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Abstract:

Programa de Alimentação dos Trabalhadores (PAT) creates tax incentives for firms to provide 20 million workers with in-kind transfers in Brazil. Economic theory supports they are distortive when compared to cash transfers but this is not clear when the latter are subject to payroll taxes. Using a propensity score analysis we find evidence that PAT increases poor households food consumption between 15.7% and 25.0% and deadweight loss associated with distortions reach US$63.1 (R$150.1) million. Overconsumption, however, may not be increasing worker's nutrition, as aimed by the program.

Keywords: In-kind transfers vs cash transfers; Programa de Alimentação dos Trabalhadores (PAT); Propensity score analysis.

JEL Codes: D11; D12; I38.

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Resumo. O Programa de Alimentação dos Trabalhadores (PAT) cria incentivos fiscais para firmas brasileiras fornecerem vale-refeição para 20 milhões de trabalhadores. A teoria econômica prevê que esse tipo de transferência é distorciva quando comparada a transferências monetárias, mas não necessariamente quando esta última está sujeita ao pagamento de impostos. Usando escore de propensão, encontramos evidências que famílias pobres beneficiadas pelo PAT consomem de 15,7% a 25,0% mais comida e que o peso morto associado a essa distorção chega a R$150,1 milhões. Entretanto, não há evidências que alimentação adicional está atingindo o objetivo do PAT de melhorar a saúde dos trabalhadores.

Palavras-chave: Transferências em produto e transferências em dinheiro; Programa de Alimentação dos Trabalhadores (PAT); Análise via escore de propensão.

JEL Classification: D11, D12, I38

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, when compared to cash transfers, such as overfeeding [1].

This work sheds light on a Brazilian meal transfer scheme named *Programa de Alimentação dos Trabalhadores* (PAT) which benefits almost 20 million workers countrywide according to the Ministry of Labor. Federal government grants tax breaks for those firms willing to 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 Brazil had workers living with minimum acceptable calorie patterns (da Silva, 1998). In this sense, the policy was designed to improve nutritional intake of workers. Currently, the government's tax break is US$1.0 (R$2.4) billion per year (Section 7). However, the program was never economically evaluated.

Since PAT is inserted in labor market context, in-kind transfers are not levied on. 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 voucher distorts consumption by comparing with a cash transfer and calculate both effects on individual's welfare.

We use a propensity score analysis to control the selection bias by using the program characteristics. 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. We show that program only distorts poor families' consumption while rich households are not affected. The food expenditures of richer households are, on average, higher than food voucher values.

We also calculate the deadweight loss of the policy between US$31.5 (R$74.9) and US$63.1 (R$150.1) million, which represent 3.2% to 6.4% of government tax breaks. Further estimates show no relation between the increased food consumption and the intake of healthier food. That means program may be failing into fulfilling its objectives of improved nourishment.

We contribute to the literature in many ways. First, we present empirical evidence against food vouchers, even when comparing with cash transfers (after tax deductions). There is no consensus at the empirical literature over distortion of in-kind transfers. Hoynes and Schanzenbach (2009) observed that vouchers lead to a small increase in food consumption for participants of the Supplemental Nutrition Assistance Program (SNAP). Accordingly, Ninno and Dorosh (2003) reported an increase in wheat consumption for individuals in Bangladesh submitted to in-kind transfers when compared to cash transfers. Cunha (2014) and Skoufias et al. (2008), on the other hand, compared in-kind and cash trasnfers to the rural poor in Mexico and concluded there is no differential effect in consumption.

Second, we present the first economic evaluation of the program. So far, program assessment consisted in judging firm's specific initiatives in terms of nutritional adequacy [3].

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

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

[3] de Moura (1986); Burlandy and Anjos (2001); Veloso and Santana (2002); Savio et al. (2005); and Geraldo et al. (2008).

In this paper, we evaluate the welfare changes and, therefore, present a cost-benefit analysis.

The paper is divided into 7 sections, considering this introduction. Section 2 establishes conceptual basis of in-kind transfer analysis and how it is applied to PAT. Section 3 explains program assignment and identification strategy used to eliminate bias selection. Section 4 details dataset and shows relevant descriptive statistics. Sections 5 and 6 respectively present estimation results and welfare considerations. Lastly, Section 7 summarizes findings, proposes policy measures and suggests future research agenda.

2 In-kind transfers

2.1 In-kind versus cash transfers

In-kind transfer is a general term attributed to give aways that restricts the bundle of products that may be acquired by consumers, such as food or non-food items, vouchers, coupons and others. Alternatively, cash transfers allow agents to buy whatever fits their budget constraint. Thus, many researchers are interested in comparing their effects, specially on food consumption. Engel's law and consumer theory contributed for this literature (Gentilini, 2007).

Engel's law asserts that as income rises, proportion spent on food items decreases, even if actual expenditure on food increases. In other words, income elasticity of food lies between zero and one, being higher for poorer than richer families. Thus, cash transfers may be useful for increasing low-income households' food consumption. One example is *Bolsa Família*, a Brazilian conditional cash transfer program that impact approximately 14 million households or 57 million individuals (Campello and Neri, 2013).

Following Cunha (2014), suppose consumers demand food (q_f) and other goods (or non-food items, q_{nf}) and they maximize an utility function $U(q_f, q_{nf})$ strictly increasing and concave in both arguments. Let p_f and p_{nf} be prices of those goods. 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.

