), which states that for each $P(X)$, there may be observations in both the treatment and control groups.

However, as we mention in the next section, the POF do not provide food consumption at an individual level, just at household level. So, from this point on we use households as our unit of analysis. Possible consequences of using households instead of individuals are further discussed in the text and two robustness checks are presented to reinforce the validity of our results.

Estimating equation (4) using Propensity Score Matching (PSM), as suggested by Rubin (1974), Rosenbaum & Rubin (1983) and Heckman et al. (1998), does not require a specific functional form for the food demand equation (see the Appendix), so it adapts better to possible nonlinearities involved in estimating the benefit and food consumption relation. Moreover, assistance specificities regarding labor market and its use mostly throughout working hours demand strong internal validity, which is achieved with PSM in comparison to other methods. Spatial program concentration and labor union influence, which mainly act in specific economic sectors, create a unique market configuration where program assignment needs more degrees of freedom to be modeled. Estimates are considered causal effects of the PAT if X contains all relevant observables, balanced for treatment and control groups after matching, and when common support holds.

On this topic, Heckman et al. (1998) and Bryson et al. (2002) discussed a tradeoff when using the propensity score, since more covariates mean higher chances of violating the common support hypothesis. In other words, including independent variables reduces bias but increases estimator variance. Such tradeoff is illustrated by different types of matching. On the one hand, nearest neighbor matching matches each beneficiary with the closest (measured by propensity score) control, and others are discarded. In this case, bias is minimized since each treated unit will be compared with only one control (Dehejia & Wahba 1999). At the same time, estimator variance increases since parameters will be calculated based on a smaller number of combinations (variance continuously diminishes even if new combinations present low quality, so that for variance what matters is the quantity, not the quality of matches) (Smith & Todd 2005). On the other hand, considering kernel based matching, a unit receives a weight between 0 and 1 if they are similar to treatment, while in neighbor matching this weight is always 1. The kernel approach increases number of controls while estimator variance diminishes. However, bias increase since the quality of matching might get worse (Smith & Todd 2005). Empirically, one must be aware that robustness is important when choosing covariates. In this sense, our results are robust to other specifications. About matching algorithms, King & Nielsen (2015) discussed how propensity score matching can increase imbalance, model dependence and bias, approximating a completely randomized experiment rather than a fully blocked experiment. They concluded that Mahalanobis Distance Matching (MDM) is less susceptible to the latter problems. For this reason, ATT was calculated with MDM in all specifications.

Since propensity score matching simulates an experiment at X (or $P(X)$), it therefore allows good estimates of the effects when there is selection on

observed variables (X). Intuitively, it is possible to find for treated unit, a similar non treated unit (based on characteristics of X) such that they can be considered the same before and after treatment, respectively. Therefore, we attribute differences between the two groups to the treatment effect (Heckman et al. 1998).

Finally, an underlying hypothesis of this work is that beneficiaries' additional food consumption does not influence market prices. Increased spending on food would shift demand outwards, pressure prices upwards, and thus reduce demand of non participants, resulting in distortion overestimation. This is a limitation of this study, since our current database only considers the demand size. Since many sectors of the food industry are competitive and there aren't many entry barriers, we believe that supply also shifts outwards in the presence of the PAT. Examination of this hypothesis is outside the scope of this paper and can be tested in future works.

In this sense, according to previous discussion (Section 2.1), possible distortions associated with in-kind transfers are measured by differences in food consumption:

$$D_f(\bar{q}_f) = q_f^{In-kind} - q_f^{Cash} \tag{8}$$

In which $D_f(\bar{q}_f)$ represents household food consumption when receiving an in-kind transfer minus demand when under cash transfer. Estimating Equation (8) involves a counterfactual problem, addressed by propensity score analysis. Using income for matching is vital due to its relevance in food consumption (Engel's Law). Those who do not receive any benefits but received an income increment equal to the benefit value are used to estimate $\hat{q}_f^{cash}$. Estimations are performed in two ways:

1. First, we consider equality between income (Y) for non-treated and income + benefit value (T) for treated workers. This version simulates decisions firms traditionally face, whether provide \$K in cash or an equivalent value in-kind:

$$Y_{D=0} = Y_{D=1} + T \Leftrightarrow T = \Delta Y$$

2. Second, we adapt the setup to the Brazilian labor market reality. Alternatively to $\$K$ in cash, beneficiary workers are provided with $\$K(1-\tau\%)$, where $\tau\%$ are payroll taxes:

$$Y_{D=0} = Y_{D=1} + T[1-\tau\%] \Leftrightarrow T = \frac{\Delta Y}{[1-\tau\%]}$$

After assessing how general food consumption of households respond to in-kind transfers, we propose a further exercise to analyze possible impacts on their nutritional status. Since the PAT's objective is to provide nutritionally adequate meals for workers, we separate food consumption into seven categories: cereals and pasta; fruits and vegetables; sugar and candies; proteins; non-alcoholic beverages; alcoholic beverages; and manufactured foods.

Our goal is to provide insights to understand if consumers qualitatively change their food consumption when receiving benefits. Still, we are aware that a complete analysis should consider vitamins, macro and micro nutrients intakes, by converting final consumption to nutrients or applying a procedure similar to Pereda & Alves (2012).

Finally, in the Appendix, we run a welfare analysis based on our results. It considers a demand system analysis framework to estimate possible distortions related to household choices when receiving benefits from the PAT.

