Neighborhood Effects of Social Security Payments to Poor Rural Families[†]

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This paper uses a structural model and data collected for the evaluation of the rural component of *Oportunidades*, Mexico's flagship social security program, to understand how regular cash payments to poor rural households affect local prices, and how price changes affect cash recipients' non-poor neighbors. The structural analysis suggests an increase in local wages and non-food prices, yet no rise in food prices. The model explains this with different directions of commodity flows (village exports food but imports non-food) and endogenous transaction costs of trade. For non-poor neighbors, this implies higher food consumption yet lower non-food consumption. Overall, non-poor neighbors' utility falls by two percent.

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1 Introduction

A. Motivation

Many emerging countries have recently started (or expanded) large-scale social security programs. Examples include Brazil's *Bolsa Familia* and Mexico's *Oportunidades* program. The former benefits about fifty, the latter around twenty million people. Benefits of South Africa's pension scheme were recently expanded for the black population. In 2006, India's government launched the National Rural Employment Guarantee Act (NREGA), which benefits more than fifty million households. Those programs all have one thing in common: They make substantial cash payments to the poorest households in rural areas.[1] The impacts of these payments on recipients' outcomes are well documented in the literature.[2]

The focus of this paper is not on payment recipients. Instead, it is studied how non-recipients living in the same neighborhood are affected. Knowledge on neighborhood effects is important when it comes to assessing the policy's overall (or distributional) impact. Yet, because most program evaluations focus on payment recipients, very little is known about welfare effects on non-recipients. Angelucci and De Giorgi (2009) and Angelucci et al. (2010) find that recipients share part of the payment with their extended family. This paper looks at another possible channel: *Local general equilibrium effects*. Economic intuition already suggests that liquidity injections into small rural communities may affect local markets hence non-recipients. Yet, as Barrientos (2012) points out, little systematic effort has been made to understand which markets are affected and how. Studying Mexico's *Oportunidades*, Barrientos and Sabatés-Wheeler (2011) conclude that "further work is needed to pinpoint with greater precision the channels and processes through which the local economic effects of transfers work".

B. Preview of main findings

Section 2 develops a local general equilibrium model. The model extends the work of Lehmann (2013), who uses a general equilibrium model to

[1]Benefits of South Africa's pension program, for example, were about twice the median income per capita in rural areas. The cash payments of *Oportunidades* amount to more than 20% of beneficiaries' pre-program household consumption.

[2]See, for example, Fizbein and Schady (2009) for *Oportunidades* and *Bolsa Familia*, Duflo (2003) for the South African pension scheme, and Basu (2013) for NREGA.

study the intra-village expansion of *Oportunidades*. The basic set-up consists of a village populated by poor and non-poor households. Each household is endowed with staple (food) as well as labor, and chooses a consumption bundle (food, non-food, leisure) which maximizes utility subject to a budget constraint. Poor households receive a social security cash payment by the federal government. The staple (food) is produced *inside* the village, while the non-food commodity is produced *outside*. The village exports a fraction of its staple and imports non-food commodities. These assumptions reflect that rural areas specialize in staple production, while importing industrialized products from urban areas.[3] Importing implies transactions costs, in particular labor. The village price of non-food consists of an exogenous component ('world market' price) *plus* an endogenous component (labor costs linked to importing non-food to the village). Labor costs are endogenous because the procurement of non-food requires village residents' labor.[4] In equilibrium the village's labor market must clear, which determines the village's wage rate hence the village price of non-food. Food prices are determined in a similar vein but, because food is exported, its village price consists of an exogenous component *minus* labor costs linked to export food. If, as is common in practice, food is sold at the farmgate (hence no village residents' labor is required for export), food prices become exogenous. In this case, if wages go up, non-food prices increase while food prices remain unaffected.

The model predicts the cash payment to increase recipients' demand for non-food items. The additional labor requirements for procurement cause growth of village wages. Higher wages have an ambiguous effect on non-food consumption of non-poor households. On the one hand, income hence demand for non-food items increases. On the other hand, the costs of importing non-food items go up. Non-food consumption decreases if the price effect outweighs the income effect. Conditions are derived under which this is the case. Food prices do not increase. The income effect from higher local wages, therefore, increases non-poor households' consumption of food yet not necessarily of non-food.

[3]Household data for rural Mexico, for example, shows that half of rural households' monthly consumption consists of imported hygiene products (e.g. soap, combs, tooth and hair brushes, detergents, whiteners), household utensils (plates, towels, combs etc.), clothing, tennis shoes and boots, school supplies (pens and paper), and energy (batteries, gas, petrol).

[4]Major national grocery chains, or other forms of non-food procurement which do not require village residents' labor, do not usually exist in villages.

Section 3 brings empirical evidence for the predictions of the model, using data collected for the evaluation of the rural component of *Oportunidades*. 506 villages were randomized into treatment and control villages, and households in these villages were classified as either poor or non-poor. Poor households in treatment villages would receive regular cash payments by the government.[5] The existing literature finds indeed no effect of *Oportunidades* on food prices, and higher food consumption of non-poor households in treatment villages (Angelucci and De Giorgi, 2009).

Little, on the other hand, is known about *Oportunidades*'s impact on non-food prices and non-food consumption. Lack of data is a major challenge: Only non-food expenditures are observed from the data, yet neither prices nor quantities. This paper approaches the data problem in two different ways, the first using reduced-form and the second using structural estimations. The reduced-form approach compares changes in non-food expenditure at the extensive margin, and finds that non-poor households in treatment villages have a lower probability of purchasing non-food items, suggesting a decrease in non-food consumption.

The structural approach uses an empirical version of the model - calibrated to the *Oportunidades* data - to simulate changes in consumed non-food quantities. In a first step, the parameters of the model are calibrated to data available on households residing in control villages. In a second step, out-of-sample forecasts are conducted: The cash transfer is added to the income of poor households in the control village sample. To test the performance of the model, the resulting simulated moments are compared to the actual moments observed in the treatment village sample. Thus, in the vein of Todd and Wolpin (2006), the experimental design of *Oportunidades* is used as a source of model validation. The model is able to replicate reasonably well the moments of the treatment group sample. This increases confidence in by the model simulated impacts of *Oportunidades* on non-food consumption. The exercise suggests a decrease in non-poor households' non-food consumption of about seven percent. Overall, non-poor households' utility falls by roughly two percent.

Section 5 studies heterogenous effects on non-poor households' *per capita* non-food consumption. Analytical expressions are derived which show how

[5]Payments were of substantial size, about 20% of the poors' pre-program household income. See Hoddinott and Skoufias (2004) for a detailed description of the program.

the sign and magnitude of the effect depend on household level parameters (endowments, preferences), as well as parameters that describe the program (size of cash payments) and local context (number of payment recipients, land distribution, aggregate agricultural productivity). Model and the data, for example, suggest that non-food consumption is more likely to decrease in non-poor households with few labor endowments, i.e. in households with below average number of adult household members.

C. Contribution

The paper contributes the literature on neighborhood effects of social transfers.[6] In particular, Angelucci and De Giorgi (2009) find positive effects of *Oportunidades* on food consumption of non-recipients. Non-food consumption is not observed from the *Oportunidades* data. This paper uses both reduced-form and structural techniques to find that, in contrast to food consumption, non-food consumption may have decreased.

