Welfare Effects of An In-Kind Transfer Program: Evidence from Mexico*

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January 20, 2017

JOB MARKET PAPER

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Abstract

In this paper, I study the effects of in-kind versus cash transfers on the welfare of poor households in rural Mexico. Using data from a governmental program which randomly transferred either a food basket or cash, I estimate a theory-consistent demand system and use it to simulate household welfare under both subsidies. Since the welfare under the in-kind transfer depends on the extent to which the transfer is distorting, I compute the shadow prices at which a household would optimally consume the subsidized food basket. I then use the shadow prices and the model of demand to compute a distribution for the willingness to pay for in-kind benefits. My results suggest that, on average, recipients value the in-kind transfer at 78 percent of its face value. Despite this distorting effect, the in-kind transfer is as cost-efficient as cash. This is due to the fact that the food basket was significantly more expensive at the retail level than at the procurement level, which implies that a cash transfer of the same cost to the government could only buy a fraction of the food basket in recipient’s local markets. This wedge in the values of the transfers is offset by the distorting effect of the in-kind subsidy. Moreover, I investigate the heterogeneity of the welfare effects across the income distribution. I find that the in-kind transfer has a regressive effect: welfare gains are larger among relatively richer households.

Keywords: in-kind transfers, cash transfers, demand system, welfare, shadow prices

JEL classification: D61, H23, H43, I38, 022

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*I thank Aureo de Paula and Valérie Lechene for invaluable advice and suggestions. I thank Orazio Attanasio, Ciro Avitabile, Antonio Cabrales, Pedro Carneiro, Valerio Dotti, Christopher Flinn, Antonio Giarino, Abhijeet Singh, Vasiliki Skreta, Michela Tincani and Marcos Vera-Hernández for helpful comments. I am grateful to Orazio Attanasio and Giacomo De Giorgi for providing me with the data.

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1 Introduction

According to recent estimates from the World Bank, more than 1.5 billion people within the developing world receive some form of assistance, either in-kind or in-cash (Honorati et al., 2015). As many developing countries are expanding the size and scope of their social protection programs, understanding the welfare implications of one transfer scheme against another is of central importance. From a theoretical perspective, a cash-equivalent transfer would always be weakly preferred to an in-kind transfer: while cash is fungible, an in-kind subsidy might distort recipient’s consumption towards the subsidized goods, potentially resulting in a welfare loss as compared to a cash-equivalent transfer (Southworth, 1945). However, the welfare gains under different transfer modalities should be weighted against their costs. If one policy is more efficient but significantly more expensive than the other, policy makers might want to implement the less efficient policy in order to maximize coverage of recipients. On one hand, due to transportation and logistic costs in-kind programs are often found to be more expensive to administer than cash (Ahmed et al., 2009; Hidrobo et al., 2014). On the other hand, if providers can take advantage of economies of scale from buying large quantities of some goods, they might be able to procure a relatively expensive bundle at a cheaper price. In countries where markets might not be well-integrated, the difference between the wholesale and the retail prices can more than compensate for the additional costs of delivery, making in-kind transfers less costly than a cash transfer of equal value to the recipient. In such a case, if the difference in the costs is large relative to the distorting effect of the in-kind transfer, in-kind subsidies might surprisingly be more cost-efficient than cash. Therefore, in order to determine which policy generates the largest welfare gains at a given cost to the provider, one would need an empirical model which is able to quantify how much an in-kind transfer is worth to a recipient.

In this paper, I propose a novel approach to compute the welfare effects of an in-kind transfer. Using data from a governmental program providing an in-kind subsidy to poor households in rural Mexico, I estimate a structural model of demand and use it to simulate the welfare impact of the transfer. From the simulation, I obtain a distribution for the willingness to pay for in-kind benefits within the population of beneficiaries. As targeting households who are relatively more needy is one of the main objectives of policy makers, one focus of this paper is to analyze the heterogeneity of household welfare across the income distribution. Moreover, I contrast household’s welfare under the in-kind transfer to that implied by an alternative cash transfer of equal cost to the government.

The simulation of the welfare impact of the in-kind subsidy is not straightforward for a variety of reasons. First, recipients might substitute goods that they usually consume with the subsidized goods. Therefore, accounting for the substitution possibilities requires estimating a demand system for both subsidized and non-subsidized goods. Second, while household demand is determined by relative prices, income and the structural parameters of the utility function, an in-kind subsidy might distort demand towards the subsidized...
goods. Hence, in order to obtain unbiased estimates of the structural parameters of the utility function one should estimate the demand system on a sample of households not receiving the in-kind transfer. This, however, does not solve the problem of how to simulate the welfare impact of the transfer. For recipients that would reduce their purchases one-to-one with the subsidized goods, the demand under an in-kind transfer would be the same that it would be under a cash transfer of equal value. As the model of demand can predict how demand responds to a change in income, it is straightforward to compute the welfare gains from the transfer for these households. Instead, the model can not directly predict the demand of households for which the transfer is distorting: for them, the demand of the subsidized goods is larger than what the model would predict from a change in income equal to the cash-equivalent value of the transfer. To overcome this issue, I use the estimated demand system to compute virtual prices for the subsidized goods. In other words, I find a set of prices for the subsidized goods (and an income level) at which a household would be as well off as he would be with the in-kind transfer. As I will show, virtual prices depend on household characteristics and on relative prices, and they can thus be computed for each household in the sample. Finally, from the distribution of the virtual prices and the indirect utility specification of a theory-consistent demand system, I construct a distribution for the welfare effects by computing household’s willingness to pay for the transfer.

The welfare analysis that I propose is simple to implement and can be used flexibly to compare recipient’s welfare under alternative in-kind policies. A similar methodology appeared in a paper by Schwab (1985), who used virtual prices in order to compute the value of a housing benefit program. In his paper, Schwab (1985) provides an application in which only one good (housing) is subsidized in-kind. Moreover, he made the restrictive assumption that the demand of the non-subsidized goods is of the constant elasticity form, which allows him to estimate the demand of housing only. My work can be viewed as a generalization of his approach, as I use state of the art techniques in the estimation of demand systems in order to model the demand of multiple subsidized goods as well as the demand of non-subsidized goods. As many in-kind programs - such as the food transfer program studied in this paper - involve the provision of multiple commodities, the use of a demand system increases the applicability of this approach. In addition, a demand system also allows to capture the substitutability between subsidized and non-subsidized goods. This is particularly important for my application, as modeling the demand of food for very poor households requires taking into account their substitution possibilities.