4 Dataset

The Household Budget Survey[12] provides income, expenses and sociodemographic information on more than 57,000 Brazilian households. It is conducted by the Brazilian Institute of Geography and Statistics (IBGE), the federal census bureau. We use the survey conducted in 2008-09. All monetary values were normalized to January 15^{th}, 2009. The unit of analysis is household and attention was focused on demographic, consumption and income information through questionnaires 1, 2 and 3, and 5, respectively. Since the POF is a sample survey, all results in the paper consider sample weights in the calculation.

All consumption of food items consumed inside and outside the house were converted to kilograms by the IBGE. Non-food items were measured by units but only for the sake of a demand system analysis performed in the Appendix. Expenses were annualized but are presented monthly when convenient and all values are also presented in dollars considering an exchange rate of R$/US$ 2.38, as of January 15^{th}, 2009.

From the total expanded sample of 57,814,083 households, 7,926,638 (13.7%) had at least one member receiving food vouchers or *cestas básicas*, which represents around 9.9 million workers. Ideally, analysis should have been performed using individuals, but the POF only provide food consumption data at household level. For 2008, official data from the Ministry of Labor reported the program had 13.4 million beneficiaries (considering all modalities) and around 10 million considering only food vouchers and *cestas básicas*, which is compatible with our sample. Monthly average net benefit is US$69.60 (R$165.60), and the benefit distribution is positively skewed (Figure 5).

Treated units are those households where at least one individual, of age between 16 and 65 and not working in the public sector, receives food vouchers or *cestas básicas* [13]. In other words, although the PAT allow implementation through self-management and outsourcing, our database only allows us to evaluate the latter, namely vouchers and food baskets. Furthermore, the majority (~95%) of the households in our database received only vouchers as benefits and therefore our conclusions should be interpreted as the results of households receiving such benefits. Accordingly, non-beneficiaries present equal characteristics but do not receive benefits.

The characteristics of the head beneficiary of the households are: 70.85% are male, 54.89% Caucasian, 73.10% married, 48.17% with private health insurance and most literate. Compared to eligible households, program households present 0.06 more members on average, heads are 1.11 years younger, more educated (2.21 more years of schooling) and have a higher income (annual: US$797.2 and per capita: US$243.5 - Table 1). Except for gender, all differences are statistically significant at the 1% level.

[12] *Pesquisa de Orçamentos Familiares* (POF).

[13] A *cesta básica* is a food basket containing staple food items such as rice, beans, milk, flour, oil, coffee and sugar, among others. Quantities in the basket can vary by company and region where it is distributed, and items may be substituted with similar ones.

From an economic activity perspective, the professional distribution of household heads is concentrated in services and industry, which account for 52% of them (Table 2). This evidence, along with income differences among groups (Figure 6), suggests that socioeconomic and sectoral factors are relevant to explain program assignment. Moreover, as mentioned in the previous discussion, income is crucial for analysis, and receives special attention in Section 5, which presents the results.

Figure 5: Household monthly average net benefit (2009 US$)

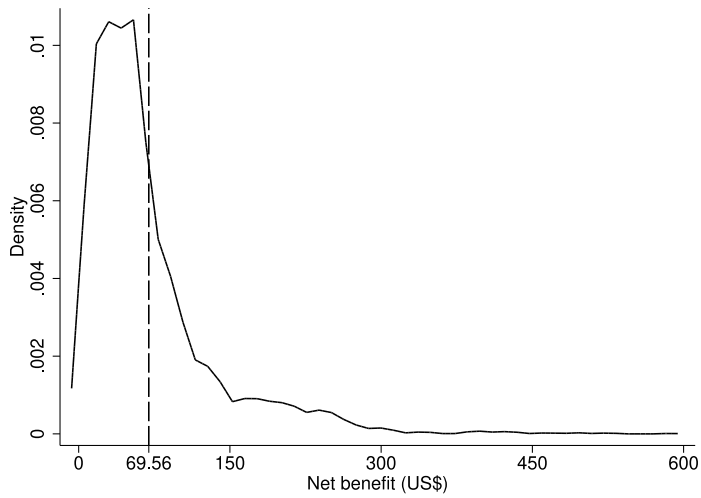


Table 1: Household heads - differences between beneficiaries (B) and non-beneficiaries (NB)

Characteristics	B mean	NB mean	Difference
# dwellers	3.46	3.39	0.06***
Man (%)	70.85	70.50	0.35
Caucasian (%)	54.89	46.09	8.80***
Married (%)	73.10	68.74	4.36***
Literate (%)	97.55	88.34	9.21***
Health insurance (%)	48.17	22.99	25.18***
Age (years)	41.98	43.09	-1.11***
Education (years)	9.15	6.94	2.21***
Annual income (US$)	1,775.88	978.66	797.22***
Annual per capita income (US$)	606.84	363.33	243.5***

*p<0.1; **p<0.05; ***p<0.01. Table presents beneficiary (B) and non-beneficiary (NB) mean samples for selected variables. Traditional mean difference testing was applied to verify differences among groups. Where (%), difference is in percentage points. Otherwise, it follows variable measures.

Table 2: Percentage of beneficiaries and non-beneficiaries by economic activity

Economic activity	Beneficiaries	Non-Beneficiaries
Services	27%	20%
Industry	25%	16%
Commerce	16%	19%
Education and Health	11%	8%
Construction	10%	12%
Transportation	8%	6%
Agriculture	2%	19%

Table shows percentage of beneficiaries and non-beneficiaries by economic sector. 27% of beneficiaries work in the service sector, while only 20% of non-beneficiaries participate in this sector. Other sectors present a similar tendency, showing their importance in explaining benefit provision.

