Beyond Cash:
Estimating Externality and Behavioural Change Effects of a non-randomized CCT programme: Paraguay case study

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Introduction

- Conditional Cash Transfer Programmes (CCTs)
- Mostly in Latin American countries: Mexico, Brazil, Chile and Colombia,
  - have been praised as the most effective policy to fight poverty in developing countries;
  - In general, its objectives are defined as:
    - to break the intergeneration transmission of poverty;
    - to alleviate poverty in the short-run;
  - Transfers depend on same actions required from the families: school attendance and health check-ups (and updating immunization cards). Conditionalities.

- Three types of programmes:
  - focused on alleviating poverty in the short-run;
  - very focused on human capital accumulation;
  - focused on medium term poverty alleviation: complementary programmes,
    - Include other components: *platicas*, family guides, training, etc.

- Tekoporã: a pilot CCT in Paraguay.
  - has some features that would allow us to place it in the third group: *platicas* and family guides, three-year limit that a family could stay in the programme;
  - Pilot started in 2005 in 5 out of 7 pre-selected districts.
  - Targeting:
    - Geographical: poorest districts according to the IPG;
    - Categorical: families with children or pregnant woman;
    - Means-testing: poorest families according to the Index of living conditions (ICV).
    - Transfer: Basic benefit 60,000 Guaranies (US$12). Extra 30,000 Guaranies (US$ 6) per child up to a limit of 4. Minimum: 90,000 and Maximum 180,000 Guaranies.

- CCT impact on consumption:
  - What we know...
    - Brazil (Oliveira et al., 2007) e Ecuador (Schady, 2006, 2007):
      - No impact on levels, only on composition;
      - Increase in child clothing and food consumption.
    - Mexico:
      - Increase in expenditures;
      - Diet diversification (Hoddinott e Skoufias, 2004);
      - Increase on food share expenditures (Attanasio e Lechene, 2002);
      - Increase in investment in the acquisition of child-related goods (Rubalcava et al., 2004).
    - Colombia (Attanasio e Mesnard, 2005):
      - Increase in food consumption, but in the same proportion of expenditures in general.

- Things we are not sure about...
  - reasons for changes (or not) on consumption level and in its composition;
  - likely candidates:
    - Increased in the income of beneficiary families;
    - co-responsibilities and complementary programmes;
    - money flows to women (mothers).
  - If non-beneficiary families are also affected by CCT programmes. Does SUTVA fail?

- Objectives:
  - To disentangle ATT into two components:
    a) participation effect (APT);
    b) externality effect (AET).
  - and further decompose these components into:
    - income effect;
    - behavioural change (changes in elasticities)
    - and unobservable changes (JMP approach)

Theoretical illustration (draft)

- Before the program, families have the same preference function $U_F(.)$, which yields the optimum consumption allocation $\left(C_1^{F*},\ldots,C_K^{F*},L_1^{F*},\ldots,L_N^{F*}\right)$
- however the manager of the program has another preference function $U_G(.)$, which yields the optimum consumption allocation $\left(C_1^{G*},\ldots,C_K^{G*},L_1^{G*},\ldots,L_N^{G*}\right)$

- During the program, a game between beneficiary families and program manager is put forward:

	Manager	
Family	income is transferred	income is not transferred
Change behaviour	$U_F\left(C_k^{G*,T}, L_n^{G*,T}\right)$, $\Pi_G\left(C_k^{G*,T}, L_n^{G*,T}\right)$	$U_F\left(C_k^{G*}, L_n^{G*}\right)$, $\Pi_G\left(C_k^{G*}, L_n^{G*}\right)$
Do not change bevariour	$U_F\left(C_k^{F*,T}, L_n^{F*,T}\right)$, $\Pi_G\left(C_k^{F*,T}, L_n^{F*,T}\right)$	$U_F\left(C_k^{F*}, L_n^{F*}\right)$, $\Pi_G\left(C_k^{F*}, L_n^{F*}\right)$

where $\Pi_G(.) = U_G(.) - T$. According to the manager:

$$\Pi_G\left(C_k^{G*}, L_n^{G*}\right) \geq \Pi_G\left(C_k^{G*,T}, L_n^{G*,T}\right) > \Pi_G\left(C_k^{F*}, L_n^{F*}\right) > \Pi_G\left(C_k^{F*,T}, L_n^{F*,T}\right)$$

