Food and Nutrient Demand in the context of the Conditional Cash Transfer "Oportunidades" in Mexico

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Abstract

The conditional cash transfer program «Oportunidades» has been implemented in Mexico in order to alleviate intergenerational poverty by investing in human capital through education, health and nutrition. We estimate food and nutrient elasticities of demand with respect to income and price by the virtue of QUAIDS. We find that beneficiary households show a higher diversity of the diet; however, this diversity is not large enough to increment the sources of macro- and micronutrient intake. The value of the beneficiaries' calorie elasticity also suggests that their need for food may not be entirely satisfied even after the reception of the monetary transfer.

Keywords: *conditional cash transfer, Quadratic Almost Ideal Demand System, income and price elasticities, nutrient intake, Mexico*

1. Introduction

Cash transfers have the purpose of immediate alleviation of poverty and the reduction of poverty, as they can ease consumption; in the long run cash transfers can help households develop human capital by investing in nutrition, health and education of its members, generate savings to acquire productive assets, get access to credit, empower particularly women, and promote social cohesion (Arnold, 2011). In most cash transfer programs, the cash is given directly to women, under the rationale that women's empowerment and control over the resources will lead to a higher expenditure on their children health, nutrition and education, which will help to attain the objectives of the program (Gitter & Barham, 2008). Cash transfers directly increase the income of recipients, which may translate into more and more nutrient dense food consumption, and thus increase diet quality (Leroy, Ruel, & Verhofstadt, 2009); however, it has been found little impact on anthropometric measures of nutritional status on recipients of conditional cash transfers (Alderman, 2014).

In order to evaluate the potential of the CCT program "Oportunidades" to accomplish its nutritional objective, i.e. to increase food consumption and to improve quality and diversity of the diet, we will analyze whether the program has achieved to improve the food availability of the program-beneficiaries compared to non-beneficiaries, and whether it has led to a more diverse and nutrient-rich food consumption for beneficiaries. These questions will be answered by deriving food and nutrient elasticities of demand with respect to income and price from a Quadratic Almost Ideal Demand System.

2. Methodology

We will use data from the 2010 Mexican National Survey on Households' Income and Expenditure (ENIGH). The module 'Daily expenditure' and 'Concentrated' of ENIGH provide data on quantity and expenditure on different food items, and household characteristics respectively. Households with similar characteristics as beneficiaries of the conditional cash transfer «Oportunidades», including similar total average income per capita (after receiving the cash transfer) were selected as control group, from now on referred to as non-beneficiaries. There are a total of 4,300 beneficiary households and 5,289 non-beneficiary households. To calculate the nutrient consumption from the food consumed reported in the survey, we used the conversion factors published especially for Mexican diets "Mexican System of Equivalent Food" (Pérez Lizaur, Marván Laborde, & Palacios, 2008). Missing values were obtained from the USDA National Nutrient Database for Standard Reference (U.S. Department of Agriculture, Agricultural Research Service., 2013)

Here we will present the summarized methodology, please refer to the complete paper (available upon request) for a detailed exposition. To estimate the expenditure allocation at the first stage budgeting level we follow Leser's approach (Leser, 1963), since it is most likely that the food Engel curve exhibits a linear formulation (Banks, Blundell, & Lewbel, 1997):

$$w_i = \alpha_i + \beta_i lnM + \gamma_i \frac{1}{M} + \varepsilon_i \tag{1}$$

where M represents total expenditure. From (1) we can derive food-at-home expenditure elasticity as $E_F^u = (\alpha_i + \beta_i)\ln M$.

The second and third stage budgeting level, i.e. different food groups and food items of each group, are estimated with the virtue of the Quadratic Almost Ideal System developed by Banks et al. (1997), taking into account the issue of zero expenditure and endogeneity as follows:

- The decision of not consuming certain products may represent to households an optimal decision for the given set of prices and income. These households represent potential consumers that may move away from the corner solution to a positive level of consumption, if there is a significant change in prices or income. We will follow the two-step estimation of a censored system proposed by Shonkwiler & Yen (1999) to handle the zero-expenditure issue.