Figure 6: Annual income distribution of beneficiary and non-beneficiary households (2009 US$)

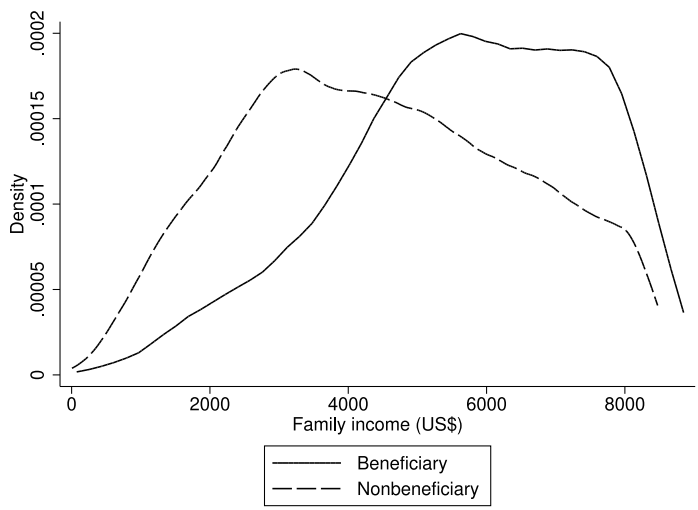
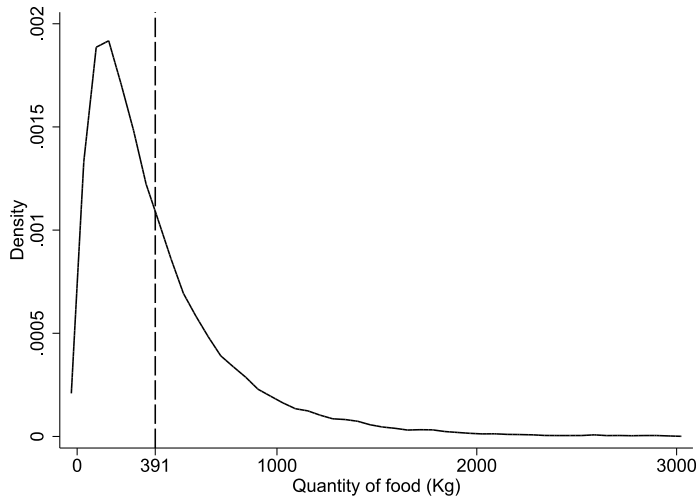
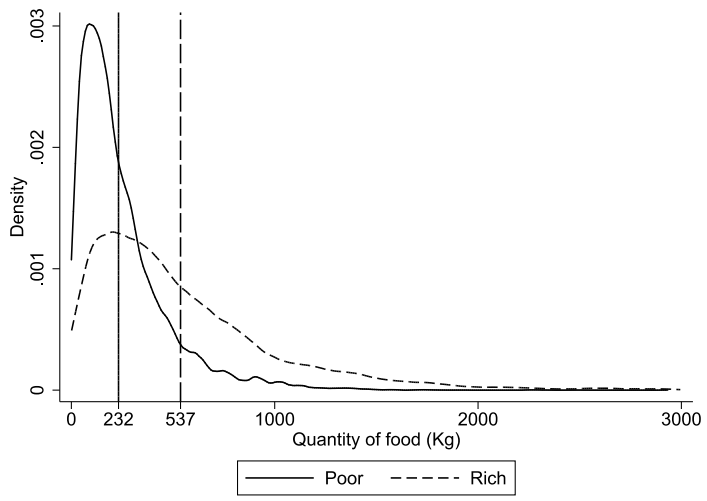


Figure 7: Annual quantity of food in Kg consumed by households



Notes: figure shows annual household food consumption in Kg. Around 90% of households consume less than 900 Kg of food but a few consume almost 6,000 Kg, making the distribution positively skewed. Average food consumption (391 Kg) is highlighted.

Figure 8: Annual quantity of food in Kg consumed by rich and poor households



Notes: Figure shows annual rich and poor household food consumption in Kg. Rich households consume 537 Kg of food on average while poor households consume 232 Kg. Rich households are defined as the top 25% of per capita income distribution and poor households the bottom 25%.

5 Results

This results section is divided in two subsections. The first presents our main results, or the effects of receiving benefits in household's food consumption. The second further divides food consumption into seven minor categories and discusses if there are any changes in composition.

5.1 Main results

In order to eliminate potential bias selection, as discussed in Section 3, we argue that (i) tax incentives, (ii) labor union pressure, and (iii) desire to raise labor productivity are relevant when defining the vector X of covariates to match treatment and control groups.

As for tax incentives, the PAT's rules establish that participating companies can deduct up to 4% from income tax. However, eligibility is restricted to those opting for the *lucro real* taxation regime, which only applies to firms whose revenues exceed US$32.8 (R$78.0) million a year. This fact limits eligibility to big companies, mainly usually located in the Southeast and South regions. That is, spatial location correlates with program assignment.

Regarding labor unions, DIEESE - Departamento Intersindical de Estatísticas e Estudos Socioeconômicos (2013) presents data on 197 collective bargaining agreements for all sectors signed between 2011 and 2012. Around 60% (120 agreements) contained clauses mentioning food benefits. Union strength is reflected in Table 2, which shows the services, industry and commerce sectors, known for strong union, concentrate most of PAT beneficiaries, a pattern not shared by non-beneficiaries. In other words, distribution across sectors changes for PAT participants.