- Assuming β is the probability of receiving the transfer in case the family changes its behaviour;
- and $1-\beta$ is the probability of NOT receiving the transfer even if the family changes its behaviour;
- α and $1-\alpha$ are the corresponding probabilities in case the family does not change its behaviour;
- Clearly, $\beta > \alpha$.
- Then, a family would change its behaviour if:

$$\beta \cdot U_F\left(C_k^{G^*,T}, L_n^{G^*,T}\right) + (1-\beta) \cdot U_F\left(C_k^{G^*}, L_n^{G^*}\right) >$$
$$\alpha \cdot U_F\left(C_k^{F^*,T}, L_n^{F^*,T}\right) + (1-\alpha) \cdot U_F\left(C_k^{F^*}, L_n^{F^*}\right)$$

- what about externality?
  - the effect of externality would take place in the following periods, when other families would emulate the behaviour of beneficiary families in a process of learning in preferences.
  - Alternatively, the learning process could lead other families to adopt the opposite behaviour of a beneficiary family.

In any case, the larger the number of beneficiaries, the larger the externalities.

Sample design

- Sampling based on the program registry (*Ficha Hogar* and payroll);
  - Baseline Information;
- Comparison group:

Reasons for Non-Receipt of Treatment

	Eligible but not treated	Per cent
Two control districts	**1,160**	**44.24**
No reason (overlooked)	**776**	**29.60**
Rejected by selection committee	542	20.67
Waiting for landless movement permission	127	4.84
Graduated due to economic autonomy	17	0.65
Total	2,622	100

Source: Soares and Ribas (2007).

- Data collection between January and April 2007;
- Sample: 1093 families (316 treated, 430 (c1) , 347 (c2)).

Incorporating externality: SUTVA fails within district

- Let $D_i = 1$ indicate household is in the programme district, $(D_i = 1, T_i = 0)$ indicate the within-community comparison group and $D_i = 0$ indicate the between-community comparison group. Then,
- Average Participation Effect on the Treated (APT) is defined as:

$$\tau_p = E\left[Y_i\left(D_i = 1, T_i = 1\right) - Y_i\left(D_i = 1, T_i = 0\right) \mid T_i = 1\right]$$

- and the Average Externality Effect on the Treated (AET) may be defined as:

$$\tau_e = E\left[Y_i\left(D_i = 1, T_i = 0\right) - Y_i\left(D_i = 0, T_i = 0\right) \mid T_i = 1\right]$$

Then, we may rewrite the *ATT* effect **Error! Reference source not found.**as the sum of both effects:

$$\tau = \tau_e + \tau_p = E\left[Y_i\left(D_i = 1, T_i = 1\right) - Y_i\left(D_i = 0, T_i = 0\right) \mid T_i = 1\right]$$

The identification of these effects requires the following unconfoundedness (CIA) assumptions:

$$T_i \perp \left(Y_i\left(T_i = 0\right), Y_i\left(T_i = 1\right)\right) \mid X_i, D_i .$$

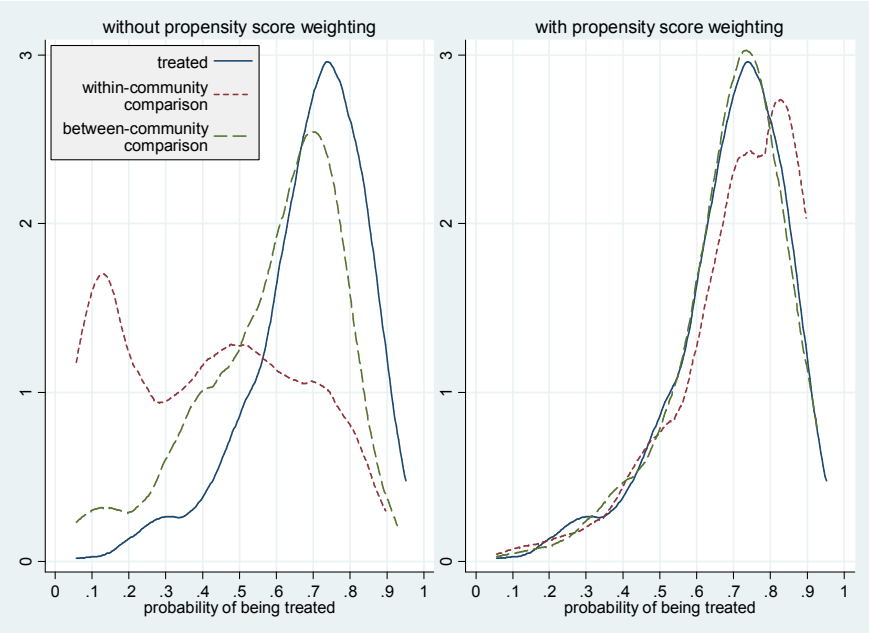
$$D_i \perp \left(Y_i\left(D_i = 0\right), Y_i\left(D_i = 1\right)\right) \mid X_i, T_i = 0 .$$