In this paper, I study the Programa de Apoyo Alimentario (PAL), a governmental program providing monthly food baskets to eligible households living in marginalized villages in Mexico. The basket subsidized by the government includes both common staples within the Mexican diet (e.g., rice, beans) and other less frequently consumed foodstuffs (e.g., breakfast cereals, canned fish). As a result of transferring some commodities that beneficiaries do not usually consume - a choice which stems essentially from paternalistic motives - the transfer might have a substantial distorting effect.

There are several reasons which make the PAL program a particularly suitable setting to assess the efficiency of in-kind transfers relative to cash transfers. First, two large surveys, one before and one after the launch of the program, collected extensive data about the consumption and expenditure of approximately 5,500 households from about 200 villages. In addition, information about the local prices of a large variety of

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2 Virtual prices were first developed by Neary and Roberts (1980) in the context of rationing constraints.
commodities, including those transferred in-kind, were obtained through surveys of local stores. This allows to measure both the cost of the in-kind transfer in recipient’s markets and its variability across villages.

Second, in order to assess the effects of alternative forms of assistance, the government conducted a randomized control trial in which recipients were either given the food basket, a cash transfer, or no transfer. The implementation of these two alternative policies gave important information about their costs. While the government paid a known wholesale price for the basket, the price data collected from the store survey reveal that the basket was substantially more expensive at the retail level. Moreover, since the government equalized the value of the cash transfer to the wholesale price paid for the food basket, the face value of the in-kind transfer was significantly larger than that of cash. More precisely, the cash transfer could only buy approximately 70 percent of the food basket. In addition, the administrative costs of the two transfer modalities have been documented by previous literature and evaluations of the PAL program (CIDE, 2006; Cunha, 2014). Even though, not surprisingly, the in-kind transfer was more expensive to administer than the cash transfer, the difference in the administrative costs was smaller in magnitude than the difference between the values of the transfers.

Therefore, in such a setting, it is unclear which policy would generate the largest welfare gains among beneficiaries at a given cost to the government. On one hand, the in-kind transfer has a higher face value than cash. On the other hand, this difference might not be large enough to compensate for the distorting effect of the in-kind transfer and for the larger administrative costs. Using the empirical tool that I have described above, I can quantify the (unobserved) value of the in-kind transfer to the recipient, and I can thus compare household welfare under both transfer schemes.

My results suggest that the size of the distorting effect of the in-kind transfer was relatively large: on average, recipients valued the transfer at approximately 78 percent of its face value. However, the magnitude of this distortion is not large enough to outweigh the difference in the values of the in-kind and cash transfers. As a result, the welfare gains from the in-kind transfer were on average larger than those from the cash transfer. While these results refer to the average recipient, there is substantial heterogeneity in the welfare effects, which reflects both variation in the prices of the food basket across villages and different characteristics of the recipients. Looking at the entire distribution of the welfare effects, I find that approximately 70 percent of the recipients would prefer the in-kind transfer to the cash transfer. Moreover, one important result of this paper is the fact that relatively richer households have a larger willingness to pay for the in-kind transfer. This indicates a regressive effect of the in-kind program. The intuition for this result is that the in-kind transfer benefits proportionally more those recipients with higher consumption levels. As none of the subsidized goods is found to be inferior, households that are relatively richer consume more, on average, of each subsidized good. As a result, the distorting effect of the in-kind transfer is smaller for these households than it is for poorer households.

The results discussed so far are from a simulation which assumes that local prices are constant. However, in-kind and cash transfers can have different effects on local prices. While the income effect from both cash and in-kind transfers can increase household demand, an in-kind transfer also increases the supply of the subsidized goods, thus leading to an ambiguous effect on prices. In a recent paper, Cunha et al. (2014) studied the effect of the PAL program on local prices and found a modest but statistically significant decline
in the prices of the transferred goods in in-kind villages. To take this effect into account, I have used the estimates in their paper to recompute the welfare effects of the program given this price change.

The results suggest an additional 10 percent increase in the welfare of the recipients over the average welfare effect without the price change. Intuitively, this is due to the fact that households pay lower prices for each additional purchase of the subsidized goods. This additional effect makes the in-kind transfer as cost-efficient as cash: the average welfare gains from the in-kind transfer are approximately equal to those of a cash transfer equal to the total costs of the food basket (i.e., the sum between the procurement and the administrative costs). These results are important from a policy perspective, but they must be interpreted under the caveat that a price change implies redistribution from producers to consumers. Given the lack of good-quality data on the supply side of the market, in my paper I do not explore whether the decrease in the price of the subsidized goods determined a significant welfare loss to the producers.

My paper is mainly related to a large literature studying the effects of in-kind versus cash transfer programs, to which it contributes in several ways. First, I have developed a general procedure to conduct welfare analysis in the presence of an in-kind subsidy program. As discussed above, this extends previous studies by modeling jointly the demand of multiple subsidized and non-subsidized goods. Second, I apply this procedure to quantify the welfare effects of a food assistance program. Other studies have focused on the estimation of the cash-equivalent value of the well-known Food Stamp Program in the US (Moffit, 1989; Whitmore, 2002).\footnote{Both papers have exploited a cash-out policy of the program in order to estimate the cash-equivalent value of the voucher. Moffit (1989) estimated a piecewise-linear constraint model, finding that the food stamps were equivalent to cash, mostly because the majority of beneficiaries were infra-marginal and partly because of potential trafficking of the vouchers. Whitmore (2002) developed a theoretical model which she used to estimate the distorting effect of the voucher. Her findings suggest that the beneficiaries valued the vouchers at approximately 80 percent of their face value.} However, the results of the welfare analysis from these studies might not be generalized to the context of developing countries for several reasons. First, voucher programs such as the Food Stamp - which give recipients freedom on how to spend the voucher on many different foodstuffs - are less restrictive than many food assistance programs in developing countries, which typically entail the direct provision of a basket of goods. Second, food represents a much larger fraction of the budget of the poor in developing countries than it is for the poor in developed countries. Third, as food voucher programs are typically spent by recipients at the retail level, they can not be used by a government to take advantage of lower prices at the wholesale level. For all these reasons, the size and even the direction of the welfare effects of food transfer programs in the developing world might not be comparable to those of existing studies in the literature. To my knowledge this is the first paper to compute the welfare effects of the direct provision of food, and to do so in the context of developing countries. As a third contribution, I focus on the heterogeneity in the welfare effects across recipients, documenting a regressive effect of the in-kind transfer. This is a relevant result for the policy debate, as it suggests that food transfers might be more beneficial to households that are relatively less needy, at least in a context in which most of the population is poor and take-up of the program is high.