- As discussed by Tafere, Taffesse, & Tamiru (2010), under the assumption of separability of durables and non-durables in household choice, there is the possibility that total expenditure is also determined by the budget shares of the different commodities. To reduce the risk of obtaining inconsistent parameter estimates, total expenditure can be regressed on its reduced form (Blundell & Robin, 1999). The residual is then added to the budget share equations together with total expenditure. Additionally, we considered it necessary to include the residual from the squared total expenditure regressed on its reduced form, since this term is also included in the QUAIDS model. After controlling for zero expenditure and endogeneity, the demand system takes the form

$$w_i^* = \Phi\left(z_{if}'\widehat{\theta}_i\right)\left\{\alpha_i + \sum_{j=1}^n \gamma_{ij}\ln p_j + \beta_i\ln\left[\frac{m}{a(\mathrm{p})}\right] + \frac{\lambda_i}{b(\mathrm{p})}\left\{\ln\left[\frac{m}{a(\mathrm{p})}\right]\right\}^2 + \tau_i\hat{e}_f +$$

$$\rho_i\hat{u}_f\right\} + d_i\phi\left(z_{if}'\widehat{\theta}_i\right) + \xi_i \tag{2}$$

Where $\Phi(.)$ and $\phi(.)$ are the cumulative distribution function and normal density function computed previously to control for zero expenditures with z as a set of household characteristics; the expression in parenthesis is the QUAIDS where i and j are the sub-indices for households and food item in the group considered respectively, m is the total expenditure on the food group, p is the N-vector of prices, plus $\hat{e}_f$ and $\hat{u}_f$, the residuals that are added to the system to control for endogeneity.

The expenditure elasticity is expressed as: $E_i = \mu_i + 1 - \varphi_i$ where $\mu_i \equiv \frac{\partial w_i^*}{\partial \ln m} = \Phi\left(z_{if}'\widehat{\theta}_i\right)\left[\beta_i + \frac{2\lambda_i}{b(\mathrm{p})}\left\{\ln\left[\frac{m}{a(\mathrm{p})}\right]\right\}\right]$ and φ_i is the 'quality' elasticity. The Marshallian price elasticities are given by $e_{ij}^u = \frac{\mu_{ij}}{w_i^*} - \delta_{ij}$, where δ_{ij} is the Kronecker delta, and $\mu_{ij} \equiv \frac{\partial w_i^*}{\partial \ln p_j} = \Phi\left(z_{if}'\widehat{\theta}_i\right)\left[\gamma_{ij} - \mu_i\left(\alpha_j + \sum_k \gamma_{jk}\ln P_k\right) - \frac{\lambda_i\beta_j}{b(\mathrm{p})}\left\{\ln\left[\frac{m}{a(\mathrm{p})}\right]\right\}^2\right]$. Hicksian price elasticities are such that $e_{ij}^c = e_{ij}^u + E_i w_j$. We compute the unconditional expenditure and price elasticities of demand, under the assumptions of weak separability, and the assumption that the price indices being used do not vary greatly with expenditure level as:

$$E_i = E_{(r)i} \cdot E_{(r)} \tag{3a}$$

$$\tilde{e}_{ij} = \delta_{rs}e_{(r)ij}^c + E_{(r)i}w_{(s)j}^*(e_{rs}^c + E_r w_s^* E_F^u) \tag{3b}$$

Ecker & Qaim (2011) extend the common calorie elasticity with respect to expenditure and prices analysis to various micro- and macronutrients. The nutrient elasticity with respect to expenditure takes then the form:

$$E_N = \frac{\sum_j \sum_f c_{ifN} s_{if} q_j E_j}{\sum_j \sum_f c_{ifN} s_{if} q_j} \tag{4}$$

The nutrient elasticity with respect to food prices is described as:

$$e_{iN} = \frac{\sum_j \sum_f c_{ifN} s_{if} q_j \tilde{e}_{ij}}{\sum_j \sum_f c_{ifN} s_{if} q_j} \tag{5}$$

The coefficient c_{ifN} measures the content of nutrient N in food item f of food group j; s_{if} is the quantity share of food item f in food group j; and q_j is the average quantity consumed of food group j. E_j and $\tilde{e}_{ij}$ are the total or unconditional expenditure and price elasticities, respectively.

3. Results and Discussion

Beneficiaries of the CCT program "Oportunidades" show, in general, higher *expenditure elasticities* of demand for food-at-home and most food groups and food items (see Table 1). That means that, ceteris paribus, an increase in income would represent a higher expenditure on food for beneficiaries than non-beneficiaries; so it could be said that participants of the program have not seen as satisfied their needs for food as non-beneficiaries. Both groups have similar total incomes, so it could be that either, the amount of the cash transfer intended to ameliorate the nutritional status of the families is not large enough to make a difference in food expenditure, or that the cash transfer received is allocated to other kind of expenditures