When it comes to labor productivity, Dasgupta & Ray (1986), Popkin (1978) and Strauss (1986) provide evidence that nutrition positively affects labor outputs, mainly for manual labor. Firms in the industry and construction sectors are aware of such results, and facilitate employees' access to adequate nutrition through PAT.

Finally, food assistance may drive decisions towards accepting specific job offers. Choosing between one or another depends on consumer preferences (Figures 3 and 4) and selection occurs if those who value food more are able to choose jobs which provide benefits. Typically, low-income workers tend to care more about food incentives, so their propensity to accept meal assisted jobs is higher. However, those employees have less bargaining power when seeking work, so it is not true they will always face this choice. Consumer tastes, along with bargaining power, may be translated in terms of socioeconomic variables such as income and education.

Therefore, considering previous discussions we calculated a Mahalanobis matching using regional, sectoral and socioeconomic covariates. Only formal workers [14] were used for analysis since formal employment is a requirement for program eligibility. Table 3 presents results of our preferred specification using simple regression bias correction, following Abadie & Imbens (2002).

Covariate balance as well as estimates without bias correction (for robustness purposes) were analyzed. Our estimates suggest households receiving benefits consume 4.1% to 5.7% more food compared to the case they receive

[14] Workers who payed income tax were considered formal.

Table 3: Estimated distortion effects of PAT benefits on food consumption (in kilograms) with bias correction

	(1) Full sample	(2) Poor	(3) Rich	(4) Full Sample	(5) Poor	(6) Rich
Benefit	11.23*	30.40**	14.33	14.95**	30.40**	28.34*
	(6.74)	(14.67)	(16.36)	(6.72)	(13.93)	(16.73)
Observations	18,235	3,648	3,625	18,235	3,647	3,625
Controls	yes	yes	yes	yes	yes	yes
Income	1	1	1	2	2	2

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. The table presents effects of treatment on food consumption in kilograms. Income 1: $Y_{D=0} = Y_{D=1} + T \Leftrightarrow T = \Delta Y$. Income 2: $Y_{D=0} = Y_{D=1} + T[1 - \tau\%] \Leftrightarrow T = \frac{\Delta Y}{[1-\tau\%]}$. Besides income, other controls are # of household members, education, race, transportation, services, South and North dummies. Poor and Rich samples represent, respectively, the bottom and top 20 percent of income distribution.

a comparable amount in cash. This difference is higher for poor households, which tend to consume between 13.0% to 21.2% more food [15]. In this sense, we can say the PAT leads households to buy more food than they would in the absence of the program. Benefits would still be distortive even when compared to cash transfers after deducting taxes [16]. Richer families, however, did not present significant differences in terms of food consumption.

The fact that we used households instead of individuals to perform our estimates could compromise the results since they are not homogeneous in terms of composition (children, adolescents and adults). To put this concern to rest we performed two robustness checks. In the first we uses the concept of "adult-equivalent" to transform residents, making them comparable to a man aged 18-30 (Rocha 1998). For the second we ran our analysis considering only the type of household that appeared most in the sample, which was those with three members, representing 25% of Brazilian households in 2008-2009. The first robustness exercise presented similar significance levels and lower magnitudes compared to the main exercise, reinforcing our previous conclusions. Although the second robustness exercise considered only 25% of the sample, significance levels of the "Poor" subsample remained practically unchanged and the magnitudes more than doubled, which is an evidence that receiving benefits strongly impacts decisions of this contingent of the population.

Since the POF only provides information regarding food vouchers, which represent about 95% of our sample, and *cestas básicas*, our results show the effects of receiving these benefits. [17] Also, our sample is adherent to the PAT's official numbers so misclassifications of beneficiaries are unlikely.

The specialized literature highlights that even slight misspecification of the propensity score model can result in substantial bias of estimated treatment effects (Kang & Schafer 2007, Smith & Todd 2005). Thus, inspired by Imai & Ratkovic (2014), who focused on propensity score balance when

[15] Percentages calculated on mean annual consumption of the control group.

[16] In other words, distortion is not a result of payroll taxes. Even with equally valued cash transfers, consumers would still buy more food when receiving the in-kind transfer.

[17] Still, we performed a robustness check removing *cestas básicas* from the analysis but conclusions remained unchanged.

defining covariates, we applied an iterative nondiscretionary method to define which variables should be used for matching.

This strategy consisted of: (i) performing probit regression to exclude variables which do not statistically change treatment probability; and (ii) iteratively eliminating variables whose remaining bias (in %) was the largest between treated and control groups after matching. Step (ii) was repeated until no significant remaining bias was found for all covariates.

Income was treated with special care in balancing procedures due to its importance in determining consumption. It is correlated with other variables such as region, education, number of household members, sectors and other demographic variables. The final set of covariates included all of them and tests showed they were balanced between treatment and control groups.

Still, the results were robust for both bias-corrected and average treatment on treated estimates. Consumption positively varied from 5.3% to 8.1% in the full sample and 15.7% to 25.0% for low income households. Again, richer households did not present evidence of distortion and taxation did not influence the results.

Another point of attention is that the estimates considered households from rural areas. Some of them produce their own food, which could distort the consumption analysis, since IBGE considers non-monetary income in its calculations. However, they represented only around 10% of the total sample and the conclusions remain unchanged when they are removed from estimations.