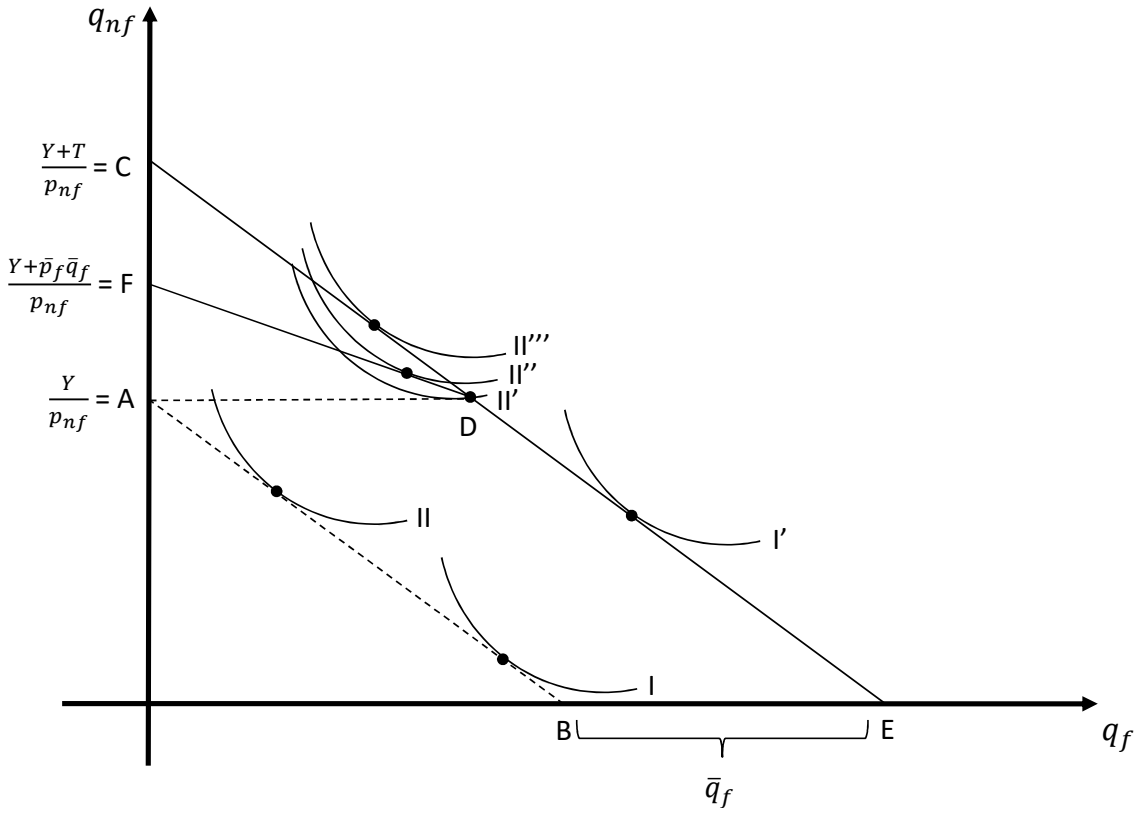

Figure 1: Impacts of in-kind and cash transfers on consumption
Source: Based on Cunha (2014), own elaboration

Suppose a cash transfer of value T which shift budget constraint to $\overline{CE}$ and an in-kind transfer of same value $\bar{q}_f = \frac{T}{p_f}$ which creates a kink [4], depending on food reselling 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 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, for the case trade is not permitted ($\bar{p}_f = 0$), then restriction of interest is $\overline{ADE}$.

Based on Figure 1, cash transfers weakly dominate in-kind since consumers face a greater set of choices. Exception occurs when $\bar{p}_f = p_f$ as 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. To see this note that under cash transfer, consumer II chooses optimal quantity associated with II''' which is lesser 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') when compared to $\bar{q}_f$.

That is to say that only *extra-marginal* transfers distort consumer choices. Individual II receives more food than desired (optimal quantities associated with II' or II'') when

[4] Kink is created where $q = \bar{q}_f$, which is $\overline{AD}$ size.

his best is achieved at II'''. Consumer I, on the other hand, is indifferent between both transfer schemes. Distortion caused by an *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 consumer demands more food than it was transferred. That is the case of individual I who demands optimal quantity associated with I' but only receives $\bar{q}_f$. For consumer II, 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 those concepts is comparison base. When evaluating an in-kind transfer in terms of extra-marginality, $\bar{q}_f$ is compared with consumer choice under cash transfer. However, to define *binding* transfers, comparison occurs with choice under in-kind transfer.

Hence, total distortion associated with an in-kind transfer of size $\bar{q}_f$ can be seen as the amount consumed above 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 cash transfer optimum (which is bad for consumer), but discounted from non-binding transfers, that improve his welfare since he is receiving an extra amount of food. In other words, extra-marginal transfers move consumer 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. As for Cunha (2014), distorting effects of in-kind transfers and its magnitude have fundamental importance for policy makers. A lack of empirical evidence exists since counterfactual behavior can never be observed. Such problem will be addressed using matching principles discussed in Section 3.

From 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 an important Brazilian public policy, *Programa de Alimentação dos Trabalhadores*[5].

2.2 Brazilian program: PAT

Programa de Alimentação dos Trabalhadores is a voluntary [6] Brazilian food program created in 1976 whose objective is to provide nutritionally adequate meals, specially for low income workers, increasing their productivity. Federal government grants tax breaks for firms willing to provide food benefits for its workers on a monthly basis. For workers and companies, the main advantage of such benefits is that regular payroll and income

[5] Worker Food Program in a free translation.
[6] Firms choose whether or not to participate.