The paper further adds to a small but growing literature on general equilibrium effects of social transfers.[7] (1) Wages: An unsettled question in the literature is whether cash payments affect wages. Angelucci and De Giorgi (2009) find no effect on wages. Alzúa et al. (2013) and Attanasio et al. (2012) find women and child wages to increase. The wage measure used in these studies divides total labor income by hours or days worked, including both inside as well as outside village labor supply and income. Because the bulk of labor supply and income is generated outside the village (in particular through seasonal migration), this wage measure does not necessarily reflect a village's wage rate. The wage proxy constructed in this paper is based only on within-village activities, and suggests village wages to increase. This seems in line with higher wages for women and children reported by the literature, because these are more likely to work inside

[6] Bobonis and Finan (2009) and Lalive and Cattaneo (2009) find that *Oportunidades* payments change the schooling decisions of payment recipients' neighbors. Neighborhood effects have also been studied for other types of interventions. See for example Miguel and Kremer (2004), who find that anti-worm treatment to some individuals - because of reducing disease transmission - generates large benefits for other individuals not receiving the treatment.

[7] For general equilibrium effects of schooling policies, see Heckman et al. (1998) and Duflo (2004), whose results suggest that policies which encourage school attendance may reduce future wages. Buera et al. (2012) predict that microfinance will lead to a more efficient distribution of capital and entrepreneurs in the economy, which will increase demand for labor, hence wages. Empirically, this prediction is supported by Kaboski and Townsend (2011) and Kaboski and Townsend (2012), who find increasing wages following the introduction of a large-scale microfinance initiative in Thailand. See also Townsend (2010) for a discussion of general equilibrium effects in credit markets in developing countries

the village. (2) Commodity prices: Lacking data on non-food prices, the few existing studies estimate cash transfers' effect on food prices, and find mostly no significant effects. (Angelucci and De Giorgi, 2009; Cunha et al., 2011).[8] This paper provides evidence for growth of non-food prices. A theory of local trade flows in the presence of endogenous transaction costs is proposed to explain why non-food prices increase while food price don't.

The paper also contributes to a recent literature combining both structural and reduced-form techniques to evaluate the impact of policy interventions.[9] In particular, Todd and Wolpin (2006) and Attanasio et al. (2012) use structural models and data from the *Oportunidades* randomized control trial to study schooling and fertility. The model developed in this paper ignores schooling and fertility, but takes a closer look at consumption. The model distinguishes between food and non-food consumption, and takes into account both the direction of local trade flows as well as the presence transaction costs of trade. Non-food quantities are not observed from the *Oportunidades* data. It is therefore not possible to estimate a 'classical' reduced-form treatment effect (i.e. to compare average non-food consumption in treatment and control villages). We calibrate the model to the experimental data and simulate *Oportunidades*'s effect on non-food consumption. The calibrated model further allows me to simulate impacts on household welfare (utility), something rarely studied in the impact evaluation literature.

2 Theory

A. The model

Consider a village populated by $g = 2$ groups of households: poorer households ($\mathbf{P}$s) and somewhat richer households ($\mathbf{R}$s)

$$g \in \{\mathbf{P}, \mathbf{R}\} \tag{1}$$

Household i in group g has two sources of initial endowment. First, a share $\bar{\lambda}_{\{i,g\}}$ of the village's staple endowment $\bar{Q}$ (the implications of endogeniz-

[8] Cunha et al. (2011) finds some effect on food prices in extremely poor and remote villages, which is expected since these villages' are producing largely for subsistence and not for export to urban areas.

[9] Kaboski and Townsend (2012) uses a structural model to understand, predict, and evaluate the impact of an exogenous microcredit intervention program in Thailand. Lise et al. (2004) build a general equilibrium model of the labor market and use the model to study the effects of the Canadian Self-Suffiency Project (SSP), a policy providing financial incentives for unemployed households to obtain stable employment.

Table 1: Notation of the model's variables and parameters

Notation	Description
Variables:	
p_L	village wage rate
x_i	non-food consumption of household i
q_i	staple (food) consumption of household i
l_i	leisure consumption of household i
L_i	labor supply of household i
Village level parameters:	
$\bar{p}_q$	market price of food
$\bar{p}_\chi$	market price of non-food
$\bar{Q}$	village's staple endowment (agricultural productivity)
Household level parameters:	
$\bar{\lambda}_i$	household i's share on the village's staple endowment
$\bar{L}_i$	labor endowment of household i
$\bar{\alpha}_q$	preference food item
$\bar{\alpha}_x$	preference non-food item
$\bar{\alpha}_l$	preference leisure
$\bar{T}_i$	cash transfer

ing staple production are discussed at the end of this section). Second, its stock of labor $\bar{L}_{\{i,g\}}$, net of labor needed to produce the household's staple endowment.

The household consumes staple, $q_{\{i,g\}}$, and a non-food commodity $x_{\{i,g\}}$.

Assumption A.1 The staple is produced inside *the village, while the non-food commodity is produced* outside *the village.*

Thus, the non-food commodity needs to be imported into village. Assumption A.1 reflects the fact that rural areas usually specialize in agricultural production, while importing manufactured and services from urban areas items (e.g. batteries). Household data from rural Mexico (see online appendix), for example, shows that at least 80 percent of the adult village population report agriculture as their main occupation. At the same time, about half of the monthly value of consumption are non-food items such as hygiene products (e.g. soap, combs, tooth and hair brushes, detergents, whiteners), household utensils (plates, sheets, towels, blankets etc.), industrialized clothing, tennis shoes and boots, school supplies (pens and paper), and energy (batteries, gas, petrol). Given the latters' industrialized nature and the aforementioned high share of labor force employed in agriculture, these non-food items are unlikely to be produced by the village. Importing these items implies transactions costs:

Assumption A.2 For each unit of consumption of x it is required one unit of labor.

The village price of x is consequently $p_x = \bar{p}_\chi + p_L$, where $\bar{p}_\chi$ is the factory price of x and p_L being the price of labor. The interpretation of x is not necessarily limited to consumption of imported non-food commodities. It can also be thought of as a consumed *service*. Think of, for example, a carpenter service: In this case $\bar{p}_\chi$ may be the remuneration of the wood and tools that the carpenter is using, and p_L the remuneration of the carpenter's labor.

Assumption A.3 Utilities are comparable between households, and each household maximizes a utility function that represents its reflexive, transitive, complete, continuous, and convex preferences.

The utility function of i writes $u_{\{i,g\}}(q_{\{i,g\}}, x_{\{i,g\}}, l_{\{i,g\}})$ where $l_{\{i,g\}}$ is consumption of leisure.

Assumption A.4 All agents treat prices as parametric, and no trade is permitted to take place except at equilibrium prices.