Many workers in the public sector (called "estatutários") do not contribute to the 'Guarantee Fund for Time of Service' (FGTS, a severance indemnity fund), which is levied on payroll, as mandatory for workers in the private sector. Some of them are also excluded from the federal government's pension program (INSS) levied on payroll. For this reason, we are not able to assure incentives for employees in the public sector (including government-owned companies) to take part in the PAT are the same of those in the private sector. Even though, we performed a robustness analysis including public workers in the sample and the main results did not change in magnitude and significance levels.

The literature on this subject reports evidence both in favor and against distortions. Hoynes & Schanzenbach (2009) showed food stamp benefits in the USA provided in voucher form [18] led to a small increase in food consumption. Accordingly, Ninno & Dorosh (2003) reported that in-kind transfers targeted at poor women and children in Bangladesh increased wheat consumption compared to cash transfers. Cunha (2014) and Skoufias et al. (2008), on the other hand, found no differential effect in consumption when comparing in-kind and cash transfers in the *Programa de Apoyo Alimentario* (PAL) [19].

5.2 Food composition analysis

Our results suggest that PAT benefits are distortive in general, but mainly for poor households. Based on the theoretical framework developed in Section 2.1, not all households reached higher indifference curves, so welfare considerations ultimately depend on their preferences (Figures 3 and 4). Rich

[18] In the context of Supplemental Nutrition Assistance Program (SNAP), the former Food Stamp Program (FSP).

[19] A Mexican government food assistance program to the rural poor.

people, however, consume food in a first-best situation (Figure 2). Clearly, they are better off receiving benefits [20], but in terms of food consumption, the program is innocuous.

Higher food consumption, however, might not imply better nutrition. The PAT's objective is to provide nutritionally adequate meals for workers. In order to assess what such extra consumption means in terms of quality, we divided food into seven categories: cereals and pasta; fruits and vegetables; sugar and candies; proteins; non-alcoholic beverages; alcoholic beverages; and manufactured foods.

As before, the specifications used were favorite specification and iterative method, both considering a cash transfer with tax incidence and bias correction through regression. Results are presented in Table 4.

Table 4: Estimated distortion effects - Quantity (annual kg per capita) with bias correction for seven food categories

		Favorite specification	Iterative method
Full sample	Cereal and pasta	-5.09**	-4.42*
	Fruits and vegetables	-3.90**	-3.28
	Sugar and candies	-1.71*	-1.63
	Meat/Chicken/Fish	-1.47	-1.77
	Nonalcoholic beverages	2.06	0.78
	Alcoholic beverages	1.14	1.56
	Manufactured Foods	1.35	1.56
20% poor	Cereal and pasta	7.80	12.63**
	Fruits and vegetables	1.29	3.90
	Sugar and candies	-1.16	-0.91
	Meat/Chicken/Fish	-3.19	-2.29
	Nonalcoholic beverages	6.86*	8.01*
	Alcoholic beverages	0.15	0.14
	Manufactured Foods	5.51	6.61*
20% rich	Cereal and pasta	-9.89**	-10.25**
	Fruits and vegetables	-2.41	-4.90
	Sugar and candies	-1.11	-1.47
	Meat/Chicken/Fish	-4.96	-6.95*
	Nonalcoholic beverages	9.87	2.21
	Alcoholic beverages	4.96*	4.83
	Manufactured Foods	4.92	3.49

*p<0.1; **p<0.05; ***p<0.01. The table shows treatment effect on treated (in kilograms) considering bias correction for seven food categories ($T = \frac{\Delta Y}{[1-\tau\%]}$). Favorite specification includes income, # of household members, education, race, transportation, services, South and North region dummies. Variables of the iterative method are income, # of household members, industry, construction, commerce, Northeast and Southeast region dummies.

Considering the full sample, the results show decreasing consumption of cereals and pasta, mainly in rich households, as well as reduced consumption of fruits and vegetables. Regarding poor households, there is positive

[20] In-kind transfer releases income to be spent on other goods.

distortion for non-alcoholic beverages and cereals. Also, although not significant, manufactured food products and alcoholic beverages presented higher consumption. The covariates balance and robustness without bias correction were verified. Besides the highlighted effects, there seems to be no significant change in consumption patterns, leading to the conclusion of no program influence on food categories. Perhaps total distortion estimated in Table 3 is evenly distributed among groups.

This analysis provides initial insights on how consumers change their food choices due to the program. However, a complete analysis should consider intakes of vitamins, macro and micronutrients by converting final consumption to nutrients or applying a procedure similar to Pereda & Alves (2012). Those authors calculated income elasticities for such variables and found 1% variation for poorer families increased consumption of fat and cholesterol proportionally more, which can be harmful in terms of health. If PAT produces a similar pattern for its beneficiaries, the authorities should be concerned about the health impacts.

Additionally, depending on the prices paid for food, consumers' welfare may be harmed. The Appendix provides some thoughts on the subject.

6 Policy Implications

The economic literature predicts there are distortion effects associated with in-kind transfers when compared to cash transfers. The empirical literature presents evidence both in favor and against this distortion. Hoynes & Schanzenbach (2009) and Ninno & Dorosh (2003), respectively for the United States and Bangladesh, found increased food consumption as a result of in-kind transfers. Cunha (2014) and Skoufias et al. (2008), on the other hand, did not find such difference in Mexico. Performing such estimation consists of comparing a unit both receiving and not receiving benefits, a classic counterfactual or missing data problem.