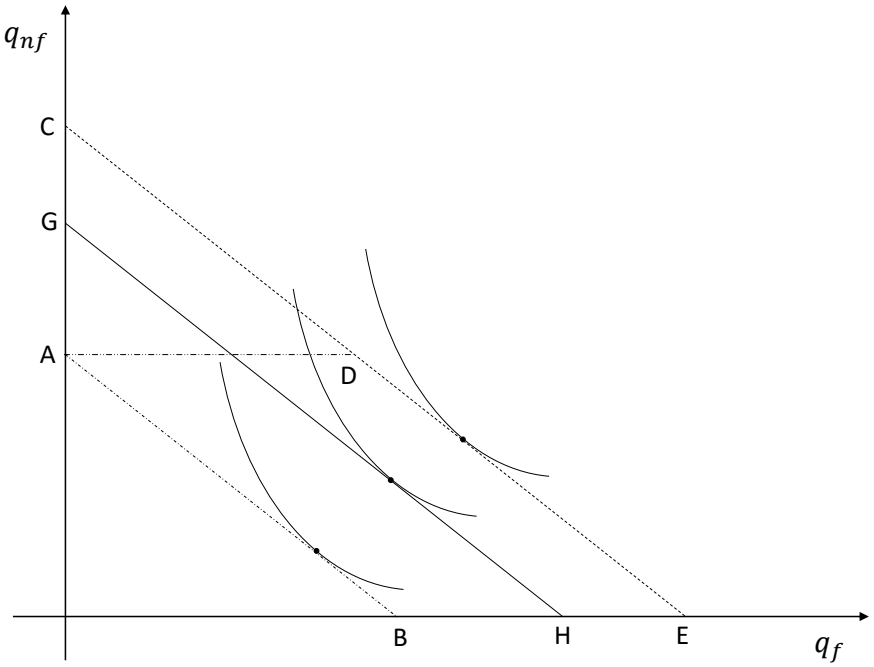

Figure 2: $q(Y+T,\mathbf{p}) \sim q(Y+p_f\bar{q}_f,\mathbf{p}) \succ q(Y+T',\mathbf{p})$

taxes do not apply.

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

When transfers are not made in-kind, they are considered salary raise and taxed accordingly, resulting in a discounted transfer $T' = (1-\tau)T$. Discount factors (τ) are payroll taxes applied over labor income in Brazil. For each additional R$1.0 payment companies pay R$1.48 and workers receive minus 8.0% to 22.2%, depending on income level. It changes traditional analysis in a way that is not obvious that T' is preferable to in-kind transfers.

Consumer preferences are represented by 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 superior (Figure 3) or inferior (Figures 2 and 4) to in-kind, depending on individuals preferences.

In other words, considering firms would not increase their spending when deciding to provide in-kind transfers or cash transfers [7], it is not trivial to infer their workers would be better off or not in terms of consumption.

For simplification purposes, analysis sticks to the case where benefits are not renegotiated (ADE restriction). In fact, PAT does not allow beneficiaries to resell benefits, but it is known that illegal traders charge consumers wiling to exchange vouchers for cash [8].

We evaluate the potential distortions in food consumption (in terms of equation 4) for program beneficiaries. Concluding PAT transfers are not distortional when compared to a discounted cash transfer, mean program reaches a first-best situation, equalizing full cash

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

[8] There are legal restrictions to this practice, although the exact proportion of benefits informally exchanged is unknown.

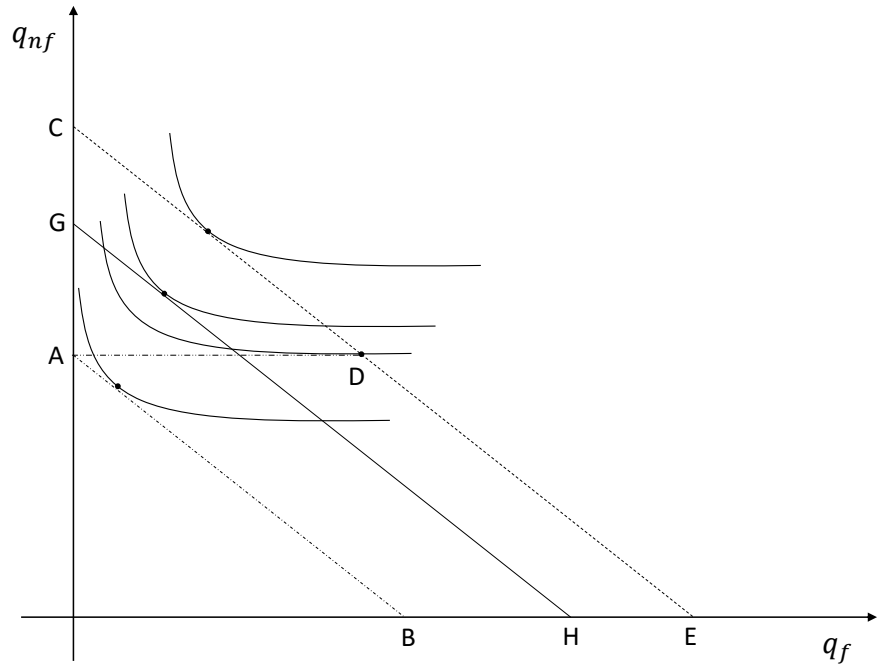

Figure 3: $q(Y+T,\mathbf{p}) \succ q(Y+T',\mathbf{p}) \succ q(Y+p_f\bar{q}_f,\mathbf{p})$