One additional contribution of this paper is to highlight and study one channel that could justify the use of in-kind transfers over cash transfers, namely the existence of differences between the procurement and the retail prices of the subsidized commodities. This is of considerable importance as it has efficiency implications, but it has received relatively little attention in the literature and in the policy debate. Among the several other justifications for the provision of in-kind transfers instead of cash, the most cited reason is
paternalism: a paternalistic donor usually wants to induce higher consumption of some merit goods, either because there are externalities from the consumption of these goods (Garfinkel, 1973) or because it believes that recipients might spend cash on non-desirable goods, such as alcohol or tobacco. In-kind transfers might also be used as a screening device to induce the non-poor to self-select out of a transfer scheme (Nichols and Zeckhauser, 1982; Blackorby and Donaldson, 1988; Gahvari and Mattos, 2007). Implicit in this argument is the idea that in-kind transfers are not as appealing to the rich as cash, either because of the low-quality of the in-kind bundle or because of stigma effects (Moffit, 1983). Other suggested reasons in favor of the provision of in-kind transfers point to lower adverse effects on labor supply, as compared to cash transfers (Fraker and Moffit, 1988; Gahvari, 1995; Hoyes and Schanzenbach, 2012); or to the possibility of lowering the price of some target good by increasing its supply, potentially achieving redistribution from producers to consumers (Coate et al., 1994; Cunha et al., 2014).

Within the literature on in-kind transfers, the distorting effect of food assistance programs has been studied extensively. In developed countries, Hoyes and Schanzenbach (2009) find that the propensity to spend on food out of the the Food Stamp Program is equal to the propensity to consume food out of cash; Griffith et al. (2014) analyze the consumption response to a targeted voucher program in the UK, finding that the voucher increased spending on the subsidized goods. In developing countries, several recent studies have used experimental or quasi-experimental methods to compare the consumption response to food transfers against the consumption response to alternative transfers, such as cash or vouchers (see Gentilini, 2016 for a review). The most rigorous evaluation of the PAL program has been conducted by Cunha (2014). The focus of his paper is to test the paternalistic justification of the program and, to this aim, he exploited the randomized design of the program to compare the consumption patterns and health outcomes of in-kind and cash recipients. While the reduced form estimates in Cunha (2014) provides some evidence of the distorting effect of the in-kind transfer, quantifying the size of the distortion and the welfare effects of the program requires the structural estimation of a model of demand. This paper addresses this gap and proposes a flexible tool to compute the differential effects of these two policies on the welfare of the recipients. It is worth noting that the main conclusions of the paper by Cunha (2014) are also instrumental to the analysis presented here. As the author does not find substantial differences in the health of cash and in-kind recipients - another dimension of interest to policy makers when choosing among different transfer modalities, this paper focuses only on the comparison of these two policies in terms of their cost-efficiency.

The rest of the paper is organized as follows. Section 2 describes a theoretical framework for studying household choice under cash and in-kind transfers, and presents a formal definition of virtual prices in the context of an in-kind transfer program. Section 3 describes the PAL program and the data. Section 4 presents the demand system and discusses the estimation strategy. Section 5 reports results from the estimation of the demand system. Section 6 describes the procedure used in the welfare analysis and presents the results. Section 7 concludes.

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4 In ongoing research, I study the effects of these transfer schemes on children’s labour supply.
5 See Currie and Gahvari (2008) for an excellent review of the literature.
2 Theoretical framework

2.1 Choice under cash and in-kind transfers

Suppose that a consumer has preferences over two goods: good \( y \) is a composite consumption good, while good \( z \) is subsidized in-kind by the government. I denote with \( q \) and \( p \) the market prices paid by the consumer to buy \( y \) and \( z \), respectively. The government can either provide a cash transfer of value \( \bar{x} \) or a fixed in-kind subsidy \( \bar{z} \). Suppose that the government pays a wholesale price \( \bar{p} \) to procure the in-kind subsidy, and assume that the cost to the government of providing the two transfers is the same, i.e. \( \bar{x} = \bar{p}\bar{z} \). For simplicity, suppose that the price paid by the consumer to buy \( z \) is equal to the wholesale price \( \bar{p} \) paid by the government, so that the cash and the in-kind transfers have the same value to the consumer.

The traditional theory of choice under cash or in-kind transfers can be represented by the diagram in Figure 1a. The pre-transfer budget set is given by \( AB \). A cash transfer shifts the budget set upwards to \( CD \). An equal-value in-kind transfer shifts it to \( CEB \), if no resale is possible; or to \( CEF \), if resale is possible but costly, i.e. if the resale price is lower than the market price. Figure 1a immediately shows that cash transfers are always weakly dominant over in-kind transfers: as the in-kind budget set is contained in the budget set under a cash transfer, consumers weakly prefer a cash transfer over an in-kind transfer of the same value. The indifference curves in Figure 1a show the preferences of two types of consumers. Consumer I has a stronger preference for good \( z \) than consumer II. Under a cash transfer, consumer I would move from \( I \) to \( I' \), where he consumes strictly more of the subsidized good than what is provided in-kind by the government. In other words, the in-kind transfer is infra-marginal for consumer I and, therefore, he would be indifferent between the two types of transfers. On the contrary, the in-kind transfer is clearly distorting for consumer II: while the consumer would move to \( II' \) under a cash transfer, with an in-kind transfer it would move to the kink point \( E \) (if resale is not possible) or to \( II'' \) (if resale is possible but costly). The consumer is thus forced to consume more of good \( z \) than what he would do with a cash transfer. In other words, the in-kind transfer is extra-marginal (or over-provided) for consumer II. It is important to remark that the extra-marginality of the in-kind transfer is defined over the counterfactual consumption of the subsidized good under an equal-value cash transfer, rather than over the pre-transfer consumption. Even though the household pre-transfer consumption of the subsidized good might be strictly lower than \( \bar{z} \), if the income elasticity of the good is sufficiently high the consumer might consume a quantity \( z \geq \bar{z} \) after receiving a cash transfer of equal value.