Without the distinction between comparison groups, one may actually assess the following confounded *ATT* estimator:

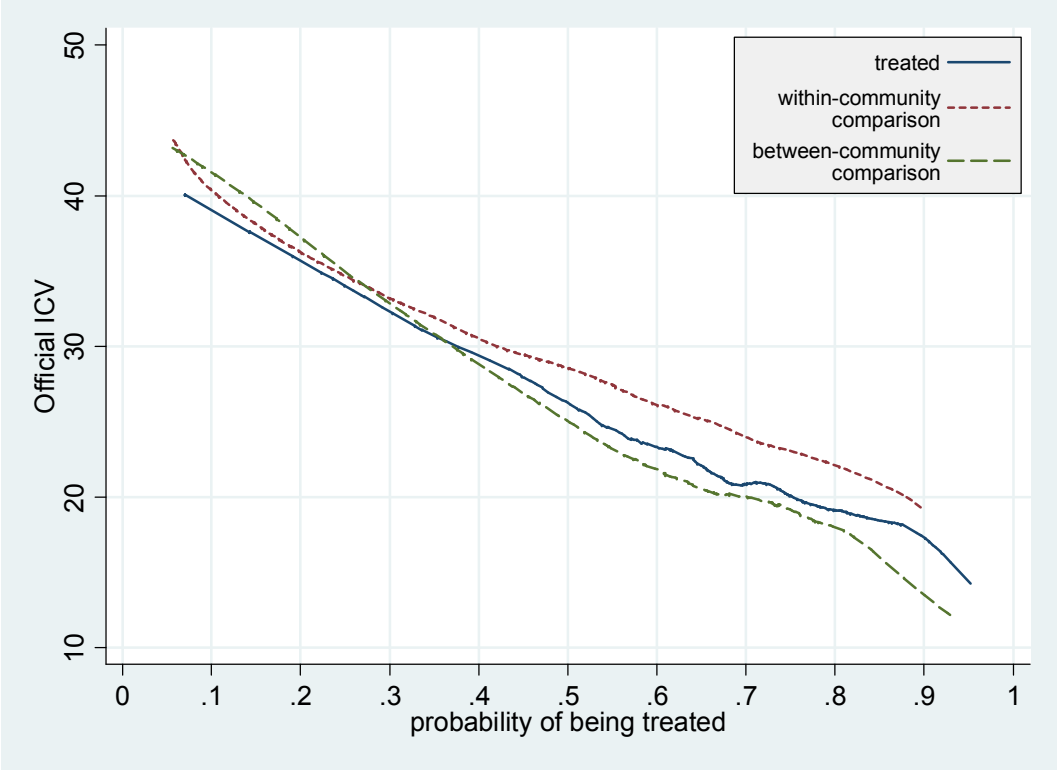
$$\begin{aligned} \hat{\tau}_c = \quad & E\left[Y_i \mid X_i, D_i = 1, T_i = 1\right] \\ & - P\left[D_i = 1 \mid X_i, T_i = 0\right] \cdot E\left[Y_i \mid X_i, D_i = 1, T_i = 0\right] \\ & - P\left[D_i = 0 \mid X_i, T_i = 0\right] \cdot E\left[Y_i \mid X_i, D_i = 0, T_i = 0\right], \end{aligned}$$

Quasi-Experimental Evaluation

- Need to *match* observations;
  - turn the comparison groups comparable to the treated;
- How?
  - Using a multinomial propensity score;



Kernel Functions of Official ICV in Relation to the Probabilities of Being Treated for Treated and Comparison Groups