Household i chooses a consumption bundle $\{q_{\{i,g\}}, x_{\{i,g\}}, l_{\{i,g\}}\}$ which maximizes its utility function subject to the household's budget constraint:

$$\max_{q_{\{i,g\}}, x_{\{i,g\}}, l_{\{i,g\}}} u_{\{i,g\}}(q_{\{i,g\}}, x_{\{i,g\}}, l_{\{i,g\}}) \quad s.t. \tag{2}$$

$$p_x \times x_{\{i,g\}} + \bar{p}_q \times q_{\{i,g\}} \equiv [\bar{L}_{\{i,g\}} - l_{\{i,g\}}]p_L + [\bar{\lambda}_{\{i,g\}} \times \bar{Q}]\bar{p}_q + \bar{T}_{\{i,g\}} \tag{3}$$

where $\bar{T}_{\{i,g\}}$ is a cash transfer granted by the government *exclusively* to $g \in \mathbf{P}$, i.e. $\bar{T}_{\{i,P\}} > 0$ and $\bar{T}_{\{i,R\}} = 0$. Under the maintained assumption of strict quasi concavity of the utility function, the solution of the household's maximization problem will result in a demand function for the food item

$$q_{\{i,g\}} : (p_L, \bar{T}_{\{i,g\}}, \mathbf{\Omega}) \to \Re \tag{4}$$

the non-food item

$$x_{\{i,g\}} : (p_L, \bar{T}_{\{i,g\}}, \mathbf{\Omega}) \to \Re \tag{5}$$

and a labor supply function ($L_{\{i,g\}} = \bar{L} - l_{\{i,g\}}$)

$$L_{\{i,g\}} : (p_L, \bar{T}_{\{i,g\}}, \mathbf{\Omega}) \to \Re \tag{6}$$

as functions of the village's wage rate (p_L), the parameter vector $\mathbf{\Omega}$={$\bar{p}_\chi$, $\bar{p}_q$, $\bar{L}_{\{i,g\}}$, $\bar{\lambda}_{\{i,g\}}$, $\bar{Q}$}, and the cash transfer $\bar{T}_{\{i,g\}}$.

B. Predictions

Lets first consider the benchmark case in which there are no local general equilibrium effects (p_L is exogenous).

PROPOSITION 2.1 ***Under assumptions A.1-A.4, we have that*** $\partial x_{\{i,P\}}/\partial \bar{T}_{\{i,P\}} > 0$ ***and*** $\partial q_{\{i,P\}}/\partial \bar{T}_{\{i,P\}} > 0$***. For*** $g \in \mathbf{R}$***, however,*** $\partial q_{\{i,R\}}/\partial \bar{T}_{\{i,P\}} = x_{\{i,R\}}/\partial \bar{T}_{\{i,P\}} = 0$***.***

Proof. A utility function which fulfills the preference requirements of assumption A.2 is the Cobb-Douglas utility function[10]

$$u_{\{i,g\}}(q_{\{i,g\}}, x_{\{i,g\}}, l_{\{i,g\}}) = q_i^{\{\bar{\alpha}_q\}}\, x_i^{\{\bar{\alpha}_x\}}\, l_i^{\{1-\bar{\alpha}_q-\bar{\alpha}_x\}} \quad \text{with } 0 < \bar{\alpha}_q+\bar{\alpha}_x < 1. \tag{7}$$

Utility maximization then yields demand and labor supply functions of the form

$$q_{\{i,g\}} = \bar{\alpha}_q[\bar{L} \times p_L + \bar{\lambda}_{\{i,g\}} \times \bar{Q} \times \bar{p}_q + \bar{T}_{\{i,g\}}]/\bar{p}_q \tag{8}$$
$$x_{\{i,g\}} = \bar{\alpha}_x[\bar{L} \times p_L + \bar{\lambda}_{\{i,g\}} \times \bar{Q} \times \bar{p}_q + \bar{T}_{\{i,g\}}]/[\bar{p}_\chi + p_L] \tag{9}$$
$$L_{\{i,g\}} = \bar{L}_{\{i,g\}} - [1 - \bar{\alpha}_q - \bar{\alpha}_x][\bar{L} \times p_L + \bar{\lambda}_{\{i,g\}} \times \bar{Q} \times \bar{p}_q + \bar{T}_{\{i,g\}}]/p_L \tag{10}$$

Deriving with respect to $\bar{T}_{\{i,P\}}$ yields $\partial q_{\{i,P\}}/\partial \bar{T}_{\{i,P\}} = \bar{\alpha}_q/p_q > 0$, and $\partial x_{\{i,P\}}/\partial \bar{T}_{\{i,P\}} = \bar{\alpha}_x/[p_\chi + p_L] > 0$, and $\partial L_{\{i,P\}}/\partial \bar{T}_{\{i,P\}} = -[1 - \bar{\alpha}_q - \bar{\alpha}_x]/p_L < 0$. For $g \in \mathbf{R}$ we have $\partial x_{\{i,R\}}/\partial \bar{T}_{\{i,P\}} = \partial q_{\{i,R\}}/\partial \bar{T}_{\{i,P\}} = 0$ and $\partial L_{\{i,R\}}/\partial \bar{T}_{\{i,P\}} = 0$. ■

The cash transfer generates a positive income effect for $g \in \mathbf{P}$. Demand for $q_{\{i,P\}}$, $x_{\{i,P\}}$ and $l_{\{i,P\}}$ increases.

The income effect for $g \in \mathbf{R}$ is zero and, consequently, demand remains unchanged. Existing empirical evidence, however, rejects these predictions. Angelucci and De Giorgi (2009), for example, show that food consumption of non-poor households increases.

Now, lets allow for local general equilibrium effects. The village's labor

[10]Proposition 2.1, however, holds for every other utility function which fulfils the preference requirements of A.2.

market equilibrium writes

$$\sum_g \sum_i L_{\{i,g\}} \equiv \sum_g \sum_i x_{\{i,g\}} \tag{11}$$

where the left hand side is the village's aggregate labor supply. By assumption A.2, the right hand side is the village's aggregate labor demand. Equation (11) assumes that the village labor market is local (i.e. limited to the village's population). This assumption is corroborated by, first, data from the 2002 *Encuesta Nacional de Hogares Rurales* (a representative household survey of rural Mexico), where only six percent of adult village residents report to do non-agricultural work in a different village. I am not aware of any studies looking at *cross-village* migration in Mexico. Existing studies exploit the Mexican census, where respondents are asked the state in which they were born (Bush, 1993). It is however difficult to conclude from cross-state migration about cross-village migration, because it is unclear to which extent cross-state migration simply reflects rural-to-urban migration. But several factors suggest the magnitude of cross-village migration to be rather low. First, land markets are often imperfect, which may constrain the acquisition of land of emigrants (Finan et al., 2005). Second, formal credit and insurance markets are imperfect and informal insurance networks within the village a dominant source of insurance (Fafchamps and Lund, 2003). Thus, emigration is costly, because it may disconnect emigrants from these networks.

Second, there are usually no large supermarket/retail chains (which receive products from its urban area headquarters) in rural villages. This implies that village residents' labor is needed to import non-food (industrialized) products from urban areas.