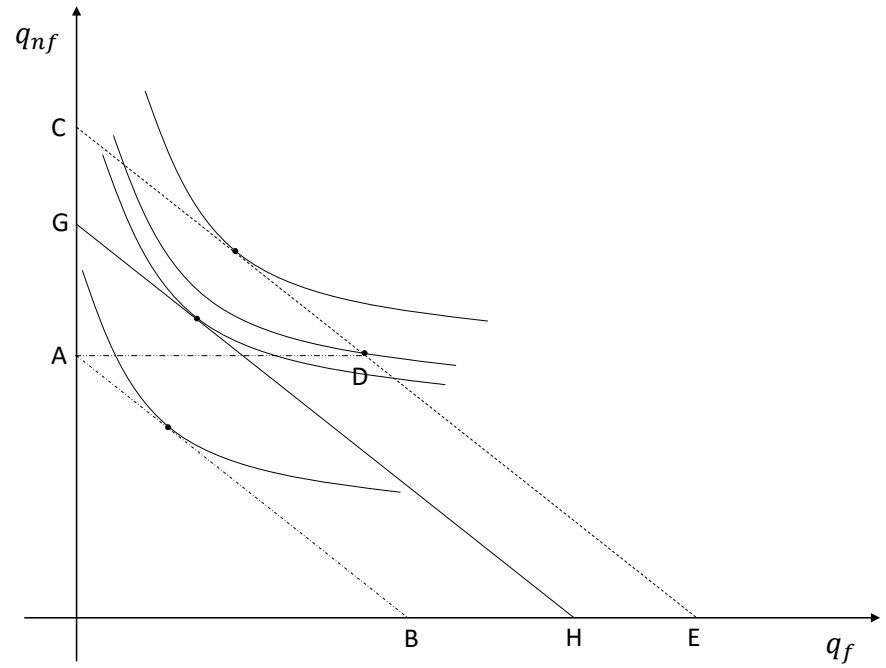

Figure 4: $q(Y+T,\mathbf{p}) \succ q(Y+p_f\bar{q}_f,\mathbf{p}) \succ q(Y+T',\mathbf{p})$

transfers (Figure 2). Now, in case program actually distorts food consumption, scenario is twofold: (i) cash transfers may be preferable (Figure 3); or (ii) in-kind transfers are preferable (Figure 4). They are both second best situations and results ultimately depend on consumer preferences.

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

3 *Empirical Strategy*

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

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

Beneficiaries (or treatment group) are formal workers of private sector [9] who are legally aged to work (16-65) and receive any kind of food benefit. Accordingly, non-beneficiaries (or control group) are formal workers of the private sector aged to work (16-65) who do not receive any type of food assistance.

Understanding benefit assignment is crucial for eliminating potential bias selection. First, joining PAT is a firm's call and there are three main reasons to motivate the participation decision: (i) fiscal incentives; (ii) labor unions pressure; and (iii) attempt to rise workers' productivity. Second, benefits may influence individual choices regarding job offers, leading those whose preferences are food tendentious to only accept assisted positions. Such mechanisms are further discussed hereafter.

As for fiscal incentives, PAT's rules establish that participating companies can deduce up to 4% of due income tax. However, eligibility is restricted to those opting for *lucro real* taxation scheme, which allows only firms whose revenues exceed $ 32.8 (R$78.0) million a year to partake. This fact limits eligibility to big corporations, usually located in Southeast and South regions. That is, spatial location correlates to program assignment.

Regarding labor unions, DIEESE (2013) presents data of 197 agreements for all sector signed between 2011 and 2012. Around 60% (120 agreements) presented clauses mentioning workforce rights towards food. Associations' strength is reflected in Table 2, which shows services, industry and commerce sectors, known for suffering great syndicate pressure, concentrate most of PAT beneficiaries and this tendency is not shared by non-beneficiaries. In other words, distribution across sector changes for PAT participants.

When it comes to labor productivity, firms may use food benefits to increase production. Popkin (1978), Dasgupta and Ray (1986) and Strauss (1986) provide evidence on nutrition positively affecting labor outputs, mainly for handwork. Industry and construction sectors are aware of such results, and facilitate employees' access to adequate nutrition through PAT.

[9] Public firms are not eligible for tax breaks, so they were removed from analysis since incentives they face are probably different from those described here.

Finally, food assistance may drive individual decisions towards accepting specific job offers. Choosing between one or another depends on consumer preferences (Figures 3 and 4) [10]. Typically, low income workers tend to care more about food, thus their willingness to accept meal assisted jobs is higher. However, those employees are the ones with less bargaining power when seeking work, so it is not true they will always face this choice. Consumers tastes, along with bargain control may be translated in terms of socioeconomic variables such as income and education.

To sum up, PAT assignment mechanism 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:

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

In other words, even if q_{1i}^f and q_{0i}^f are correlated with D_i, they become independent given the observables that explain participation X_i [11]. As shown by Rosenbaum and Rubin (1983), X may be merged into a propensity score, $P(X)$, and equation 6 remains valid with the following change:

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

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

Estimate equation 4 using Propensity Score Matching (PSM) [12] does not require an specific functional form for the food demand equation (Section 6), thus it adapts better to possible nonlinearities involved in estimating benefit and food consumption relation. Moreover, assistance specificities regarding labor market and its use mostly throughout working hours demand strong internal validity [13]. Spatial program concentration and labor unions influence, which prevalently act in specific economic sectors, creates a unique market configuration where program assignment needs more degrees of freedom to be modeled. Estimates are considered causal effects of PAT if both X contains all relevant observables [14] and common support holds.[15]

[10] Selection occurs if those who value food more are able to choose jobs which provide benefits.

[11] $q_{1i}^f, q_{0i}^f \perp\!\!\!\perp D_i | X_i, \forall i$.

[12] Rubin (1974), Rosenbaum and Rubin (1983), Heckman et al. (1998).