Adjusting (weighting) on observable variables

- Combination of two methods to estimate ATT (Hirano e Imbens, 2002):
  - Regression:
- ATT=ATP+AET:

$$Y_i = \alpha_0 + \tau_p \cdot T_i + \tau_e \cdot D_i + \alpha_1' X_i + \alpha_2' \left[X_i - E\left(X_i \mid T_i = 1 \right) \right] \cdot T_i + \alpha_3' \left[X_i - E\left(X_i \mid T_i = 1 \right) \right] \cdot D_i + \varepsilon_i ,$$

$$\tau = \tau_p + \tau_e$$

- Confounded ATT:

$$Y_i = \gamma_0 + \tau_c \cdot T_i + \gamma_1' X_i + \gamma_2' \left[X_i - E\left(X_i \mid T_i = 1 \right) \right] \cdot T_i + \xi_i$$

- Why?

$$\begin{aligned}\tau_c = \quad & E\left[Y_i \mid X_i, D_i = 1, T_i = 1\right] \\ & - P\left[D_i = 1 \mid X_i, T_i = 0\right] \cdot E\left[Y_i \mid X_i, D_i = 1, T_i = 0\right] \\ & - P\left[D_i = 0 \mid X_i, T_i = 0\right] \cdot E\left[Y_i \mid X_i, D_i = 0, T_i = 0\right]\end{aligned}$$

- Weighting:

$$\hat{\omega}\left(T_i, D_i, X_i\right) = T_i + \frac{\hat{p}\left(X_i\right) \cdot \left(1 - T_i\right) \cdot D_i}{\hat{e}\left(X_i\right)} + \frac{\hat{p}\left(X_i\right) \cdot \left(1 - D_i\right)}{1 - \hat{p}\left(X_i\right) - \hat{e}\left(X_i\right)}$$

$$p\left(X_i\right) = P\left[D_i = 1, T_i = 1 \mid X_i\right]$$

$$e\left(X_i\right) = P\left[D_i = 1, T_i = 0 \mid X_i\right]$$

Balancing Property:

$$E\left[x_i \mid p\left(X_i\right), T_i = 1\right] = E\left[x_i \mid p\left(X_i\right), D_i, T_i = 0\right] \quad \forall x_i \in X_i$$

Results – Participation and Externality

- ATT without considering externalities are quite different from those that take them into consideration;
- As for per capita consumption, there has been an increase of 20% for those who participate in the programme.

Participation, externality, and total effects of *Tekoporã* on consumption level of treated households

		Effect of Treatment on Treated		
	confounded	participation (1)	externality (2)	total (1) + (2)
log of per capita consumption	0.1028***	0.2128***	-0.2786***	-0.0658
	(0.0369)	(0.0485)	(0.0705)	(0.0627)
log of per capita monetary consumption	0.1079**	0.2059***	-0.2578***	-0.0519
	(0.0457)	(0.0603)	(0.0878)	(0.0781)
log of per capita food consumption	0.0560	0.1401***	-0.2019***	-0.0618
	(0.0395)	(0.0528)	(0.0767)	(0.0682)
saving rate	0.1978***	0.0649	0.2279**	0.2928***
	(0.0480)	(0.0619)	(0.0913)	(0.0814)

Source: Own calculation based on the Evaluation Survey.
Note: Significant at *10%, **5% and ***1%. Standard error in parenthesis.

- However, this effect is totally mitigated by a negative externality,
- And the reason for that is the fact that saving rates is completely "externalized"

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Source: Own calculation based on the Evaluation Survey.
Note: Significant at *10%, **5% and ***1%. Standard error in parenthesis.

- Similarly, participation in the program reduces the share of food and increases the share of other items.
- However, the food share is externalized with the opposite sign.

Participation, externality, and total effects of *Tekoporã* on monetary consumption composition of treated households

	Effect of Treatment on Treated			
	confounded	participation(1)	externality(2)	total (1) + (2)
food share	-0.0514***	-0.0733***	0.0593**	-0.0140
alcohol beverage share	-0.0007	0.0015	-0.0072***	-0.0056***
tobacco share	0.0021	0.0040**	-0.0026	0.0013
adult clothing share	0.0010	0.0102***	-0.0188***	-0.0086*
child clothing share	0.0278***	0.0255***	0.0019	0.0274***
education share	0.0059*	0.0026	-0.0014	0.0012
health share	0.0158**	0.0266***	-0.0076	0.0190
housing share	-0.0032	-0.0085***	0.0084*	-0.0002

Source: Own calculation based on the Evaluation Survey.
Note: Significant at *10%, **5% and ***1%. Standard error in parenthesis.

- In general, program reduces the share of adult clothing;
- However, among beneficiaries, the share of this item is higher.