As I will explain in Section 6, this distinction is important since it motivates the procedure that I use to compute the welfare effects of the in-kind transfer.

In the scenario discussed so far, it was assumed that the values of the cash and in-kind transfers were the same to the consumer. Now, suppose that the retail price paid by the consumer to buy good \( z \) is larger than the wholesale price paid by the government, i.e. \( p > \bar{p} \). In such a case, the value of the in-kind transfer to the consumer would be higher than the value of the cash transfer, i.e. \( \bar{x} < \bar{p}\bar{z} \). This situation is represented in Figure 1b, together with the indifference curves of two types of consumers. The in-kind transfer has a higher income effects than the cash transfer: while the cash transfer shifts the budget constraint to \( FG \), the in-kind transfer shifts it to \( CEB \) (assuming no reselling of the subsidized good). In such an asymmetric scenario, some consumers might prefer the in-kind transfer to the cash transfer: consumer III in Figure 1b is better off.
with the in-kind transfer, while consumer IV prefers the cash transfer to the in-kind subsidy. Clearly, whether a consumer prefers one transfer scheme or the other depends on his preferences and on the difference in the income effects generated by the two transfers.

2.2 Virtual price for the subsidized goods

In the previous subsection I have described, for simplicity, an economy with only two goods. Of course, the same conclusions can be extended to an economy with many different goods. I now present a more general discussion of the theory of virtual prices for an economy in which there are multiple goods. This subsection is largely based on Neary and Roberts (1980)’s and Deaton (1981)’s original works about the theory of choice under rationing. Let $y$ be the vector of goods that the consumer freely chooses and $z$ be the vector of goods subsidized in-kind by the government. Let $q$ and $p$ be the vector of prices associated with $y$ and $z$, respectively. I assume that the consumer has a well-defined preference ordering over $(y, z)$, which can be represented by a strictly quasi-concave, differentiable and increasing utility function $u(y, z)$. Suppose $x$ is the initial income of the consumer.

I start by presenting the expenditure minimization problem of a consumer who is not restricted to consume a fixed level of good $z$. The consumer chooses $y$ and $z$ so to reach a level of utility $u$, given prices $q$ and $p$,

$$ e(q, p, u) = \min_{y, z} \left\{ qy + pz : u(y, z) \geq u \right\}. \quad (1) $$

The solution to problem (1) gives the compensated “unrestricted” demands for $y$ and $z$, which I denote

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6 A similar framework is also presented in Schwab (1985).
Consider a transfer scheme in which the government can subsidize a fixed quantity $\bar{z}$ of good $z$. Given the discussion in Section 2.1, the effects of the in-kind subsidy on the consumer’s utility depend on whether the transfer restricts the consumer to choose $z = \bar{z}$ or not. If the consumer is infra-marginal, then the subsidy will only have income effects and, therefore, would be identical to an equal-value cash transfer. In such a case, the consumer would optimally consume $\bar{z}$ and possibly complement it by additional purchase in the market. Denoting with $u^1$ the maximum level of utility attainable with an in-kind subsidy for an infra-marginal consumer, we must have $e(q, p, u^1) = x + p\bar{z}$. In other words, the income necessary to reach the utility level $u^1$ is the same as the initial income of the consumer plus the market value of the in-kind transfer.

Consider now the problem of an extra-marginal consumer. As this individual would consume less of good $z$ under a cash-equivalent transfer, with an in-kind subsidy his choices are restricted to consume $z = \bar{z}$ and to allocate income $x$ to buy good $y$. Therefore, the restricted expenditure minimization problem amounts to choose $y$ to solve

$$\bar{e}(\bar{z}, q, u) = \min_y \{qy : u(y, \bar{z}) \geq u\}.$$  \hfill (2)

Let $\bar{y} = \bar{y}^e(\bar{z}, q, u)$ be the compensated constrained demand of $y$. I denote with $u^*$ the highest utility level attainable by an extra-marginal consumer. The virtual price of good $z$ is defined as the price that would induce an unrestricted consumer to consume exactly $\bar{z}$ of good $z$ to achieve utility level $u^*$, given the price vector $q$. In other words, the virtual price $p^*$ solves

$$\bar{y} = \bar{y}^e(\bar{z}, q, u^*) = y^e(q, p^*, u^*).$$  \hfill (3)

Given convexity and strict monotonicity of preferences, such a price will always exist (Neary and Roberts, 1980). In addition, strict quasi-concavity of the utility function guarantees its uniqueness (Deaton, 1981). The virtual price can be used to find how the restricted and unrestricted expenditure functions are related. We can write

$$e(q, p^*, u^*) = qy^e(q, p^*, u^*) + p^*\bar{z}^e(q, p^*, u^*)$$

$$= q\bar{y}^e(\bar{z}, q, u^*) + p^*\bar{z}$$

$$= \bar{e}(\bar{z}, q, u^*) + p^*\bar{z}$$

where, in the second line, I have used equations (3) and the last line follows from the definition of constrained expenditure function in (2). The above expression has a nice interpretation. It says that the expenditure necessary to reach the utility level $u^*$ for an unrestricted consumer given the price vectors $q$ and $p^*$ is equal to the expenditure necessary to achieve the same utility level for a restricted consumer who
receives a transfer \( z \), plus the in-kind transfer evaluated at the virtual price \( p^* \). The term \( p^*z \) can thus be thought as a “virtual value” of the in-kind transfer for the consumer. As the household would not have chosen to buy \( z = \bar{z} \) if they were given a cash transfer of the same value, the value that the household attaches to the transfer is indeed lower than the market value, i.e. \( p^*\bar{z} < p\bar{z} \).