Table 1. Unconditional Marshallian expenditure and own-price elasticities

	Expenditure share		Expenditure Elasticity				Own-price Elasticity			
	Ben.	Non-Ben.	Beneficiaries		Non-Ben.		Beneficiaries		Non-Ben.	
Food-at-home	0.498	0.452	0.434	(0.00)	0.348	(0.00)				
Staple foods	0.545	0.562	0.559	(0.01)	0.406	(0.01)				
Beans	0.201	0.145	0.502	(0.00)	0.355	(0.00)	-0.477	(0.09)	-0.411	(0.12)
Wheat	0.246	0.234	0.499	(0.00)	0.354	(0.00)	-0.709	(0.05)	-0.464	(0.05)
Rice	0.125	0.078	0.517	(0.00)	0.341	(0.04)	-0.890	(0.23)	-0.623	(0.27)
Potatoes	0.127	0.108	0.522	(0.00)	0.390	(0.00)	-0.672	(0.19)	-0.654	(0.22)
Maize	0.302	0.435	0.619	(0.00)	0.423	(0.01)	-1.107	(0.06)	-0.520	(0.05)
Animal products	0.173	0.174	0.334	(0.01)	0.268	(0.01)				
Beef	0.193	0.208	0.323	(0.00)	0.255	(0.00)	-1.544	(0.49)	0.016	(0.16)
Chicken	0.262	0.239	0.311	(0.00)	0.226	(0.00)	-0.167	(0.16)	-0.469	(0.11)
Milk	0.203	0.234	0.319	(0.00)	0.274	(0.02)	-1.151	(0.38)	-0.798	(0.12)
Eggs	0.266	0.240	0.279	(0.00)	0.225	(0.00)	-0.472	(0.08)	-0.604	(0.09)
Pork	0.077	0.080	0.322	(0.00)	0.274	(0.00)	-0.394	(0.7)	-0.303	(0.33)
Vegetables	0.087	0.073	0.397	(0.01)	0.330	(0.00)				
Zucchini	0.144	0.163	0.369	(0.05)	0.293	(0.00)	1.445	(0.86)	-0.766	(0.33)
Onion	0.212	0.198	0.381	(0.00)	0.298	(0.00)	-0.575	(0.11)	-0.817	(0.09)
Green tomato	0.174	0.164	0.362	(0.05)	0.321	(0.00)	0.212	(0.52)	-0.976	(0.31)
Tomatoes	0.471	0.475	0.037	(0.00)	0.023	(0.00)	-0.583	(0.03)	-0.554	(0.02)
Fruits	0.057	0.055	0.342	(0.00)	0.275	(0.00)				
Orange/Lemon	0.233	0.251	0.324	(0.05)	0.293	(0.00)	-0.705	(0.78)	-0.120	(0.40)
Apple	0.215	0.238	0.263	(0.00)	0.222	(0.00)	-0.391	(0.72)	-0.050	(0.48)
Papaya	0.081	0.041	0.225	(0.00)	0.182	(0.00)	15.014	(8.80)	0.213	(3.21)
Banana	0.472	0.469	0.264	(0.03)	0.219	(0.00)	-0.974	(0.30)	-0.387	(0.22)
Complements	0.138	0.137	0.436	(0.01)	0.328	(0.01)				
Alcohol	0.065	0.085	0.376	(0.00)	0.304	(0.00)	-7.139	(7.28)	13.555	(4.18)
Sugar	0.285	0.256	0.422	(0.01)	0.308	(0.00)	-0.890	(0.17)	0.002	(0.32)
Soda	0.338	0.354	0.464	(0.00)	0.332	(0.00)	-1.042	(0.11)	-0.660	(0.07)
Fat & oil	0.292	0.273	0.411	(0.01)	0.304	(0.00)	-0.762	(0.11)	-0.692	(0.24)
Chips	0.021	0.032	0.293	(0.00)	0.289	(0.00)	1.327	(1.27)	-0.172	(1.35)

Note: Standard errors in parentheses   Source: own estimation.

rather than food. However, a positive outcome of the program is that beneficiaries present higher *expenditure shares* on fruits and vegetables compared to non-beneficiaries, probably as a result of the nutritional and health recommendations provided by the program. Table 1 also shows than an increase in income would favor mostly staple food consumption, which in turn will be translated into high *nutrient-expenditure elasticities*, particularly calories, protein, carbohydrates, iron and zinc, and low *nutrient-expenditure elasticities* for vitamins A and C, as shown in table 2.