The Worker Food Program (PAT) is an important Brazilian public policy whose objective is to provide nutritionally adequate meals for workers, to improve their productivity. In this paper, we used a propensity score framework to test whether the program presents such distortions. Our results indicate that the program's transfers are distortive, but only for poor households. Among them, affirming which household prefers cash or in-kind transfers ultimately depends on preferences. Rich families, on the other hand, face a first-best situation where the program is innocuous in changing food consumption and, thus, their nutritional intake.

Two policy considerations arise from the evidence. First, PAT participation should be a choice also for workers, not only firms. This would improve poor employees' welfare which depends on preferences under distortion. Those who reach higher indifference curves under program transfers would participate (Figure 4), while others (Figure 3) would choose cash instead, maximizing their welfare.

Poor households that make less than two minimum wages (around R$2,000) do not pay income tax, only contribute to the INSS and FGTS. This fact in addition to the incentive showed above would make some of them rationally opt-out of the program without asking for compensation.

Second, high-income employees should not be able to receive benefits. They are unquestionably better off in this situation, but transfers do not contribute to reaching the PAT's objectives. It is questionable if they need food assistance in order to improve their productivity in the first place. From the government point of view, resources could be saved or reallocated to obtain more efficient results.

Rich individuals would rationally opt-out of the program without asking for compensation because the benefit represents a very small percentage of its income. Also, it may represent relevant transaction costs since it may not be accepted in all establishments and the use of voucher may be negatively valued by its peers.

Then, it would be necessary to define an income threshold so that only poor workers would partake. According to PAT's rules, they are defined as those who receive less than five times the minimum monthly wage or US$2,195.40 (R$5,225.00). It may be rational to adapt this value depending on the economic sector and local/regional differences in food costs. Manual jobs usually demand more calorie intake, so laborers should present a higher turning point and specific research should be conducted in this sense.

The same propensity score analysis was conducted for food subgroups and no pattern emerged, i.e., there was no significant alteration in terms of consumption quality. Still, no conclusion should be assumed until further analysis in terms of intake of vitamins, macro and micronutrients. As highlighted in Section 5, nutritional aspects will shed light on the program's real impacts on health.

We expect the evidences presented here will allow a discussion regarding PAT's design. A program of this magnitude, which reaches more than 20 million workers, should be discussed more thoroughly. If, in fact, no nutritional improvement is reached, the PAT fails in its main objective and needs to be rethought.

A welfare analysis, conducted in the Appendix, suggests that the program costs US$2.8-3.8 (R$6.5-8.9) million in deadweight loss or 20-55% of government tax breaks per year.

Still, many other aspects need to be taken into consideration when redesigning the program. For example, it certainly creates spillover effects in terms of job creations. PAT benefits are widely used, boosting other sectors such as restaurants and supermarkets or even creating new ones, like companies that manage food voucher provision. However, it is not clear if the jobs created, as well as income and taxes generated are enough to offset program inefficiencies.

References

Abadie, A. & Imbens, G. (2002). *Simple and bias-corrected matching estimators for average treatment effects*. Cambridge: National Bureau of Economic Research.

Banks, J., Blundell, R. & Lewbel, A. (1997). Quadratic Engel curves and consumer demand. *Review of Economics and Statistics*, Cambridge, v. 79, p. 527–539.

Blundell, R., Pashardes, P. & Weber, G. (1993). What do we learn about consumer demand patterns from micro data? *American Economic Review*, Nashville, v. 83, p. 570–597.

Bryson, A., Dorsett, R. & Purdon, S. (2002). *The use of propensity score matching in the evaluation of active labour market policies*. London: London School of Economics and Political Science. (Working Paper n. 4).

Burlandy, L. & Anjos, L. A. (2001). Acesso a vale-refeição e estado nutricional de adultos beneficiários do Programa de Alimentação do Trabalhador no Nordeste e Sudeste do Brasil, 1997. *Cadernos de Saúde Pública*, Rio de Janeiro, v. 17, p. 1457–1464.

Campello, T. & Neri, M. C. (2013). *Programa Bolsa Família: uma Década de Inclusão e Cidadania*. Brasília: Instituto de Pesquisa Econômica Aplicada.

Cunha, J. M. (2014). Testing paternalism: cash versus in-kind transfers. *American Economic Journal: Applied Economics*, Nashville, v. 6, p. 195–230.

Dasgupta, P. & Ray, D. (1986). Inequality as a determinant of malnutrition and unemployment: theory. *Economic Journal*, Oxford, v. 96, p. 1011–1034.

Deaton, A. & Muellbauer, J. (1980). An almost ideal demand system. *American Economic Review*, Nashville, v. 70, p. 312–326.

Dehejia, R. H. & Wahba, S. (1999). Causal effects in nonexperimental studies: reevaluating the evaluation of training programs. *Journal of the American Statistical Association*, Abingdon, v. 94, p. 1053–1062.

DIEESE - Departamento Intersindical de Estatísticas e Estudos Socioeconômicos (2013). Projeto de Proposta de reformulação do Programa de Alimentação do Trabalhador - PAT. *Relatório Final sobre o Programa de Alimentação do Trabalhador (PAT)*, São Paulo.

Gentilini, U. (2007). *Cash and Food Transfers: a Primer*. Rome: World Food Programme.

Geraldo, A. P. G., Bandoni, D. H. & Jaime, P. C. (2008). Aspectos dietéticos das refeições oferecidas por empresas participantes do Programa de Alimentação do Trabalhador na Cidade de São Paulo, Brasil. *Revista Panamericana de Salud Pública*, Washington, v. 23, p. 19–25.