In order to write the above expression in a more compact way, I define \( x^* \equiv e(q, p^*, u^*) \) and use the fact that the income necessary to achieve utility level \( u^* \) for an extra-marginal consumer receiving an in-kind subsidy \( \bar{z} \) must be equal to \( x \), i.e. \( e(\bar{z}, q, u^*) = x \). This implies that

\[
x^* = x + p^*\bar{z}.
\]

In the application that I will present in Section 6, equations (3) and (4) are used to compute the virtual prices of the subsidized goods. These equations ensure that the utility level attained by an unrestricted consumer given the price vectors \( q \) and \( p^* \) and income \( x^* \) is the same utility level reached by an extra-marginal consumer receiving an in-kind transfer \( \bar{z} \). As a result, the consumer’s utility from receiving an in-kind transfer can be computed from an unrestricted indirect utility function evaluated at \( x^*, q \) and \( p^* \).

3 The PAL program and the data

3.1 Description of the PAL program

The Programa de Apoyo Alimentario (PAL) is a governmental program launched in 2004 which currently covers approximately 2 percent of total households in Mexico. The main objective of PAL is the improvement of the nutritional status and living conditions of the target population. Program recipients were selected according to the following two-stage procedure. The first stage defined the eligibility criteria for participating villages. Villages are considered eligible if they have a population of less than 2,500 inhabitants, are highly marginalized and do not receive other transfer programs, such as Liconsa or Oportunidades. Another necessary condition for eligibility requires the village to be accessible and close enough to a store managed by DICONSA, the governmental agency in charge of administering the program and responsible for the distribution and supply of food products. In the second stage of the eligibility procedure, poor households within eligible villages were selected based on the results of a means test, which created a poverty threshold using observable household characteristics. Households below the poverty threshold were offered the PAL program.

The program provides monthly in-kind food baskets containing ten goods, which were selected by nutri-
tionists to provide a balanced diet. The list of goods and the quantities contained in the PAL box are reported in Table 1. The second column of the table reports, for each commodity, the percentage of households that were consuming less than the subsidized quantity prior to the introduction of the program. As one can see, along with goods that are widely consumed by Mexican households (such as rice, beans and vegetable oil), the in-kind transfer includes several goods that are consumed infrequently (pasta soup, cookies) or very rarely (cereals box, corn flour, lentils, canned fish, powdered milk). While the rationale for the choice of such a consumption bundle was mainly paternalistic (i.e., to improve the nutritional status of targeted households by inducing them to consume more nutritious food), the fact that a large fraction of the PAL box is constituted by goods that households do not usually consume might imply large distorting effects of the program.

Table 1: PAL food commodities

| Commodity        | Amount of the transfer (kg) | Percentage of baseline households consuming less than the transferred quantity | Baseline average value of the transfer (pesos) | Baseline SD of the value of the transfer (pesos) |
|------------------|-----------------------------|--------------------------------------------------------------------------------|-----------------------------------------------|-------------------------------------------------|
| Beans            | 2                           | 0.07                                                                           | 20.85                                         | 3.68                                            |
| Vegetable oil   | 1 (lt)                      | 0.10                                                                           | 10.46                                         | 0.93                                            |
| Rice             | 2                           | 0.31                                                                           | 13.05                                         | 4.50                                            |
| Pasta soup       | 1.2                         | 0.60                                                                           | 13.22                                         | 2.18                                            |
| Cookies          | 1                           | 0.71                                                                           | 18.77                                         | 5.05                                            |
| Canned fish      | 0.6                         | 0.83                                                                           | 15.09                                         | 6.03                                            |
| Corn flour       | 3                           | 0.87                                                                           | 17.58                                         | 16.98                                           |
| Lentils          | 1                           | 0.92                                                                           | 11.01                                         | 6.34                                            |
| Cereals box      | 0.2                         | 0.95                                                                           | 7.78                                          | 3.46                                            |
| Powdered milk    | 1.92                        | 0.96                                                                           | 78.12                                         | 60.88                                           |
| Total            | 208.9                       |                                                                                | 65.36                                         |                                                 |

Notes: The table reports the list of foods included in the PAL box, the quantities of each good per box, the percentage of households consuming less than the transferred quantities at baseline, the mean and standard deviation of the monetary value of each commodity in the box. Calculations in column 2 are based on a sample of 5494 baseline households. Calculations in columns 3 and 4 are based on 196 baseline sample villages and use the median unit value in the village to compute the value of the transfer.

In alternative to the in-kind transfer, around 5 percent of PAL beneficiaries, those living in localities that DICONSA could not reach regularly, were offered a monthly cash transfer. The government set the cash transfer equal to 150 pesos (approximately US$ 13), which corresponds to the government wholesale cost of buying the food basket. This choice created a wedge between the cost of the in-kind transfer to the government and the purchasing cost of the same basket in recipient’s local markets: indeed, when evaluated at locality prices, the food basket was, on average, around 33 percent more expensive. The third and last columns of Table 1 report the mean and standard deviation of the value of each commodity in the food basket. As one can see, not only the average value of the in-kind transfer is greater than the value of the cash transfer, but there is also a lot of variability in the value of the PAL box, which reflects the variation in the prices of PAL commodities across villages.

Compared to household’s income, both transfers were sizable: the in-kind transfer represented, on av-
average, 18 percent of recipient household’s baseline food expenditure and 11 percent of total expenditure. Similarly, the cash transfer represented 13 percent of household’s baseline food expenditure and 8 percent of total expenditure.

Program take-up was high, being around 87 and 93 percent for recipients of cash and in-kind transfers, respectively (see Appendix A1). It has been shown in the literature that in-kind food subsidies might be associated with stigma effects (Moffit, 1983) or that they might induce the non-poor to self-select out of the program (Nichols and Zeckhauser, 1982; Blackorby and Donaldson, 1988; Gahvari and Mattos, 2007). Within the present context, the fact that the take-up of the PAL program is very high provides some evidence that stigma effects or self-targeting are unlikely to occur or to be marginal.