[13] Achieved with PSM in comparison with other methods.

[14] Also if those variables are balanced for treatment and control groups after matching.

[15] Regarding this issue, Heckman et al. (1998) and Bryson et al. (2002) discuss a trade off when using propensity score since more covariates mean higher chances of violating common support hypothesis. In other words, including independent variables reduces bias but increases estimator variance. Such trade off is illustrated by different types of matching. On the one hand, nearest neighbor matching matches each beneficiary with closest (measured by propensity score) control, and others are discarded. In this case, bias is minimum since each treated individual will be compared with only one control (Dehejia and 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. That is, for variance what matters is quantity, not quality of matchings) (Smith and Todd, 2005). On the other hand, considering a kernel based matching, individuals receive a higher weight if similar to treatment, not equal, as in neighbor matching. It increases number of controls and estimator variance diminishes. However, bias increase since quality of matchings might get worse (Smith and Todd,

As propensity score simulates an experiment at X (or $P(X)$), it, therefore, allows for good estimate of effects when there is selection on observed (X). Intuitively, it is possible to find for each PAT participant, a similar non treated individual (based on characteristics of X) in a way they can be considered the same before and after treatment, respectively. Therefore, we attribute differences between both groups to the treatment effect. (Heckman et al., 1998)

Finally, an underlying hypothesis of this work is that beneficiaries food consumption does not influence market prices. Increased expending in food would shift demand outwards, pressure prices up and, consequently, diminish demand of non program participants, resulting in distortion overestimation. However, this is not believed to be true since people would continue spending money to eat in case of program absence. Moreover, a great number of restaurants and supermarkets spatially well distributed approximates food market of a competitive equilibrium, eliminating such interference.

4 Dataset

The Brazilian Household Budget Survey[16] provides income, expenses and sociodemographic information for more than 57,000 Brazilian households. It is collected by the Brazilian Bureau of Geography and Statistics (IBGE), an entity run by federal administration [17], which is in charge of government statistics in country. Last available survey was collected in 2008-09. All monetary values were normalized for January 15^{th} of 2009. The unit of analysis is households and attention was focused on demographic, consumption and income [18] information through questionnaires 1, 2 and 3, and 5, respectively.

All consumption of food items [19] were converted to kilograms. Non-food items were measured by units [20]. Expenses were annualized but are presented monthly when convenient. All values are in dollars [21]. Data did not allow differentiation between PAT categories: self-management and/or outsourcing. Self-management represents firms which provide cooked or non-cooked meals for its workers. It may involve *in natura* food supply and own restaurants. Outsourcing defines firms which delegate the latter tasks to an specialized firm and/or provide cards (vouchers) and coupons restricted to food acquisition. Companies are free to provide benefits in more than one modality (e.g. one may run a personal restaurant and also provides workers with meal vouchers). We consider that the treatment represents receiving at least one of PAT categories.

From total expanded sample of 57,814,083 households, 7,926,638 (13.7%) have at least one member receiving food benefits [22]. For 2008, official data from Ministry of Labor

2005). Empirically, one must be aware robustness is important when choosing covariates. In this sense, results are robust to other specifications. About matching algorithms, King and Nielsen (2015) discuss how propensity score may increase imbalance, model dependence and bias, approximating a completely randomized experiment rather than a fully blocked experiment. Authors conclude Mahalanobis Distance Matching (MDM) is less susceptible to latter problems. For this reason, ATT was calculated with MDM in all specifications.

[16] Pesquisa de Orçamentos Familiares (POF).

[17] Under Ministry of Planning, Budget and Management.

[18] Including benefits, trasnfers, etc.

[19] Analysis consider both items consumed inside and outside the house.

[20] For example, acquisition of a shirt or socks were both treated as clothing units. Other categories besides food are only used in Section 6 for a demand system analysis.

[21] The exchange rate is R$/US$2.38, as of January 15^{th}, 2009.

[22] Ideally, analysis should have been performed using individuals. However, POF does not provide food

reported program had 13.4 million beneficiaries, which is compatible with 1.69 PAT workers per family. Monthly average net benefit is US$69.6 (R$165.6) and the benefits distribution is positively skewed (Figure 5).

Beneficiaries are those individuals aged between 16 and 65, not working in public sector and receiving any type of food benefits, which are identified in POF as meal vouchers or *cestas básicas* [23]. Accordingly, non-beneficiaries present equal characteristics but do not receive benefits.

The household head's characteristics of beneficiary families are: 70.85% are man, 54.89% caucasian, 73.10% married, 48.17% own health insurance and most are literate. Compared to eligible families, program households present 0.06 more dwellers on average, heads are 1.11 years younger, more educated (2.21 years) 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 1% level.

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

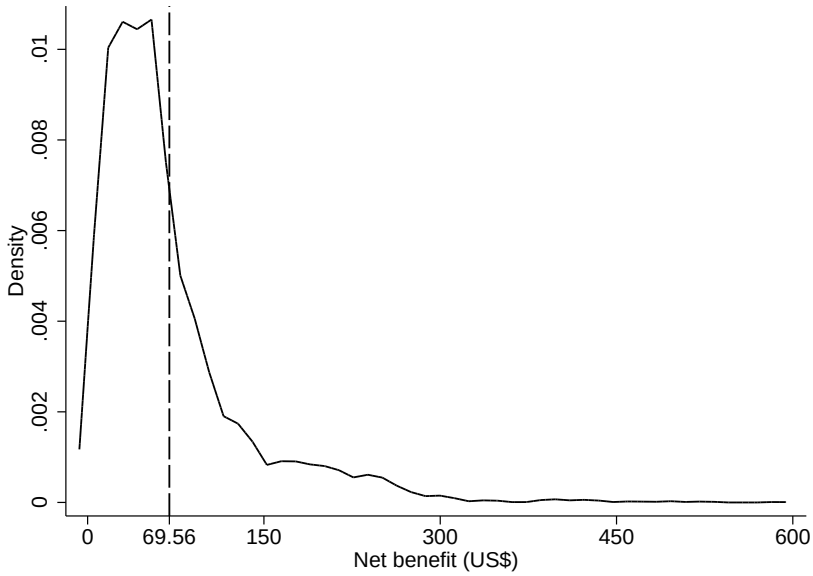

Figure 5: Household monthly average net benefit (2009 US$)

consumption at such disaggregated level.