PROPOSITION 2.2 ***(Endogenous wages) Under assumptions A.1-A.4,*** $\partial q_{\{i,R\}}/\partial \bar{T}_{\{i,P\}} > 0$***. However,*** $\partial x_{\{i,R\}}/\partial \bar{T}_{\{i,P\}} > 0$ ***only if (1) labor endowment of*** $i \in \mathbf{R}$ ***is sufficiently large, or (2) staple endowment of*** $i \in \mathbf{R}$ ***is sufficiently low.***

Proof. Substituting (9) and (10) into (11) and solving for p_L yields

$$p_L^* = \frac{\bar{p}_\chi[(\bar{\alpha}_x - 1)(\bar{Q} \times \bar{p}_q + \sum_i \bar{T}_{\{i,P\}})]}{\sum_i \bar{T}_{\{i,P\}} + \bar{Q} \times \bar{p}_q - \bar{\alpha}_x \bar{p}_\chi \sum_g \sum_i \bar{L}_{\{i,g\}}}. \tag{12}$$

Note that the equilibrium wage is positive only if

Assumption A.5: $\bar{\alpha}_x \sum_g \sum_i \bar{L}_{\{i,g\}} > [\sum_i \bar{T}_{\{i,P\}} + \bar{Q} \times \bar{p}_q]/\bar{p}_\chi$, i.e. if the village's aggregate labor endowment is large enough to allow the village's aggregate consumption demand for x to be satisfied. Substituting (12) into (8) and deriving with respect to $\bar{T}_{\{i,P\}}$ yields $\partial q_{\{i,R\}}/\partial\bar{T}_{\{i,P\}} > 0$. Substituting (12) into (9) and deriving with respect to $\bar{T}_P$ yields

$$\frac{\partial x_{\{i,R\}}}{\partial \bar{T}_{\{i,P\}}} = \frac{[\bar{L}_{\{i,R\}}\bar{p}_\chi - \bar{\lambda}_{\{i,R\}}\bar{Q}\bar{p}_q][\bar{\alpha}_x - 1]\sum_g\sum_i \bar{L}_{\{i,g\}}}{-(\sum_g\sum_i \bar{L}_{\{i,g\}}\bar{p}_\chi - \bar{Q}\bar{p}_q - \sum_i \bar{T}_{\{i,P\}})^2} \tag{13}$$

By assumption A.5 the denominator in equation (13) is always negative. Since $\bar{\alpha}_x < 1$, the term $[\bar{\alpha}_x - 1]$ in the numerator is always negative. Consequently, the sign of $\partial x_{\{i,R\}}/\partial\bar{T}_{\{i,P\}}$ will depend on the sign of the first term in brackets in the numerator. We have that

$$\frac{\partial x_{\{i,R\}}}{\partial \bar{T}_{\{i,P\}}} > 0 \text{ if } \bar{L}_{\{i,R\}}/\bar{\lambda}_{\{i,R\}}\bar{Q} > \bar{p}_q/\bar{p}_\chi. \quad \blacksquare \tag{14}$$

The intuition behind proposition 2.2 is the following: The cash grant increases cash recipients' demand for non-food items. Importation of these items requires labor. The village's labor demand increases, raising the village's equilibrium wage.[11] A higher wage, however, has an a priori ambiguous effect on non-food consumption of the remainder of the village population not receiving cash transfers. On the one hand, higher wages imply a positive income effect which ceteris paribus increases consumption of non-food items. On the other hand, because $p_x = p_\chi + p_L$, higher wages raise the village price of these non-food items, making their consumption more expensive. Non-food consumption of non-poor households decreases if the price effect outweighs the income effect. According to condition (14) this is the case, for example, when a non-poor households' labor endowment is low.[12]

C. Discussion

The model is simple in that there is no credit and insurance market, and schooling conditionalities that come with *Oportunidades* are disregarded. Furthermore, the model does not allow for changes in agricultural production, and assumes away transaction costs for staple exports. In the

[11]

$$\frac{\partial p_L^*}{\partial \bar{T}_{\{i,P\}}} = \frac{\bar{\alpha}_x[\bar{\alpha}_x - 1]\bar{p}_\chi^2\sum_g\sum_i \bar{L}_{\{i,g\}}}{-[\bar{\alpha}\sum_g\sum_i \bar{L}_{\{i,g\}}\bar{p}_\chi - \sum_i \bar{T}_{\{i,P\}} - \bar{Q}\times\bar{p}_q]^2} > 0 \tag{15}$$

[12] The intuition of this result is provided in section 5, where heterogenous effects are discussed and empirically tested for.

following we discuss the implication of these omissions.

(i.) School enrollment, classroom attendance, and social interactions
Higher payments are made to households that send their children to school. Paul Schultz (2004) finds a significant impact of *Oportunidades* on school enrollment and school attendance. In our model, school enrollment can be interpreted, at least in the short term, a as reduction in a household's net labor endowment. Consider the stylized case where the loss of child income corresponds exactly to the value of the *Oportunidades* payment. In this case, a poor household's budget constraint does not change. Demand for food, non-food, and leisure remains unaffected, but labor supply decreases. Lower labor supply drives up equilibrium wages. As in proposition 2.2, for non-poor households, higher wages imply an increase in food consumption but not necessarily in non-food consumption.

Bobonis and Finan (2009) and Lalive and Cattaneo (2009) find that, due to peer effects and social interactions inside the village, *Oportunidades* also increase school enrollment of non-poor households residing in the same neighborhood. If non-poor households enroll their children in school, the income effect from higher local wages will be lower.
(ii.) Risk sharing
Angelucci and De Giorgi (2009) find poor households to partially share the *Oportunidades* payment with their extended family. This would increase non-poor households' income, on top of the increase in wages. The data suggests the overall magnitude of sharing to be rather modest, since less than 5% of non-poor households report to have recently received monetary or in-kind transfers from family and friends.

(iii.) Exogenous vs. endogenous agricultural production, and farmgate selling
Exogenous staple production may be reasonable in the short, but not credible in the long-run. The implications of endogenizing staple production will depend on assumptions about the agricultural market. First, consider the standard separable agricultural household model setting (Singh et al., 1986), with a perfect village labor market, no transaction costs for selling staple, and a surplus-producing village, i.e. exogenous agricultural prices. The increase in local wages resulting from the presence of *Oportunidades* would cause agricultural production to fall. Second, consider the case where the village is not producing a surplus. The price of the staple

becomes endogenous. Higher demand exhibits upward pressure on prices which, ceteris paribus, increases production. Agricultural production falls if higher wages outweigh the price effect. Third, in the case of transaction cost for exporting the staple, higher wages imply a decrease in a farmer's selling price hence production.

Should agricultural production fall, this would dampen the income effect from higher wages. Consequently, the increase in non-poor households' food consumption would be smaller, and a decrease in non-food consumption even more likely.

Another possibility is that non-poor households are credit constrained and invest additional wage income into agricultural production. In this case, the increase in food consumption would be higher, and a decrease in non-food consumption less likely.

The model assumes that there are no transaction costs for exporting staple. Fafchamps and Hill (2005) show that farmgate selling is the most common selling method of farmers in Uganda. For Mexico, we are not aware of any quantitative study that documents the most common selling method of farmers. In field work the author conducted in about twenty *Oportunidades* villages, farmers reported to sell their harvest directly to a crop merchant who visits the village with a truck after harvest. This suggests small transaction costs for farmers to sell their produce. There may, however, be villages or regions were, for some reason, farmgate selling is not common. In this case, farmers need to transport their produce to the next regional market. If labor is the only source of transaction costs - and assuming, for ease of exposition, that the export of one unit of staple requires one unit of the village's labor - then the village price of staple is $p_q = \bar{p}_Q - p_L$, where $\bar{p}_Q$ is the exogenous market price of staple. Transaction costs for food exports further reinforce the increase in the food consumption of non-poor households, because higher wages reduce the price of staple.