Participation, externality, and total effects of *Tekoporã* on monetary consumption composition of treated households

	Effect of Treatment on Treated			
	confounded	participation(1)	externality(2)	total (1) + (2)
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adult clothing share	0.0010	0.0102***	-0.0188***	-0.0086*
child clothing share	0.0278***	0.0255***	0.0019	0.0274***
education share	0.0059*	0.0026	-0.0014	0.0012
health share	0.0158**	0.0266***	-0.0076	0.0190
housing share	-0.0032	-0.0085***	0.0084*	-0.0002

Source: Own calculation based on the Evaluation Survey.
Note: Significant at *10%, **5% and ***1%. Standard error in parenthesis.

- The fall in the share of alcohol beverage is completely due to externality;
- The effect on the increase in expenditures with child clothing and health is not externalized (co-responsibilities on beneficiaries)

Participation, externality, and total effects of *Tekoporã* on monetary consumption composition of treated households

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	confounded	participation(1)	externality(2)	total (1) + (2)
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health share	0.0158**	0.0266***	-0.0076	0.0190
housing share	-0.0032	-0.0085***	0.0084*	-0.0002

Source: Own calculation based on the Evaluation Survey.
Note: Significant at *10%, **5% and ***1%. Standard error in parenthesis.

Measuring income and behavioural change effects

- J-M-P decomposition (1993):
  - Suppose that $Y_{i,D,T} = g_{D,T}\left(W_{i,D,T}, F^{-1}_{D,T}\left(\theta_{i,D,T} \mid W_{i,D,T}\right)\right)$.
  - If $\overline{g}(.,.)$ and $\overline{F}(.)$ are counterfactual functions:

$Y_{i,D,T} = Y^{W}_{i,D,T} + Y^{g}_{i,D,T} + Y^{u}_{i,D,T}$, where

$$Y^{W}_{i,D,T} = \overline{g}\left(W_{i,D,T}, \overline{F}^{-1}\left(\theta_{i,D,T} \mid W_{i,D,T}\right)\right),$$

$$Y^{g}_{i,D,T} = g_{D,T}\left(W_{i,D,T}, \overline{F}^{-1}\left(\theta_{i,D,T} \mid W_{i,D,T}\right)\right) - \overline{g}\left(W_{i,D,T}, \overline{F}^{-1}\left(\theta_{i,D,T} \mid W_{i,D,T}\right)\right)$$

$$Y^{u}_{i,D,T} = g_{D,T}\left(W_{i,D,T}, F^{-1}_{D,T}\left(\theta_{i,D,T} \mid W_{i,D,T}\right)\right) - g_{D,T}\left(W_{i,D,T}, \overline{F}^{-1}\left(\theta_{i,D,T} \mid W_{i,D,T}\right)\right)$$

- Therefore:

$$\tau = E\left[\left(Y_{i,1,1}^{W} - Y_{i,0,0}^{W}\right) + \left(Y_{i,1,1}^{g} - Y_{i,0,0}^{g}\right) + \left(Y_{i,1,1}^{u} - Y_{i,0,0}^{u}\right) \mid T_i = 1\right]$$

$$\tau_p = E\left[\left(Y_{i,1,1}^{W} - Y_{i,1,0}^{W}\right) + \left(Y_{i,1,1}^{g} - Y_{i,1,0}^{g}\right) + \left(Y_{i,1,1}^{u} - Y_{i,1,0}^{u}\right) \mid T_i = 1\right]$$

$$\tau_e = E\left[\left(Y_{i,1,0}^{W} - Y_{i,0,0}^{W}\right) + \left(Y_{i,1,0}^{g} - Y_{i,0,0}^{g}\right) + \left(Y_{i,1,0}^{u} - Y_{i,0,0}^{u}\right) \mid T_i = 1\right]$$

- In practice:
  - Income elasticity (and each one of its components) is estimated non-parametrically for both groups (comparison and treated) in a first stage;
  - In a second stage, the impact on each component is estimated as we have done before.
  - Finally, the variance of each estimator is corrected according to the variance of the first stage.

Results – Income Effect vs. Behavioural Change

- ATP effect on consumption level and on food consumption and on saving rates is basically determined by incrases in income.