[23] *Cesta básica* is a food box containing essential food items consumed by a typical Brazilian family such as rice, beans, milk, flour, oil, sugar, among others.

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 test is applied to verify differences among groups. Where (%), difference is in percentual points. Otherwise, it follows variable measure.

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

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 with services, while only 20% of non-beneficiaries participate in this sector. Other sectors present a similar tendency, showing their importance in explaining benefit provision.

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

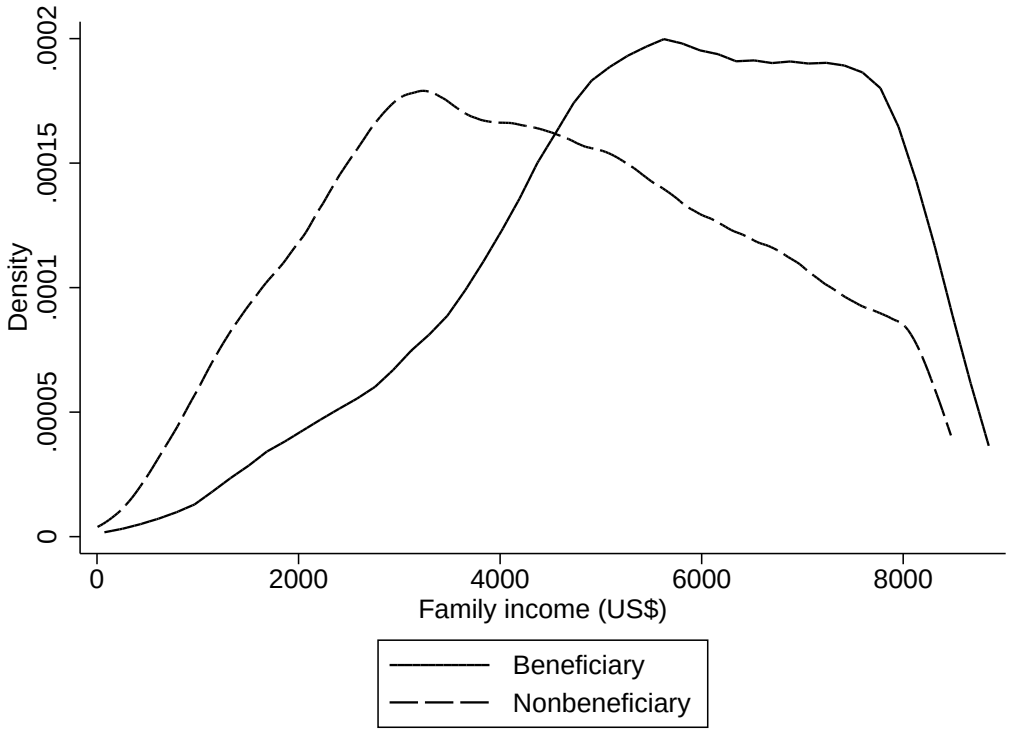

Figure 6: Annual income distribution of beneficiary and non-beneficiary families (2009 US$)

5 Results

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

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

$D_f(\bar{q}_f)$ 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 a propensity score analysis (Section 3). Using income to match is vital due to its relevance in food consumption (Engel's Law). Those who did not receive any benefits but received a higher income that equals benefit value were used to estimate $\hat{q}_f^{cash}$. Estimations are performed in two ways:
1. Firs, one considers equality between income (Y) for non-treated and income + benefit value (T) for treated. Such version simulates decisions firms traditionally face, provide \$K in cash or an equivalent value in-kind:

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

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

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

Considering discussion of Sections 3 and 4 a mahalanobis matching was estimated

using regional, sectoral and socioeconomic covariates. Table 3 presents results of our preferred specification using simple regression bias correction, following Abadie and Imbens (2002).

	(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
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: $Y_{D=0} = Y_{D=1} + T[1 - \tau\%] \Leftrightarrow T = \Delta Y[1 - \tau\%]$.
Besides income, other controls are #dwellers, education, race, transportation, services, south and north dummies. Poor and Rich samples represent, respectively, 20 percent bottom and 20 percent top of income distribution.

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

Covariates balance as well as estimates without bias correction (for robustness purposes) are analyzed. Overconsumption estimates considering labor market taxes range from 4.1% to 5.7% for full sample and 13.0% to 21.2% for poor households [24]. Benefits would still be distortive even when compared to cash transfers after deducting taxes. [25]. Richer families, however, did not present signs of excess in food consumption.

Only formal workers [26] were used for analysis since formality is an exigence for program eligibility. Moreover, POF only provides information for three (out of six) types of benefits: voucher *alimentação*, voucher *refeição* and *cesta básica*. This is not a problem for estimations. Possible other beneficiaries are not being classified accordingly, but still receive food benefits. So, if there is a distortion even without considering such workers, calculated effects most likely represent a lower bound.