3 Empirical Evidence: Income vs. Price Effect

A. Commodity Price Effects

As of 2000, there are about 195,000 villages in Mexico.[13] As long as it

[13]Source: 2000 Census. A location is defined as village if it has less than 2,000 inhabitants.

remains a net exporter of staple a single village can be considered as a staple price taker. *Oportunidades* can thus not be expected to differently affect staple prices in the 320 and 186 control villages. This has been confirmed empirically by Angelucci and De Giorgi (2009) and Hoddinott and Skoufias (2004), who compare staple prices in treatment and control villages, and do not find statistically significant differences.

Less is known regarding *Oportunidades*'s impact on non-food prices, because the latter are not observed from the data. We attempt to infer changes in non-food prices by looking at the extensive margin of non-food expenditure. The following linear probability model is estimated:

$$\text{expense(yes/no)}_{i,t}^{\text{non-food}} = \text{const.} + \theta\,\text{treat village}_i + \gamma X_i^{'} + \epsilon_{i,t} \quad \text{if} \;\; i \in \text{ineligible} \tag{16}$$

where $\text{expense(yes/no)}_{i,t}^{\text{non-food}}$ is a dummy which takes the value 1 if household i had positive expenditures for non-food items during the past month, zero otherwise. The subscript t denotes the post-baseline data waves March 1999 (12 months after baseline) and November 1999 (18 months after baseline), respectively. The variable treat village$_i$ is a dummy that indicates whether household i lives in a treatment village, i.e. a village where *Oportunidades*-eligible households do receive cash transfers (as opposed to control villages, where eligible households do not). Only *Oportunidades*-ineligible households are included in the regression. $X_i^{'}$ is set of controls, including state and time dummies. Standard errors are clustered at the village level in order to take into account the intra-village correlation of the individual error term $\epsilon_{i,t}$.

In the presence of price effects on non-food items one would expect, ceteris paribus, that $\theta < 0$. Higher non-food prices imply, everything else equal, a reduction in demand for non-food items - which will eventually lead to a corner solution (zero expenditure) for some households.

Table 2 displays the OLS estimates of the linear probability model in equation (16). The first column shows that *Oportunidades*-ineligible households in treatment villages are significantly more likely to have zero non-food expenditure. From column (2) to (5), which break down the result by non-food category, we conclude that the effect reported in column (1) is

Table 2: Extensive margin treatment effects: Monthly non-food expenditure of *Oportunidades*-ineligible households (linear probability model estimates)

		by expenditure category			
	(1) non-food expenditure all categories	(2) hygiene and home supplies	(3) toys	(4) clothing	(5) shoes
treat village	-0.009***	-0.015***	0.004	-0.007	-0.001
	(0.003)	(0.006)	(0.006)	(0.016)	(0.018)
controls	Yes	Yes	Yes	Yes	Yes
number of obs	9646	9646	9646	9646	9646
R-squared	0.011	0.014	0.013	0.029	0.056

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Table shows OLS estimates for the model $\text{expense(yes/no)}_{i,t}^{\text{non-food}} = \text{const.} + \theta\, \text{treat village}_i + \gamma X'_{i,t_0} + \epsilon_{i,t}$ if $i \in$ ineligible. $\text{expense(yes/no)}_{i,t}^{\text{non-food}}$ is a dummy which takes the value 1 if household i had positive expenditures for non-food items during the past month, zero otherwise. Subscript t denotes the post-baseline data waves March 1999 (12 months after baseline) or November 1999 (18 months after baseline). treat village_i indicates whether household i lives in a treatment village. X'_i is set controls, including state and time dummies. Standard errors clustered at village level.

mainly driven by a reduction in expenditure of hygiene and households supply products. This may be seen as additional evidence for the model of section 2, which predicts price hikes for items which a village imports. Hygiene products (e.g. soap, shampoo, etc.) and households supplies (e.g. detergents) are typical examples of items that are not produced by the village, but which have to be imported from outside the village.

A note on identification: Behrman and Todd (1999) show treatment and control group samples to be balanced at baseline, and Angelucci and De Giorgi (2009) report no differential attrition rates. In terms of measurement error, ineligible households in treatment villages may underreport their expenditure in order to appear eligible for *Oportunidades*. If this would be true then one should expect ineligibles' reported non-food expenditure to be lower in treatment villages. This, however, is not the case.

B. Income Effect

Previous studies have estimated the impact of *Oportunidades* on wages. Angelucci and De Giorgi (2009) report no changes in wages. Their wage measure, however, include all sources sources of labor supply, including agricultural wage labor. Because agricultural wage labor constitutes a large share of total hours worked, yet largely being seasonal work on some commercial farm away from the village (Taylor and Dyer, 2009), these wage measures are not likely to capture the village's wage rate.

We construct a wage proxy which is based on economic activities that occur inside the village. Our wage proxy, ω, is calculated as the sum of reported daily profits from within-village activities (e.g. petty sales, tailoring, washing and ironing, etc.). It is then checked whether this wage proxy, ω_i, is different between treatment and control villages. The following model is estimated:

$$\omega_{i,t} = \text{const.} + \theta \, \text{treat village}_i + \gamma X_i^{'} + \epsilon_{i,t} \quad \text{if} \;\; i \in \text{ineligible} \tag{17}$$

Column (1) and (2) in table 3 report the resulting treatment effects. The Tobit estimate is our preferred estimate given the relatively large frequency of left-censoring in the data. The latter suggests that daily service profits of ineligible households increase by, on average, 2.3 Mexican *Peso*. The OLS estimate is lower than that, yet still statistically significant.

Columns (3) to (6), which report estimates of equation (17) using different measures of labor supply as dependent variable, provide further evidence for higher village wages. The results suggest that ineligible households in treatment villages work more hours per day and more days per months in the above mentioned within-village commercial activities.

A raise in village wages also seems in line with the results of Alzúa et al. (2013) and Attanasio et al. (2012). Alzúa et al. (2013) - using both inside and outside village labor supply in the calculation of their wage measure - find an increase in wages of women only. Attanasio et al. (2012), using a wage measure similar to Alzúa et al. (2013), find child wages to increase. Since women and children are more likely to work inside the village, these studies' findings may be interpreted as additional evidence that *Oportunidades* raised local wages.

Table 3: Treatment effect on Oportunidades-ineligible households' daily service profits

	dependent variable:					
	daily income		hours per day		days per months	
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	Tobit	OLS	Tobit	OLS	Tobit
treat village	0.098*	2.298**	0.034	1.080**	0.260	4.264**
	(0.053)	(0.920)	(0.053)	(0.519)	(0.170)	(1.906)
controls	Yes	Yes	Yes	Yes	Yes	Yes
number of obs	9511	9511	9529	9529	9553	9553

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Table shows estimates of the model $x_{i,t}$=const.+θ treat village$_i$+$\gamma X_i^{'}$+$\epsilon_{i,t}$ if $i \in$ ineligible. In columns (1) and (2), the dependent variable is daily profits (past week average) made from non-agricultural within-village commercial activities (e.g. petty trade, tailoring, washing and ironing, etc.) of household i, measured in Mexican *Peso*. The exchange rate in 1999 was roughly 1 US Dollar=10 Mexican *Peso*. In columns (3) and (4), the dependent variable is a household's daily hours worked (past week average) in these activities. In columns (5) and (6), the dependent variable is a household's monthly days worked in these activities. Subscript t denotes the post-baseline data waves March 1999 (12 months after baseline) or November 1999 (18 months after baseline). treat village$_i$ indicates whether household i lives in a treatment village. Only *Oportunidades*-ineligible households are included in the regression. $X_i^{'}$ is set of controls, including state and time dummies. Standard errors at the village level. The top percentile of the dependent variable is excluded.