Heckman, J. J., Ichimura, H. & Todd, P. (1998). Matching as an econometric evaluation estimator. *Review of Economic Studies*, Oxford, v. 65, p. 261–294.

Hoffmann, R. & Santiago, L. A. T. (2017). O auxílio alimentação no Brasil: seu efeito na distribuição da renda e no Índice de Massa Corporal dos empregados, conforme dados da Pesquisa de Orçamentos Familiares de 2008-2009. *Segurança Alimentar e Nutricional*, Campinas, v. 24, p. 83.

Hoynes, H. W. & Schanzenbach, D. (2009). Consumption responses to in-kind transfers: evidence from the introduction of the food stamp program. *American Economic Journal: Applied Economics*, Nashville, v. 1, p. 109–139.

Imai, K. & Ratkovic, M. (2014). Covariate balancing propensity score. *Journal of the Royal Statistical Society*, London, v. 76, p. 243–263.

Kang, J. D. Y. & Schafer, J. L. (2007). Demystifying double robustness: a comparison of alternative strategies for estimating a population mean from incomplete data. *Statistical Science*, Durham, v. 22, p. 523–539.

King, G. & Nielsen, R. (2015). Why Propensity Scores should not be used for matching. *Political Analysis*, Cambridge, v. 27, p. 36.

Mazzon, J. A. (2016). *4O anos do Programa de Alimentação do Trabalhador*. São Paulo: Blucher.

Moura, J. B. (1986). Avaliação do Programa de Alimentação do Trabalhador no Estado de Pernambuco, Brasil. *Revista de Saúde Pública*, São Paulo, v. 20, p. 115–128.

Ninno, C. D. & Dorosh, P. (2003). Impacts of in-kind transfers on household food consumption: evidence from targeted food programmes in Bangladesh. *Journal of Development Studies*, Abingdon, v. 40, p. 48–78.

Pereda, P. (2008). *Estimação das equações de demanda por nutrientes usando o modelo Quadratic Almost Ideal Demand System (QUAIDS)*. 2008. Dissertação (Mestrado em Economia) - Faculdade de Economia, Administração e Contabilidade, Universidade de São Paulo, São Paulo.

Pereda, P. C. & Alves, D. C. O. (2012). Qualidade alimentar dos brasileiros: teoria e evidência usando demanda por nutrientes. *Pesquisa e Planejamento Econômico*, Rio de Janeiro, v. 42, p. 239–260.

Poi, B. P. (2012). Easy demand-system estimation with QUAIDS. *Stata Journal*, California, v. 12, p. 433–446.

Popkin, B. M. (1978). Nutrition and labor productivity. *Social Science & Medicine*, Amsterdam, v. 12, p. 117–125.

Ray, R. (1983). Measuring the costs of children: an alternative approach. *Journal of Public Economics*, Amsterdam, v. 22, p. 89–102.

Rocha, S. (1998). *Renda e Pobreza - Medidas per Capita versus Adulto-Equivalente*. Brasília: Instituto de Pesquisa Econômica Aplicada.

Romani, A. (2019). Apesar de proibido, 39% dos trabalhadores vendem o vale-refeição. *Revista Veja*, São Paulo. Disponível em: https://veja.abril.com.br/economia/apesar-de-proibido-39-dos-trabalhadores-vendem-o-vale-refeicao/.

Rosenbaum, P. R. & Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, Oxford, v. 70, p. 41–55.

Rubin, D. B. (1974). Estimating causal effects of treatment in randomized and nonrandomized studies. *Journal of Educational Psychology*, Washington, v. 66, p. 688–701.

Savio, K. E. O., Costa, T. H. M., Miazaki, E. & Schmitz, B. A. S. (2005). Avaliação do almoço servido a participantes do Programa de Alimentação do Trabalhador. *Revista de Saúde Pública*, São Paulo, v. 39, p. 148–155.

Silva, M. H. O. (1998). *O Programa de Alimentaçäo do Trabalhador - PAT. Estudo do desempenho e evolução de uma política social*. 1998. Dissertação (Mestrado em Saúde Pública) - Escola Nacional de Saúde Pública Sergio Arouca, Fundação Oswaldo Cruz, Rio de Janeiro.

Skoufias, E., Unar, M. & González-Cossío, T. (2008). *The Impacts of Cash and In-Kind Transfers on Consumption and Labor Supply: Experimental Evidence from Rural Mexico*. Washington, DC: World Bank.

Smith, J. A. & Todd, P. E. (2005). Does matching overcome LaLonde's critique of nonexperimental estimators? *Journal of Econometrics*, Amsterdam, v. 125, p. 305–353.

Strauss, J. (1986). Does better nutrition raise farm productivity? *Journal of Political Economy*, Chicago, v. 94, p. 297–320.

Veloso, I. S. & Santana, V. S. (2002). Impacto nutricional do Programa de Alimentação do Trabalhador no Brasil. *Revista Panamericana de Salud Pública*, Washington, v. 11, p. 24–31.

Appendix A Welfare analysis

As previously discussed, evidence suggests that PAT benefits distort food consumption, delivering more food at a fixed price than consumers would buy under cash transfers. In other words, households are forced to acquire goods at a higher price than desired, damaging welfare. Figure A.1 depicts this situation where deadweight loss (DWL) can be approximated through a triangle [21]:

$$DWL \approx \frac{1}{2}\left(\Delta Q . \frac{\Delta Q}{\epsilon_{P,Q}} . \frac{P^m}{Q^m}\right) < 0 \tag{A.1}$$

Equation (A.1) is a lower bound, since the exact DWL area is bounded by a demand curve, not a straight line. Quantity variation (ΔQ) is estimated in Section 5, so demand price elasticity ($\epsilon_{P,Q}$) must be considered [22]. A demand system framework is used for this purpose.