Specialized literature highlights that even slight misspecification of propensity score model can result in substantial bias of estimated treatment effects (Kang and Schafer (2007); Smith and Todd (2005)). Thus, inspired by Imai and Ratkovic (2014), who focus on propensity score balance when defining covariates, an iterative non discretionary method is proposed to define which variables should be used for matching.

Strategy consists in: (i) run probit regression in order to exclude variables which do not statistically change treatment probability; and (ii) iteratively eliminate variables whose remaining bias (in %) was the largest between treated and control groups after

[24] Percentages calculated over mean annual consumption of control group.
[25] 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 in-kind.
[26] Were considered formal those workers who payed income tax.

matching. Step (ii) is repeated until no significant remaining bias is achieved for all covariates.

During estimation process, however, it was difficult to balance income, leading to sets of covariates where it was pruned. This is unacceptable due to its importance in explaining food consumption. For this reason, process was run for a initial variable set which did not contain such variable and then added after balance was performed.

Curiously, final set of covariates after iterative method did not present socioeconomic variables, although contained sectoral and demographic controls, as in favorite specification. This was surprising since they were expected to play an important role in determining food consumption.

Still, results were robust for both bias corrected and average treatment on treated estimates. Consumption excess varies from 5.3% to 8.1% in full sample and 15.7% to 25.0% for poor. Again, richer families did not present evidence of distortion and taxation did not influence results.

Another point of attention is that estimates consider families from rural areas. Some of them produce their own food , which could distort consumption analysis. However, they represent only around 10% of total sample and results remain unchanged if they are removed from analysis.

Literature on this subject reports evidences both in favor and against distortions. Hoynes and Schanzenbach (2009) shows food stamp benefits provided in voucher form [27] lead to a small increase in food consumption. Accordingly, Ninno and Dorosh (2003) reports that transfers in-kind targeted to poor women and children in Bangladesh increased wheat consumption when compared to cash transfers. Cunha (2014) and Skoufias et al. (2008), on the other hand, find there is no differential effect in consumption when comparing in-kind and cash transfers for *Programa de Apoyo Alimentario* (PAL) [28].

Results suggest PAT benefits are distortive in general, but mainly for poor families. Based on analysis developed in Section 2.1, not all households are reaching higher indifference curves, so welfare considerations ultimate depend on their preferences (Figures 3 and 4). Rich people, however, consume food as in a first-best situation (Figure 2). Clearly, they are better off receiving benefits [29], but in terms of food consumption, program is innocuous.

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

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

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

[28] A Mexican government's food assistance program to the rural poor.

[29] In-kind transfer releases income to be spent in other goods.

		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
	Industrialized	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
	Industrialized	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
	Industrialized	4.92	3.49

*p<0.1; **p<0.05; ***p<0.01

Table measures treatment effect on treated (in kilograms) considering bias correction for seven food categories. Favorite specification includes income, # dwellers, education, race, transportation, services, south and north dummies. Variables of iterative method are income, #dwellers, industry, construction, commerce, northeast and southeast dummies.

Table 4: Estimated distortion effects for $T = \Delta Y[1 - \tau\%]$ - Quantity (annual kg per capita) with bias correction for seven food categories

Considering full sample, results show decreasing consumption of cereal and pasta, mainly driven for rich households, as well as reduced consumption of fruits and vegetables. Regarding poor families, there is positive distortion for non-alcoholic beverages and cereals. Also, although not significant, industrialized products and alcoholic beverages present consumption raising. Covariates balance and robustness without bias correction are checked. Besides highlighted effects, there seems to be no significant change in consumption patterns, leading to a conclusion of no program influence in food categories. Maybe, total distortion estimated in Table 3 is evenly distributed among groups.

Analysis provide first insights on how consumers change their food choices once under the program. However, a complete qualitative analysis should necessarily consider vitamins, macro and micro nutrients intakes, similar to Pereda and Alves (2012). Authors calculate income elasticities for such variables and conclude 1% variation for poorer families increase consumption of fat and cholesterol proportionally more, which can be harmful in terms of health. If PAT produces a similar pattern for its beneficiaries, authorities should be concerned regarding healthy impacts of policy.

Additionally, excess of food consumption may be harmful for consumers in terms of welfare. Next section provides some thoughts on the subject.

6 Welfare analysis

As previously discussed, evidence suggests PAT benefits distort food consumption, delivering more food at a fixed price than consumers would buy under cash transfers. In other terms, households are forced to acquire goods at a higher price than desired, damaging welfare. Figure 7 depicts this situation where deadweight loss (DWL) can be approximated through a triangle [30]:

$$DWL \approx \frac{1}{2}\left(\Delta Q.\frac{\Delta Q}{\epsilon_{P,Q}}.\frac{P^m}{Q^m}\right) < 0 \tag{9}$$

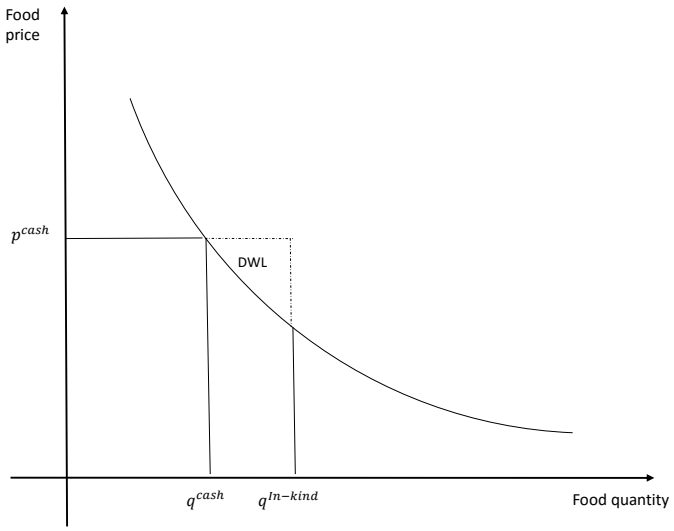

Figure 7: Deadweight Loss

Equation 9 is a lower bound since exact DWL area is bounded by demand curve, not a straight line. Quantity variation (ΔQ) is estimated in Section 5, so demand price elasticity ($\epsilon_{P,Q}$) must be accounted [31]. A demand system framework is used for this purpose.