4 Effects on Consumption and Utility

A positive income effect - in the absence of a price effect on food - implies a positive effect of *Oportunidades* on food consumption of *Oportunidades*-ineligible households. That *Oportunidades* has indeed had a positive effect on food consumption of ineligible households is documented in Angelucci and De Giorgi (2009), who find positive treatment effects on food consumption of program-ineligible households.

Estimating *Oportunidades*'s effect on non-food consumption of program-ineligible households is complicated by the fact that only non-food expenditure is observed from the data, yet neither non-food prices nor quantities. In section 3, we have already provided some suggestive evidence that *Oportunidades* may have lead to a decrease in non-food consumption: *Oportunidades*-ineligible households in treatment villages are significantly less likely to have positive expenditure for non-food items (Table 2).

Another way of inferring changes in non-food quantities is by using an empirical version of the structural model introduced in section 2. In a first step, we calibrate the parameters of the model to the data available on households residing in control villages.[14]. Having obtained values for the parameters of the model, we then add the cash transfer to the income of the Oportunidades-*eligible* household in control villages, and solve the model. This yields a vector of (on control villages) *simulated* outcomes.

The predictions of the model are shown in table 4. The model predicts an increase in ineligibles' monthly food consumption of roughly four percent. This compares to about two percent observed from the experimental data. The model predicts an increase in ineligibles' monthly non-food consumption *expenditure* of 3.9 percent. This compares to 4.7 percent observed from the experimental data.

The model replicates reasonably well the actual treatment effects. This increases my confidence in the model's simulated changes in non-food quantities. Recall that the latter are not observed from the experimental data. The model, however, predicts a decrease in non-food consumption of about seven percent.

[14]In the appendix, we provide a detailed description of the calibration

Table 4: Structural estimation *Oportunidades*'s consumption effects

	Oportunidades-ineligible Households	
	(1) observed	(2) predicted
Panel I: *Food consumption*		
control group mean (C)	756.85	731.08
treatment group mean (T)	757.34	759.44
$T - C$	14.01	28.35
(s.e)	(11.16)	
$(T - C)/C$	0.019	0.039
Panel II: *Non-food expenditure* [quantity]		
control group mean (C)	679.00[n/a]	592.51[29.17]
treatment group mean (T)	700.44[n/a]	615.49[27.09]
$T - C$	31.94[n/a]	22.98[-2.08]
(s.e)	(24.68)	
$(T - C)/C$	0.047[n/a]	0.039[-0.071]

The first row of column (1) in panel I and II show March 1999 sample means of household monthly food consumption (Mexican *Peso* value) and non-food expenditure (Mexican *Peso* value) of program ineligible households living in control villages. In 1999, the exchange rate was roughly 1 US Dollar=10 Mexican *Peso*. The second row of column (1) in panel I and II show ENCEL survey (March 1999) sample means of household monthly food consumption (Mexican *Peso* value) and non-food expenditure (Peso value) of program ineligible households living in treatment villages. The third row of column (1) in panel I and II shows the treatment effect (θ) obtained from the treatment effect regression $x_i = \text{const.} + \theta \text{treat village}_i + \epsilon_i \; \forall \; i \in \text{ineligible}$, where x_i is household monthly food consumption (panel I), and household monthly non-food expenditure (panel II), respectively. The fourth row of column (1) in panel I and II show the ratio of treatment effect (third row) over the control group mean (first row). Column (2) in panel I and II show the by the general equilibrium model simulated values. Values in [] are consumed quantities (non-food quantities are not observed from the *Oportunidades* data).

5 Heterogenous Effects

So far, the analysis has focused on average effects. In this section we turn to heterogenous effects. Proposition 2.2 states that the neighborhood effect is

1. decreasing in a household's labor endowment, in the case of non-food consumption
2. not related to a household's labor endowment, in the case of food consumption

In the model, this is because large-labor-endowment households have lower per capita consumption, ceteris paribus, than low-labor-endowment households (i.e. two households with the same staple endowment but different labor endowments will have different per capita consumption). Therefore, if local wages (hence non-food prices) increase, per capita non-food consumption of the low-labor-endowment households will be more adversely affected. To see this, consider a simple cobb-douglas household per capita demand function for non-food, $x_i/\bar{L}_i = \alpha_x I_i/p_x$, with $I_i = p_L\bar{L}_i + \bar{p}_q\lambda_i\bar{Q}$ and $p_x = p_\chi + p_L$. The notation is the same as in section 2 (table 1). This demand function can be rewritten as $x_i/\bar{L}_i = \alpha_x p_L/[p_\chi + p_L]$-$\alpha_x[\bar{p}_q\lambda_i\bar{Q}]/([p_\chi + p_L]$. Deriving with respect to p_L yields

$$\frac{\alpha_x}{p_\chi + p_L} - \frac{\alpha_x[p_L \times \bar{L}_i + \bar{p}_q\lambda_i\bar{Q}]}{[p_\chi + p_L]^2\bar{L}_i}. \tag{18}$$

The first term of expression (18) is always positive and not related to a households' labor endowment. The second term, on the other hand, is inversely related to a households' labor endowment.

For per capita food consumption (with demand function $q_i/\bar{L}_i = \alpha_q I_i/\bar{p}_q$ the equivalent of expression (18) is $\alpha/\bar{p}_q$. Thus, if local wages increase, per capita food consumption of low-labor-endowment and high-labor-endowment households should be equally affected.

In order to test these predictions, the following regression model is estimated:

$$\begin{aligned} \text{expense\_pcapita}^{\text{non-food}}_{i,t} &= \text{constant} + \theta_1 \text{ treat village}_i \\ &+ \theta_2 \text{ treat village}_i \times \text{hhsize\_small} \\ &+ \alpha\text{hhsize\_small} + \gamma X'_{i,t_0} + \epsilon_{i,t} \\ &\quad \text{if } \ i \in \text{ineligible}, \end{aligned} \tag{19}$$

where expense_pcapita$^{\text{non-food}}_{i,t}$ is per capita monthly household non-food expenditure. We are primarily interested in the regression coefficient on the interaction effect treat village$_i$ × hhsize_small, where variable hhsize_small is a dummy indicating if the number of adult household members is below the sample average, and the variable treat village$_i$ is a dummy that indicates whether household i lives in a treatment village, i.e. a village where *Oportunidades*-eligible households do receive cash transfers. The subscript t denotes the post-baseline data waves March 1999 (12 months

Table 5: Heterogenous consumption effects of *Oportunidades* on ineligible households

	dependent variable:			
	non-food consumption		food consumption	
	(1)	(2)	(3)	(4)
treat village	9.273	23.157**	12.419**	0.857
	(7.862)	(10.048)	(5.193)	(4.863)
treat×hhsize_small		-17.453*		11.324*
		(10.105)		(5.855)
number of obs	9337	9337	9272	9272
R-squared	0.004	0.013	0.008	0.055