The transfer is not conditional on family size and, whenever possible, it was given to a woman (the household head or the spouse of the head). Transfers were originally intended to be conditional on the attendance of monthly sessions (*platicas*) in health, nutrition and hygiene. Classes were held by a three-members Committee of Beneficiaries, who were selected among educated members within the village and received special training for teaching the classes. The Committee of Beneficiaries was also responsible for receiving and delivering the food baskets and the cash payments. However, although the courses were meant to be a mandatory requirement for the receipt of the transfer, session attendance was de facto not enforced (Skoufias et al., 2008). Indeed, self-reported data on session attendance revealed that participants only participated in about a third of the sessions that they were supposed to attend (see Appendix A1).

### 3.2 The PAL experiment and the data

The data used in this paper are from an experimental trial which was conducted with the purpose of evaluating the program’s impact. Among the universe of eligible villages, 206 villages in six states (Chiapas, Guerrero, Oaxaca, Quintana Roo, Tabasco and Veracruz) were randomly selected to participate in the experimental trial. Each village was randomly assigned to one of the following treatment groups: (i) an in-kind transfer without education classes (52 villages); (ii) an in-kind transfer plus education classes (51 villages); (iii) a cash transfer plus education classes (53 villages); (iv) a control group (50 villages). Since one of the objectives of the experimental design was to study the effect of information and education classes over and above the effect of the in-kind transfer itself, some localities were randomly assigned to receive a pure unconditional in-kind transfer. However, in practice the randomization was confounded and classes were taught also in those in-kind villages that were randomized out of the education component. Previous evaluations of the program did not find evidence that attendance of the sessions had any differential effect on food consumption (Cunha, 2014), a result which is consistent with the lack of enforcement of the conditionality requirement that I discussed above. For these reasons, in my paper I do not consider the effects of the education

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10 More than 70 percent of recipients were female, both for the cash and for the in-kind group.
11 Originally there were 208 villages included in the experimental trial, but two of them were not re-surveyed at follow-up because of troubles in the communities which could result in risks for interviewers’ safety.
12 According to Gonzalez-Cossio et al. (2006) and Skoufias et al. (2008) this was due to poor supervision of local program administrators. Appendix A1 discusses the extent of contamination in more detail.
13 The effect of session attendance on health outcomes has been studied by Avitabile (2012). The author finds small improvement in the health behavior of women in the in-kind plus education group as compared to women in the in-kind group, but no effect for men.
component and I pool together all villages that received the in-kind benefits.

In each of the 206 villages included in the experiment, around 33 households were randomly selected to participate in a pre and post-intervention survey conducted by the National Institute of Health (INSP). The baseline survey took place between October 2003 and April 2004, while follow-up data were collected two years apart, from October to December 2005. The PAL transfer began to be delivered after the completion of the baseline survey.

The household survey provides extensive information about consumption and expenditure of a large variety of food commodities collected through a seven days recall. Expenditure on other commodities was elicited through weekly, monthly and six months recalls and include ten broad categories: personal care and housekeeping products, clothing, fuel and utilities, medical expenses, house-ware, rent, schooling costs, tobacco, toys, transportation costs. A part from standard demographic characteristics of the household and of its members, the survey provides detailed information about durable possession, the characteristics of the dwellings and the receipt of welfare programs different than PAL. The follow-up survey also provides complete information on the receipt of the PAL transfers, including the number of benefits received, their timing, the person beneficiary of the program within the household and the number, content and timing of the education classes that the beneficiary has attended.

In addition, local stores were surveyed, both at baseline and at follow-up, in order to gather information about prices of a large variety of food commodities. As information about prices is central in the estimation of a demand system, I postpone the description of the available data to section 4, where I discuss thoroughly the methodology adopted to construct prices for each commodity in the demand system.

### 3.3 The Sample

As I will explain in more detail in Section 4.4, I estimate the demand system on the baseline sample and use the sample of control households at follow-up to compute the welfare effects of the in-kind transfer program through a simulation exercise. Even though no data after the introduction of the program are used in the estimation, I have excluded from the analysis some villages in which the program was not correctly implemented or in which there are reasons to suspect that data are measured with error. In particular, of the original 206 experimental villages, I have excluded two localities where households started to receive PAL prior to the baseline survey, potentially causing some bias in the estimation of the demand system. Four villages did not receive PAL benefits, as confirmed by self-reported data: two refused to participate in the PAL program and two were ineligible for PAL because received Oportunidades. Moreover, when constructing expenditure aggregates of the goods in the demand system, I use consumption data rather than expenditure data in order to account for self-production and receipt of in-kind payments (see Section 4.3). If some control households received in-kind subsidies because of confounding of the treatment of because of spillovers from in-kind villages, the expenditure of the household would be measured with error, potentially affecting the simulation exercise. For this reason, I have further excluded one control locality that received in-kind transfers and two villages (one control and one in-kind) that are geographically contiguous. Finally, as I will document in Section 4.3, the construction of commodity prices requires geographical imputation of missing prices at the municipality or state level. Since in the sample there is only one village from the
state of Quintana Roo, it is infeasible to construct price measures for households in this village, and it is thus dropped from the analysis.

Within the remaining 196 sample villages, there are 5,494 households observed both at baseline and at follow-up. Since there are missing values for the expenditure of some commodities, the sample used in the estimation includes fewer households.

I do not use data from attrited households to estimate the demand system, and focus only on those households that are observed in both survey waves. Household attrition was rather low in the sample, being around 12 percent. However, it was significantly higher in control localities than in treatment localities and induced some change in household composition (see Appendix A2). In the empirical analysis, I take this into account by controlling for household demographics. The implicit assumption is that, conditional on demographic characteristics, attrition is random.

3.4 Descriptive statistics

In Table 2, I present some descriptive statistics from the sample of households. While doing so, I also check that households in different treatment villages have similar characteristics ex-ante. The first three columns of Table 2 report the mean of the relevant variable for the control sample, the in-kind sample and the cash sample, respectively. The next three columns show the differences in the relevant variable between one treatment group and another. The average household is formed of five members and has two children younger than twelve. Households are in general low-educated: for 60 percent of the households, the household head has not finished primary school, and for only 18 percent of the households the head has a secondary school degree or higher. On average, the head has completed four years of school. Around 15 percent of the sample is headed by a female and approximately 18 percent is constituted by indigenous households. The statistics in Table 2 confirms that the sample is poor: per capita food expenditure is 300 pesos per month (approximately US$ 27), while per capita total expenditure is 480 pesos per month (approximately US$ 44). Overall, almost 70 percent of the household budget is spent on food. Within nonfood expenditure, the large majority of household income is spent on personal care and housekeeping products, fuel and utilities and transportation costs (respectively 23, 20 and 16 percent of nonfood budget). Table 2 also shows that the sample is balanced across treatments: a part from a lower percentage of female headed households in the cash group as compared to the control group, all other household characteristics do not present statistically significant differences across the three treatment arms. Despite the sample being balanced, in the estimation of the demand system and in the welfare analysis I will control for household covariates in order to allow for a flexible response of the demand to household demographics.