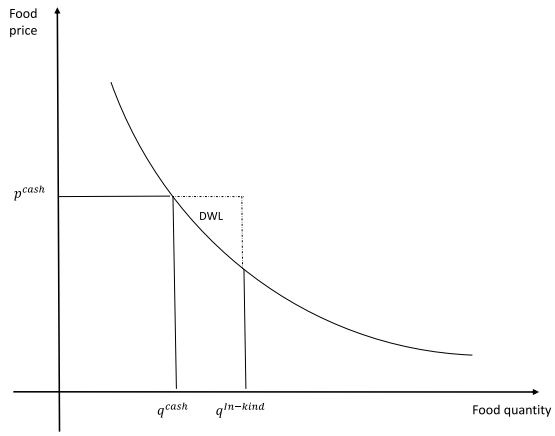
As in Pereda (2008), the evolution of functional forms of the demand equations was guided to satisfy restrictions derived from rational consumer behavior. The Almost Ideal Demand System (AIDS) proposed by Deaton & Muellbauer (1980) is theory consistent as long additivity, homogeneity and symmetry constraints are valid. The model was improved by Blundell et al. (1993) and Banks et al. (1997) to account for empirical nonlinearities between expenditure and income. This model is known as the Quadratic Almost Ideal Demand System (QUAIDS).

Here we use an extended version of QUAIDS which incorporates demographics using the scaling technique introduced by Ray (1983) (Poi 2012). The equation is indicated below:

[21] Note that $\Delta P = \frac{\Delta Q}{\epsilon_{P,Q}} . \frac{P^m}{Q^m}$. P^m and Q^m are, respectively, mean prices and quantities.

[22] Note that deadweight loss is negative because individuals consume larger quantities than they would at given prices, p^{cash}.

Figure A.1: Deadweight Loss



$$w_i = \alpha_i + \sum_{j=1}^{k} \gamma_{ij} lnp_j \quad + \quad (\beta_i + \eta_i^{'} z) ln\left[\frac{m}{\bar{m}_0(\mathbf{z})a(\mathbf{p})}\right] + \tag{A.2}$$

$$+ \quad \frac{\lambda_i}{b(\mathbf{p})c(\mathbf{p},\mathbf{z})}\left\{ln\left[\frac{m}{\bar{m}_0(\mathbf{z})a(\mathbf{p})}\right]\right\}^2$$

where $c(\mathbf{p},\mathbf{z}) = \prod_{j=1}^{k} p_j^{\eta_j{}'\mathbf{z}}$.

In the equation, $w_i = p_i q_i / m$ is category $i's$ expenditure share; α_i is a constant; lnp_j is log of prices; m is household income; $a(\mathbf{p})$ and $b(\mathbf{p})$ are price functions; and $\bar{m}_0(\mathbf{z})$ accounts for household characteristics. Expenditure share equations and elasticities are obtained using iterated feasible generalized nonlinear least-squares, as described in Poi (2012).

Besides food, nine other categories [23] completed the demand system: beauty and clothing; cleaning and hygiene; communication and transportation; education; equipment and furniture; health; housing and others; leisure; and utilities and maintenance. Expenditure and quantities consumed were merged by household to allow price calculations. When not available [24], prices of the closest region were used as proxies.

Compensated price elasticities for food were calculated between 0.35-0.38 [25] in a demand system accounting for regional, sectoral and socioeconomic variables. Estimates, along with beneficiary households (Section 4), are used to estimate deadweight loss associated with distortion. Results are presented in Table A.1.

[23] Categories were created by aggregating similar products provided by the POF.

[24] At given prices, households can optimally choose not to consume a good but price in this case is not observable.

[25] Estimated price elasticities decrease with income.

For the market as a whole, deadweight loss lies between US$20.3 (R$48.2) and US$40.6 (R$96.6) million. Poor households alone account for US$2.8-3.8 (R$6.5-8.9) million, which represents 9.2-13.6% of total distortion value.

Using Mazzon (2016) [26] and PAT number of beneficiaries in 2008, we calculate government total tax breaks between US$6.8 (R$16.1) and US$13.6 (R$32.3) million. That is to say that considering only low-income household, distortions may represent between 20% and 55% of government's tax breaks.

[26] Tax breaks are estimated between R$ 1.20 and R$ 2.41 per worker.

Table A.1: Deadweight loss associated with distortion in food consumption

Sample	Full		20% Poor	
Model specification	Favorite specification	Iterative method	Favorite specification	Iterative method
Quantity (Control)	366.1	365.8	233.3	233.8
Quantity (Treated)	387.0	395.5	282.7	292.3
Price (US$ 2009)	1.70	1.70	1.48	1.47
Comp. price-elasticity	0.385	0.385	0.357	0.357
DWL per household (US$)	2.56	5.12	19.64	26.82
# of households	7,926,638	7,926,638	139,885	139,885
DWL (US$ million 2009)	**20.25**	**40.61**	**2.75**	**3.75**

The table calculates deadweight associated with distortion in food consumption. For each sample, both favorite and iterative model specifications are considered. The analysis focuses on two subsamples: full; and 20% bottom of income distribution. Compensated price-elasticities are calculated for each sample.