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The dependent variable in columns (1) and (2) is per capita monthly household non-food expenditure, and in columns (3) and (4) per capita monthly food consumption, all measured in Mexican *Peso*. In 1999, the exchange rate was roughly 1 US Dollar=10 Mexican *Peso*. Subscript t denotes the post-baseline data waves March 1999 (12 months after baseline) or November 1999 (18 months after baseline). treat village indicates whether household lives in a treatment village. Only *Oportunidades*-ineligible households are included in the regression. Standard errors are clustered at the village level. *hhsize_small* is a dummy indicating if the number of adult household members is below the sample average. Controls include time and state dummies, household size and land size. The top percentile of the dependent variable is excluded.

after baseline) and November 1999 (18 months after baseline), respectively. X_i' is set of controls, including state and time dummies. Standard errors are clustered at the village level, and the top-percentile of the dependent variable is excluded.

Columns (1) and (2) in table 5 report the OLS estimates of equation (19). Column (1) shows that the coefficient on the treatment village dummy is positive (though imprecisely measured) when the interaction effects treat village$_i$ × hhsize is excluded. Including the interaction effects, as column (2) shows, changes the picture. The coefficient on treat village$_i$ × hhsize_small is positive. This suggests that the impact of *Oportunidades* on ineligibles' non-food consumption, $\theta_1 + \theta_2$, is higher for households with above average number of (adult) members.

Columns (3)-(4) show the results of (19) but with per capita food consumption as dependent variable. As expected, the impact of *Oportunidades* on ineligibles' food consumption, $\theta_1 + \theta_2$, is not strongly related to the average number of (adult) household members.

6 Concluding Remarks

This paper studied how redistributive transfers the poorest households of a village affect consumption of the remainder of the village population. This is an important question when measuring the distributional (or overall welfare) impact of cash transfers. Yet, most impact evaluations focus on beneficiaries while 'spill-over' effects remain understudied. From the set of possible channels through which spill-over effects may operate, this paper explored the role of local general equilibrium effects. A structural model of a village populated by poor and non-poor households - calibrated to data from the *Oportunidades* randomized control trial - suggests that transfers to the poor households generate competing local price effects which increase food consumption, yet potentially decrease non-food consumption of non-poor households. Overall, we find non-poor households' utility to decrease by about two percent.

The lack of data on non-food consumption and prices is the main challenge of the empirical analysis. In the absence of such data, we propose a structural approach to estimate non-food quantities. The results rely on the strong assumption that the model is correctly specified. Further research, with observed data on non-food consumption and prices, would be useful to support the model's predictions. Impact evaluations of cash transfer programs usually collect data on non-food expenditure, but not on consumed quantities. We hope the results presented in this paper will encourage researchers to collect such data in the future.

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7 Appendix

7.1 Calibration

A. Model equations

The model described in section 2 can be written as a set of nine equations:

Household full income is given by

$$\begin{aligned} I_P &= \bar{L}_P \times p_L + \bar{Q}_P \times \bar{p}_q + \bar{T}_P \\ I_R &= \bar{L}_R \times p_L + \bar{Q}_R \times \bar{p}_q \end{aligned}$$

Where I_P and I_R denote the full income of the average *Oportunidades*-eligible (Poor) and *Oportunidades*-ineligible (Rich) household, respectively. $\bar{L}_P$ and $\bar{L}_R$ are labor endowments, $\bar{Q}_P$ and $\bar{Q}_R$ are staple endowments, $\bar{T}_P$ is the *Oportunidades* cash transfer, p_L and $\bar{p}_q$ denote the village wage rate and staple price, respectively.
Labor supply is given by

$$\begin{aligned} L_P &= \bar{L}_P - \bar{\alpha}_l \times I_P/p_L \\ L_R &= \bar{L}_R - \bar{\alpha}_l \times I_R/p_L, \end{aligned}$$

where $\bar{\alpha}_l$ is the Cobb-Douglas preference for leisure.
Demand for non-food items is given by

$$\begin{aligned} x_P &= \bar{\alpha}_x \times I_P/p_x \\ x_R &= \bar{\alpha}_x \times I_R/p_x, \end{aligned}$$

where $p_x = \bar{p}_\chi + \bar{m} \times p_L$, with $\bar{p}_\chi$ being the market price of non-food items. The parameter $\bar{m}$ describes how many units of labor are needed to import one unit of the non-food item, and $\bar{\alpha}_x$ is the Cobb-Douglas preference for non-food items.
Demand for food-items is given by

$$\begin{aligned} q_P &= \bar{\alpha}_q \times I_P/\bar{p}_q \\ q_R &= \bar{\alpha}_q \times I_R/\bar{p}_q, \end{aligned}$$

where $\bar{\alpha}_q$ is the Cobb-Douglas preference for food.
A village's labor market equilibrium is given by

$$(\bar{n}_P \times x_P + \bar{n}_R \times x_R)\bar{m} = \bar{n}_P \times L_P + \bar{n}_R \times L_R,$$

where $\bar{n}_P$ and $\bar{n}_R$ denote the number of *Oportunidades*-eligible and *Oportunidades*-ineligible village residents, respectively.

B. Calibration

We calibrate the model exploiting data available on the *control group* of the *Oportunidades* randomized control trial (March 1999 data wave). The vector of model parameters is:

$$\mathbf{\Omega} = \{\bar{p}_\chi, \bar{p}_q, \bar{L}_i, \bar{Q}_i, \bar{\alpha}_{\{q\}}, \bar{\alpha}_{\{x\}}, \bar{m}, \bar{n}_i\} \quad i \in \{\mathbf{P}, \mathbf{R}\} \tag{20}$$

In Mexico, the staple is corn. 78 percent of households in the control group cite corn as their main cultivated crop. Corn is also the dominant ingredient in the food consumption basket of Mexicans. A value for the market price of corn ($\bar{p}_q$) can be observed directly from administrative records (Ministry of Agriculture). Monthly corn production (in kilogram) of the average *Oportunidades*-eligible household in the control group (which amounts to roughly 300kg) is taken for $\bar{Q}_P$. In an analog manner, monthly corn production (in kilogram) of the average *Oportunidades*-ineligible household in the control group (which amounts to roughly 450kg) is taken for $\bar{Q}_R$. The number of eligible households in the average control village, $\bar{n}_P$, is 35.3. The number of ineligible households in the average control village, $\bar{n}_R$, is 8.8.