Decomposition of the participation effect of *Tekoporã* on consumption level of treated households

	Effect of Participation on Treated				
	total	marginal income	total income	income elasticity	non-observables
log of per capita consumption	0.2128***	0.0683	0.0962**	0.0255	0.0911
	(0.0485)	(0.0506)	(0.0391)	(0.0679)	(0.0738)
log of per capita monetary consumption	0.2059***	0.0581	0.0481	0.0216	0.1363
	(0.0603)	(0.0772)	(0.0413)	(0.0819)	(0.0929)
log of per capita food consumption	0.1401***	0.0845	0.1137**	-0.0435	0.0698
	(0.0528)	(0.0559)	(0.0460)	(0.0800)	(0.0841)
saving rate	0.0649	0.0953*	0.1123***	0.0565	-0.1039
	(0.0619)	(0.0536)	(0.0434)	(0.0728)	(0.0852)

Source: Own calculation based on the Evaluation Survey.
Note: Significant at *10%, **5% and ***1%. Standard error in parenthesis.

- With regard to AET it is mainly explained by changes in income elasticity.
- Overall, the programme leads families to save more and consume less, given its income level.

Decomposition of the externality effect of *Tekoporã* on consumption level of treated households

	Effect of Externality on Treated				
	total	marginal income	total income	income elasticity	non-observables
log of per capita consumption	-0.2786***	-0.0136	-0.0222	-0.1627**	-0.0937
	(0.0705)	(0.0556)	(0.0479)	(0.0787)	(0.0943)
log of per capita monetary consumption	-0.2578***	-0.0098	-0.0109	-0.1556*	-0.0913
	(0.0878)	(0.0818)	(0.0450)	(0.0887)	(0.1166)
log of per capita food consumption	-0.2019***	-0.0179	-0.0313	-0.1165	-0.0541
	(0.0767)	(0.0623)	(0.0559)	(0.0885)	(0.1030)
saving rate	0.2279**	-0.0209	-0.0167	0.1815**	0.0631
	(0.0913)	(0.0613)	(0.0555)	(0.0877)	(0.1138)

Source: Own calculation based on the Evaluation Survey.
Note: Significant at *10%, **5% and ***1%. Standard error in parenthesis.

- All APT estimates on the composition of monetary expenditures are not much influenced by income increases;
- Actually, in some cases, the effect of change in elasticities is quite evident.

Decomposition of the participation effect of *Tekoporã* on monetary consumption composition of treated households

	Effect of Participation on Treated				
	total	marginal income	total income	income elasticity	non-observables
food share	-0.0733***	-0.0021	-0.0026	-0.0613**	-0.0093
tobacco share	0.0040**	0.0000	-0.0001	0.0025	0.0016
adult clothing share	0.0102***	-0.0001	-0.0007	0.0109**	-0.0001
child clothing share	0.0255***	0.0010	0.0013	0.0258***	-0.0016
health share	0.0266***	-0.0011	0.0018	0.0076	0.0172
housing share	-0.0085***	0.0006	-0.0019	-0.0030	-0.0037

Source: Own calculation based on the Evaluation Survey.
Note: Significant at *10%, **5% and ***1%. Standard error in parenthesis.

- With regard to AET on composition of expenditures, the income effect does not play a major role.

Decomposition of the externality effect of *Tekoporã* on monetary consumption composition of treated households

	Effect of Externality on Treated				
	total	marginal income	total income	income elasticity	non-observables
food share	0.0593**	0.0003	-0.0019	0.0570**	0.0042
alcohol beverage share	-0.0072***	0.0001	0.0001	-0.0017	-0.0055***
adult clothing share	-0.0188***	-0.0002	0.0004	-0.0154***	-0.0038
housing share	0.0084*	-0.0001	0.0017	0.0054	0.0013

Source: Own calculation based on the Evaluation Survey.
Note: Significant at *10%, **5% and ***1%. Standard error in parenthesis.

Final considerations.

- CCT can lead to changes in the whole community, rather than affecting only beneficiary families. These effects are quite important when discussing how to measure the parameter of interest (ATT) and increase the efficiency of CCT programs.
- It is not always the case that the so-called externality effect has the same sign as the participation effect. Some impacts can be mitigated due to social interaction.
- Although some of the impacts of *Tekoporã* are due to the increase in the income of beneficiary families, many impacts are due to change in the behaviour of the families.

- The explanation is that the income effect might be insufficient to provoke changes in consumption patterns.
- Therefore, some complementary programmes and conditionalities can be quite important to achieve higher impact on some outcomes.
- If this is the case, the role of the transfer – thought of alleviating income deprivation in the short term – can be limited in terms of changing family's behaviour.
- Our research agenda includes comparative studies among different programmes to see the impact of different designs on the important of income and behavioural change effects on the observed outcomes.