Table2. Nutrient elasticity of demand with respect to expenditure

	Energy (kcal)	Protein	Lipids	Carbohydrates	Fiber	Vit A	Vit C	Folic Acid	Iron	Calcium	Zinc
Beneficiaries	0.475	0.450	0.413	0.516	0.507	0.242	0.095	0.464	0.479	0.491	0.486
Non-Beneficiaries	0.342	0.314	0.302	0.369	0.349	0.204	0.081	0.303	0.320	0.339	0.336

Source: own estimation.

Table 3 shows nutrient-price elasticities for beneficiaries only. These elasticities reflect, at nutrient level, the substitution effects among and within food groups after a price shock. In general, these values are low which means that beneficiary households are able to substitute among and within food groups to adjust their nutrient intake whenever prices change. Nevertheless, nutrient intake of beneficiary households is very sensitive to price changes of maize, beans, eggs, and tomatoes. The dependence on such few food products to obtain all macro- and micronutrients is of great concern since it shows the potential risk of malnutrition, and thus poor cognitive development, if a price shock occurs. On the other hand, an increase in the price of soda will stimulate an important macro- and micronutrients intake.

Table3. Beneficiaries' nutrient elasticity of demand with respect to price

	Energy (kcal)	Protein	Lipids	Carbo-hydrates	Fiber	Vit A	Vit C	Folic Acid	Iron	Calcium	Zinc
Beans	0.022	-0.045	0.069	0.009	-0.174	0.019	0.026	0.054	-0.122	-0.152	-0.025
Wheat	-0.019	-0.083	0.054	-0.050	0.028	0.027	0.038	-0.201	-0.045	-0.001	0.073
Rice	0.015	-0.004	0.015	0.010	0.054	0.007	0.009	-0.208	-0.013	0.046	0.043
Potatoes	0.023	0.004	0.028	0.022	-0.010	0.007	0.009	-0.025	-0.008	0.002	0.039
Maize	-0.097	-0.089	0.099	-0.202	-0.244	0.036	0.048	0.127	-0.088	-0.189	-0.421
Beef	0.010	-0.031	0.011	0.016	0.014	-0.050	0.000	0.013	-0.009	0.072	-0.046
Chicken	0.019	-0.016	0.012	0.031	0.031	0.111	0.001	0.028	0.026	0.075	-0.009
Milk	0.013	0.042	0.010	0.009	0.016	0.027	0.000	0.014	0.040	-0.101	0.047
Eggs	0.022	-0.001	-0.004	0.042	0.045	-0.242	0.001	0.040	-0.005	0.005	0.018
Onion	0.015	0.011	0.013	0.017	0.009	-0.004	-0.077	-0.007	0.015	0.018	0.013
Tomatoes	0.052	0.038	0.041	0.061	0.053	-0.013	-0.061	0.040	0.048	0.053	0.045
Apple	0.008	0.009	0.002	0.011	0.008	-0.014	-0.430	-0.018	0.013	0.013	0.011
Banana	0.012	0.017	0.003	0.016	0.014	-0.012	-0.162	-0.006	0.021	0.026	0.019
Sugar	-0.065	0.030	0.017	-0.128	0.049	-0.002	0.003	0.046	0.037	0.037	0.041
Soda	0.131	0.066	0.214	0.094	0.090	-0.005	0.007	0.079	0.085	0.086	0.056
Fat & oil	-0.140	0.028	-0.511	0.040	0.034	-0.002	0.003	0.029	0.036	0.037	0.029

Source: own estimation.

4. Conclusions

An increase in income of beneficiaries of the conditional cash transfer program "Oportunidades" would lead to higher consumption of food and also a greater consumption of food in terms of calories as compared to non-beneficiaries. That is, beneficiary households would rather consume staple foods that are rich in calories, than fruits or vegetables that are

relatively poorer in calories. This results from a not yet satisfied need for food, even after the reception of the cash transfer. It could be that either, the amount of the cash transfer is not large enough to make a difference in food consumption, or that households are spending the cash received on other goods rather than food, thus undermining the nutritional objective of the program.

However, a positive outcome of the program, possibly due to the nutritional and health talks provided to women participating in the program, is the observed diversity of the food consumed among and within food groups. Nevertheless, this diversification of the diet has not been large enough to multiply the sources of macro- and micronutrients intake. Beneficiary households are remarkably vulnerable to price changes of maize, tomatoes, beans, and eggs. An increase in prices of any of these products would result in an important macro- and micronutrient availability loss. It is of concern then, the little cushion effect that this program would provide in the case of a general food prices increase, especially because of the importance of micronutrient intake for proper child development. Certainly, the income effect is much higher when it comes to increase the availability of macro- and micronutrients to beneficiary households, whereby it is of utmost importance to ensure that the cash transferred is intended to food purchases.

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