Values for the following parameters can neither be obtained from administrative records nor from the *Oportunidades* RCT data:

$$\mathbf{\Lambda} = \{\bar{p}_\chi, \bar{L}_i, \bar{\alpha}_q, \bar{\alpha}_x, \bar{m}\} \quad i \in \{\mathbf{P}, \mathbf{R}\} \tag{21}$$

In order to obtain values for these parameters, we exploit that some of the model's endogenous *variables* are observed from the control group data: (1) monthly quantity of consumed food (q_P^{RCT} and q_R^{RCT}) of the average eligible and ineligible household, respectively; (2) monthly inside-village labor supply (L_P^{RCT} and L_R^{RCT}); (3) monthly non-food expenditure $(p_x \times x_P)^{RCT}$ and $(p_x \times x_R)^{RCT}$. Denote this vector

$$\mathbf{Y}_{\mathbb{C}}^{RCT} = \{q_i^{RCT}, (p_x \times x_i)^{RCT}, L_i^{RCT}\} \tag{22}$$

where the *RCT* superscript (randomized control trial) and $\mathbb{C}$ subscript is used to indicate sample averages of the *Oportunidades* control group. Denote $\mathbf{Y}^{sim}(\mathbf{\Lambda})$ the vector of from the model simulated values of these variables. We then calibrate $\mathbf{\Lambda}$ by minimizing the standardized squared distance between $\mathbf{Y}_{\mathbb{C}}^{RCT}$ and $\mathbf{Y}^{sim}(\mathbf{\Lambda})$

$$\min_{\mathbf{\Lambda}} E = \left(\frac{\mathbf{Y}_{\mathbb{C}}^{RCT} - \mathbf{Y}^{sim}(\mathbf{\Lambda})}{\mathbf{Y}_{\mathbb{C}}^{RCT}} \right)^2 \tag{23}$$

The full calibration writes

$$\begin{aligned} \min_{\Lambda} E &= \sum_{i=P,R} \left(\frac{q_i^{RCT} - \bar{\alpha}_q \times I_i/\bar{p}_q}{q_i^{RCT}} \right)^2 \\ &+ \sum_{i=P,R} \left(\frac{(p_x \times x_i)^{RCT} - p_x \times x_i}{(p_x \times x_i)^{RCT}} \right)^2 \\ &+ \sum_{i=P,R} \left(\frac{L_i^{RCT} - [\bar{L}_i - \bar{\alpha}_l \times I_i/\bar{p}_L]}{L_i^{RCT}} \right)^2 \end{aligned}$$

$$s.t.$$

$$\begin{aligned} p_x &= \bar{p}_\chi + \bar{m} \times p_L \\ I_i &= \bar{L} \times p_L + \bar{Q}_i \times \bar{p}_q + \bar{T}_i \\ x_i &= \bar{\alpha}_x \times I_i/p_x \\ (n_P^{RCT} \times x_P^{RCT} + n_R^{RCT} \times x_R^{RCT})\bar{m} &= n_P^{RCT} \times L_P^{RCT} + n_R^{RCT} \times L_R^{RCT} \\ 1 &= \bar{\alpha}_x + \bar{\alpha}_q + \bar{\alpha}_l \end{aligned}$$

where $i \in \{P, R\}$.

7.2 Tables for Online Appendix

Table 6: Descriptive statistics: monthly household consumption

	(1) October 1998	(2) March 1999	(3) November 1999
hygiene products (soap, combs, tooth and hair brushes detergents, whiteners)	40.1	50.3	59.2
household utensils (ollas, platos, cazuelas sartenes, sabanas, toallas y cobijas)	4.6	6.2	9.8
fuels (gas, carbon, petrol)	14.3	10.4	16.7
electricity (batteries, light, etc.)	21.6	24.0	25.3
industrialized clothes	55.4	116.5	105.2
shoes (tennis shoes, boots, etc.)	59.3	114.7	104.6
school supplies (pens, paper, etc.)	15.6	10.0	28.3
total non-food expenditure	344.9	468.9	495.1
total value of consumed food items	513.1	471.5	520.0

Displayed values are sample means of the control group sample. All values are in Mexican *Peso*. In 1999, the exchange rate was roughly 1 US Dollar=10 Mexican *Peso*.

Table 7: Descriptive statistics: Main occupational choice

	(1) October 1998 (in %)	(2) March 1999 (in %)	(3) November 1999 (in %)
agricultural day laborer (*jornalero*)	60.35	60.13	64.42
other employment in agricultural sector	14.93	12.72	14.87
self-employed	10.86	13.4	8.89
family business	5.06	4.72	3.77
ejidatario	6.87	5.87	6.42

Displayed values are sample means of the control group sample.

Table 8: Descriptive statistics: Non-agricultural labor supply

	(1) yes/no (in %)	(2) hours per day	(3) days per week	(4) revenue per month
October 1998				
tailoring	1.14	4.3	4.3	220.2
preparing food for sale	0.72	5.6	3.7	284.9
construction/carpenter	0.79	8.7	5.5	560.1
buying and reselling	2.17	7.0	5.7	478.6
transport	0.15	5.6	2.9	1127.5
fixing items	0.01	8.0	6.0	400.0
wash, iron, cooking for pay	1.19	5.3	3.0	102.0
other	3.84	7.0	5.3	1052.5
March 1999				
tailoring	0.77	4.2	4.1	140.8
preparing food for sale	0.35	5.3	4.2	281.1
construction/carpenter	0.87	8.5	5.2	478.1
buying and reselling	2.42	7.3	6.4	394.4
transport	0.09	5.1	3.5	1162.5
fixing items	0.02	8.0	3.5	1030.0
wash, iron, cooking for pay	1.04	5.5	3.2	164.1
other	2.00	6.5	5.1	442.1
November 1999				
tailoring	0.48	4.0	4.2	242.7
preparing food for sale	0.24	4.7	3.4	275.9
construction/carpenter	0.24	8.1	5.1	900.0
buying and reselling	0.51	7.1	5.0	338.7
transport	0.05	8.2	3.4	466.0
fixing items	0.00	.	.	.
wash, iron, cooking for pay	0.69	5.4	3.0	112.6
other	0.59	6.2	5.0	582.4

Values shows are sample means of the control group. Values in columns (2) to (4) are conditional on 'yes' in column (1).

Table 9: Descriptive Statistics: Counterfactual characteristics

	Eligible Households	Ineligible Households
	(1) Mean [Std.Dev.]	(2) Mean [Std.Dev.]
Household and Community Characteristics		
Gini Index for agricultural land ownership	0.71	
	[120.7]	[124.9]
Pre-program household poverty score	701.6	882.5
	[120.7]	[124.9]
Monthly food consumption (per capita, peso value)	182.5	198.4
	[163.6]	[153.2]
Monthly food expenditure (per capita, peso value)	137.3	169.6
	[130.1]	[145.4]
Monthly non-purchased food consumption (per capita, peso value)	38.85	27.86
	[591.9]	[48.1]
Monthly household disposable income (in peso)	662.1	795.3
	[362.6]	[2129.8]
Cultivated area (in hectare)	0.46	0.75
	[2.77]	[2.31]
Hourly wage rate	5.27	6.97
	[36.14]	[25.12]
Livestock holding (principal component index)	-0.21	0.06
	[2.41]	[3.63]
Household size	5.44	4.82
	[2.60]	[2.53]
Indigenous household head	0.36	0.17
	[0.48]	[0.37]
Education of head		
no	32.55	26.35
primary	62.03	64.52
secondary	4.92	6.95
tertiary	0.51	2.19
N	6857	1949

Calculations are based on the March 1999 Encel survey. Column (1) displays the sample mean of *Oportunidades*-eligible households residing in control villages. Column (2) displays the sample mean of *Oportunidades*-ineligible households residing in control villages. Standard deviations are reported in brackets. Differences between column (1) and (2) are all statistically significant.