Finally, the last three rows of Table 2 report some descriptive statistics for the sample of villages. The average value of the PAL box in a village, computed using village-level prices, is approximately 210 pesos,

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14 The attrition rate at the individual level is higher and approximately equal to 18 percent.
15 Around 70 percent of female heads are either widowed or separated. I have classified a household as indigenous if at least one household member reported speaking an indigenous language.
16 Food expenditure includes the value of self-production, gifts, in-kind payments (see Section 4.3 for a discussion). I have excluded expenditure for special events and ceremonies and expenditure for hospitalization from the computation of total expenditure since they do not represent common consumption patterns (Deaton and Zaidi, 2002).
17 See Appendix B3 for descriptive statistics about nonfood expenditure.
with no significant difference across treatment groups. The dataset does not have information about the size of the villages and their proximity to urban centers, which might be important factors in explaining different consumption patterns. In order to get information about these characteristics, I have merged the PAL data with a nationwide locality dataset compiled by the INEGI (the Mexican national institute of statistics), which reports the population size and the geographical coordinates of all Mexican villages and municipalities. I have computed the geodetic distance between a PAL village and the closest urban locality in the INEGI dataset. Descriptive statistics show that villages are quite small and relatively isolated: the average village has a population of approximately 680 inhabitants and it is about 10 kilometers away from the closest urban center. Once again, there are no statistically significant differences across the treatment groups.

Table 2: Descriptive statistics by treatment group

|                                | Control (1) | In-Kind (2) | Cash (3) | Diff. (1)-(2) (4) | Diff. (1)-(3) (5) | Diff. (2)-(3) (6) |
|--------------------------------|-------------|-------------|----------|-------------------|-------------------|------------------|
| Number of household members    | 4.78        | 4.63        | 4.58     | -0.16             | -0.20             | 0.05             |
|                                | (2.18)      | (2.14)      | (2.09)   | (0.17)            | (0.19)            | (0.16)           |
| Number of children 0 to 5      | 0.75        | 0.68        | 0.67     | -0.06             | -0.08             | 0.01             |
|                                | (0.91)      | (0.88)      | (0.85)   | (0.06)            | (0.07)            | (0.06)           |
| Number of children 6 to 17     | 1.50        | 1.40        | 1.34     | -0.11             | -0.16             | 0.05             |
|                                | (1.49)      | (1.44)      | (1.46)   | (0.11)            | (0.12)            | (0.10)           |
| Age of household head          | 44.87       | 45.42       | 45.62    | 0.55              | 0.75              | -0.20            |
|                                | (14.98)     | (15.50)     | (15.55)  | (0.90)            | (0.97)            | (0.78)           |
| Education of the household head| 4.19        | 4.24        | 3.97     | 0.05              | -0.22             | 0.27             |
|                                | (3.66)      | (3.66)      | (3.56)   | (0.23)            | (0.25)            | (0.22)           |
| Female head                    | 0.16        | 0.14        | 0.12     | -0.02             | -0.04*            | 0.02             |
|                                | (0.37)      | (0.35)      | (0.33)   | (0.02)            | (0.02)            | (0.01)           |
| Indigenous household           | 0.22        | 0.18        | 0.14     | -0.04             | -0.08             | 0.03             |
|                                | (0.41)      | (0.38)      | (0.35)   | (0.07)            | (0.07)            | (0.05)           |
| Per capita food expenditure (monthly) | 312.65   | 294.28      | 299.19   | -18.36            | -13.46            | -4.91            |
|                                | (226.64)    | (201.06)    | (239.96) | (19.08)           | (19.25)           | (15.50)          |
| Per capita total expenditure (monthly) | 501.19 | 468.86      | 478.70   | -32.33            | -22.49            | -9.85            |
|                                | (380.72)    | (340.76)    | (356.48) | (33.29)           | (34.31)           | (26.71)          |
| Budget share of food           | 0.67        | 0.68        | 0.67     | 0.01              | 0.00              | 0.01             |
|                                | (0.17)      | (0.18)      | (0.18)   | (0.01)            | (0.02)            | (0.01)           |
| Value of PAL box               | 204.16      | 211.68      | 212.95   | 7.52              | 8.78              | -1.27            |
|                                | (39.90)     | (71.87)     | (77.98)  | (9.89)            | (12.78)           | (13.65)          |
| Distance to urban center       | 12.14       | 9.93        | 10.56    | -2.21             | -1.58             | -0.63            |
|                                | (11.72)     | (8.73)      | (9.67)   | (1.96)            | (2.21)            | (1.62)           |
| Total population in the village| 826.32      | 659.35      | 622.51   | -166.97           | -203.81           | 36.84            |
|                                | (651.20)    | (606.87)    | (561.89) | (115.64)          | (127.06)          | (102.60)         |
| N                              | 1278        | 2753        | 1463     |                   |                   |                  |

Notes: "Indigenous Household" is an indicator equal to one if at least one household member speaks an indigenous language. Per capita food and total expenditures are expressed in pesos per month. The value of the PAL box is computed using baseline median unit values in the village. Numbers in parentheses are standard errors, clustered at the village level, for the differences in columns (4) to (6) and standard deviations elsewhere. *, **, *** denotes significance at the 10, 5, 1 percent level, respectively.