A comprehensive review of literature on the subject can be found in Pereda (2008). Succinctly, the evolution of functional forms of the demand equations was guided to satisfy restrictions derived from consumer rational behavior. Almost Ideal Demand System (AIDS) proposed by Deaton and Muellbauer (1980) is theory consistent as long additivity, homogeneity and symmetry constraints are valid. Model was lately 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 Quadratic Almost Ideal Demand System (QUAIDS).

[30] 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.

[31] Note deadweight loss is negative because individuals are consuming larger quantities than they would be willing to at given prices, p^{cash}.

This work uses an extended version of QUAIDS (Poi, 2002) which incorporates demographics using a scaling technique introduced by Ray (1983) (Poi, 2012). Equation is described below:

$$w_i = \alpha_i + \sum_{j=1}^{k} \gamma_{ij} lnp_j + (\beta_i + \eta_i' z) ln\left[\frac{m}{\bar{m}_0(\mathbf{z})a(\mathbf{p})}\right] + \\ + \frac{\lambda_i}{b(\mathbf{p})c(\mathbf{p},\mathbf{z})}\left\{ln\left[\frac{m}{\bar{m}_0(\mathbf{z})a(\mathbf{p})}\right]\right\}^2 \tag{10}$$

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

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

Besides food, other nine categories [32] completed 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 family to allow price calculations. When not available [33], prices of the closest region were used as proxy.

Compensated price elasticities for food were calculated between 0.35-0.38 [34] in a demand system accounting for regional, sectoral and socioeconomic variables. Estimates, along with beneficiary families (Section 4), are used to estimate deadweight loss associated with distortion. Results are presented in Table 5.

For the market as whole [35], deadweight loss is evaluated between US$31.5 (R$74.9) and US$63.1 (R$150.1) million. Poor households alone account for US$4.3-5.8 (R$10.1-13.8) million, which represents 9.2-13.6% of total distortion value.

Values represent around 3.2-6.4% of total tax breaks provided by federal government, i.e., on average, 4.8% of government investments in PAT are lost due to distortions.

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

[33] At given prices, families may optimally choose for not consuming a good but price in this case is not observable.

[34] Estimated price elasticities decreases with income.

[35] Market size is US$26.3 (R$62.7) million (Section 7).

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$ 2015)	2.64	2.65	2.30	2.29
Comp. price-elasticity	0.385	0.385	0.357	0.357
DWL per family (US$)	3.97	7.96	30.50	41.66
# of families	7,926,638	7,926,638	139,885	139,885
DWL (US$ million 2015)	**31.46**	**63.07**	**4.27**	**5.83**

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

Table 5: Deadweight loss associated with distortion in food consumption (US$)

Next section concludes and provides insights in terms of policy.

7 Policy Implications

Economic literature predicts there are distortion effects associated with in-kind transfers when compared to cash transfers. Empirical literature presents evidences both in favor and against the existence of this distortion. Hoynes and Schanzenbach (2009) and Ninno and Dorosh (2003) find, respectively for the United States and Bangladesh, an increase in food consumption as a result of in-kind transfers. Cunha (2014) and Skoufias et al. (2008), on the other hand, do not find such difference in Mexico. Performing such estimation consists in comparing individuals both receiving and not benefits, a classical counterfactual or missing data problem.

Programa de Alimentação dos Trabalhadores (PAT) is an important Brazilian food assistance public policy whose objective is to provide nutritional adequate meals for workers. In this paper we use a propensity score framework to test whether program presents such distortions. Our results indicate that the program's transfers are distortive, but only for poor households. Among them, affirming which household prefer cash or in-kind transfers ultimately depends on their preferences. Rich families, on the other hand, face a first-best situation where program is innocuous in rising food consumption and, therefore, their nutritionsl intake. Our welfare analysis suggests that the program costs 4.8% of government tax breaks or US$47.3 (R$112.5) of deadweight loss.

Two policy considerations arise from the evidences. 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) could receive cash instead, maximizing their welfare.

Second, high income employees should not be able to receive benefits. They are unquestionably better off in this situation, but transfers do not contribute for PAT in reaching its objectives. From government point of view, resources could be saved or reallocated for more efficient results.

However, defining a threshold for poor workers is no trivial task. According to today's rules, they receive less than five minimum wages US$1,848.80 (R$4,400.00) a month. It may be rational to adapt this value depending on economic sector. Manual jobs usually demand more calorie intake, so laborers should present a higher turning point. Specific researches should be conducted in this sense.

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

These evidences will allow a discussion regarding program real relevance. If, in fact, no nutritional improvement is reached, PAT fails in its essence. Thus, are there reasons why it should not cease to exist? Certainly, spillover effects may be one. PAT benefits are widely used, boosting other sectors such as restaurants and supermarkets or even creating new ones, as meal voucher providers. However, it is not clear if the job creations and income and taxes generated are enought to offset program inefficiencies.

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