\(^{18}\)INEGI classifies a locality to be urban if it has a population of least 2,500 inhabitants. See Appendix B2 for further details on the construction of this variable.
4 The Model of Demand

4.1 Separability between food and non food

Estimation of a demand system requires information about commodity prices and expenditure. Unfortunately, price measures for nonfood commodities can not be constructed given the available data. The store surveys collected information about the prices of several food commodities, but not about the prices of nonfood. In addition, the household survey collected information about nonfood expenditure from household self-recalls, but not about the quantities purchased. As a result, it is not possible to construct unit values (that is, the ratio between the expenditure and the quantity consumed of a given good) for nonfood commodities. The lack of data on the prices of nonfood commodities is a common problem to many studies using household surveys from developing countries. On one hand, a greater effort is exerted in the collection of food consumption data since food represents a large fraction of the household budget. On the other hand, it is intrinsically difficult to collect data about prices of nonfood, both because many nonfood commodities might be infrequently available in local markets and because the larger variability in some nonfood prices (e.g. toys) would require additional information about other product characteristics (e.g., the specific type of toy, brand, quality, etc.).

Given this limitation in the data, I assume that household preferences are weakly separable between food and nonfood consumption, and I model only the demand for food. In other words, let \( u = u(q_f, q_{nf}) \) be a generic household utility function which depends on a consumption vector of food commodities, \( q_f \), and of nonfood commodities, \( q_{nf} \). I assume that \( u = f(v_f(q_f), v_{nf}(q_{nf})) \), where \( v_f \) and \( v_{nf} \) are the food and nonfood subutilities, respectively. Under separability, the demand of different food commodities within the food vector \( q_f \) are derived from the maximization of the subutility \( v_f(q_f) \) subject to the budget constraint \( q_f p_f = x_f \), where \( p_f \) denotes a vector of prices for food commodities and \( x_f \) if the total expenditure in food. The Marshallian demands \( q_i = g(p_f, x_f), i = 1, \ldots, N \), possess all the standard properties of demand functions and they depend only on the prices of food commodities and on total food expenditure (Deaton and Muellbauer, 1980b).

The assumption of separability is certainly a strong one but is dictated by the lack of data about prices of nonfood commodities. This assumption has been tested in different contexts and there is mixed evidence in the literature about its validity. Separability between food and nonfood has been explicitly tested by Moschini et al. (1994). Their study finds some evidence in support of separability between food and nonfood in a sample from the US, with results that are robust to several specifications for the demand system. On the other hand, Browning and Meghir (1991) rejected separability between commodity demand and labor supply, while Hussain (2006) found evidence against separability between nondurables and labor supply and between nondurables and housing.

If the separability assumptions fail, estimates of the demand system would potentially be biased. The direction of the bias can not be determined so that it is unclear whether the estimated welfare effects would represent a lower or upper bound. However, two observations are in order.

First, as noted in Section 3.4, food expenditure represents a large fraction of total expenditure, being on average 67 percent of baseline total expenditure. Since food constitutes such a large fraction of household...
income, estimation of the welfare effects on the demand for food is an economically meaningful exercise. Moreover, the large budget share of food indicates that the sample is very poor so that, potentially, substitutability between food and nonfood might be quite small.

Second, there is no evidence that PAL changed significantly the consumption of nonfood commodities (Cunha, 2014). While this might be due to a variety of reasons, it is possible that the welfare effects of the program are mainly concentrated on the demand of food, in which case the cost of imposing separability might be relatively small.\footnote{The program might not have had an effect on nonfood consumption for a variety of reasons. For example, prices of nonfood commodities might have increased. Another possibility is that the transfers were in general given to women, a fact which might have changed the allocation of resources within the household (see Attanasio and Lechene, 2014). Although interesting, the investigation of the specific reason is beyond the scope of this paper and is left to future research.}

### 4.2 QUAIDS

The empirical model that I use to estimate household demand is the quadratic almost ideal demand system (QUAIDS) proposed by Banks et al. (1997). It is a generalization of the well-known almost ideal demand system (AIDS) introduced by Deaton and Muellbauer (1980a). The QUAIDS uses a more flexible, non-linear, functional form to model the relationship between budget shares and total expenditure, which allows goods to be necessities at some income levels and luxuries at others. In addition, the QUAIDS preserves all the desirable properties of the AIDS and, in particular, its consistency with consumer theory. The functional form used in the QUAIDS is represented by

\[
 w_i = \alpha_i + \sum_{j=1}^{N} \gamma_{ij} \ln(p_j) + \beta_i \ln \left( \frac{\ln(a(p))}{b(p)} \right) + \lambda_i \ln \left( \frac{x}{a(p)} \right) + u_i, \tag{5}
\]

\[i = 1, \ldots, N,\] where \(w_i\) is the share of expenditure in commodity \(i\); \(\ln(p_j)\), for \(j = 1, \ldots, N\), is the natural logarithm of the price for commodity \(j\); \(x\) is total food expenditure; and \(u_i\) is an error term. The terms \(a(p)\) and \(b(p)\) are price indices defined by

\[
 \ln(a(p)) = \alpha_0 + \sum_k \alpha_k \ln(p_k) + \frac{1}{2} \sum_j \sum_k \gamma_{jk} \ln(p_j) \ln(p_k)
\]

\[
b(p) = \prod_{i=1}^{N} p_i^{\beta_i}
\]

The demand system can accommodate the inclusion of demographic characteristics and controls, which is done by assuming that the intercepts in each equation are linear functions of a vector of demographic variables \(d\), including a constant, i.e.

\[
 \alpha_i = \alpha_i' d.
\]

Since the model gives a system of equations whose dependent variables, the commodity shares \(w_i\), sum up to one, the following adding-up restrictions must be imposed:
\[
\sum_{i=1}^{N} \alpha_i = 1; \sum_{i=1}^{N} \beta_i = 0; \sum_{i=1}^{N} \gamma_{ij} = 0, j = 1, \ldots, N; \sum_{i=1}^{N} \lambda_i = 0. \tag{6}
\]

Moreover, in order to be consistent with utility maximization, the following additional restrictions must hold:

**Homogeneity**
\[
\sum_{i=1}^{N} \gamma_{ij} = 0, i = 1, \ldots, N \tag{7}
\]

**Symmetry**
\[
\gamma_{ij} = \gamma_{ji}. \tag{8}
\]

Homogeneity requires that the demand functions are homogeneous of degree zero in prices, while symmetry requires that the cross price derivatives of the compensated demand functions are identical. Note that homogeneity is automatically satisfied when symmetry and adding-up restrictions are imposed in the system.

Banks et al. (1997) have shown that the demand system in equation (5) can be derived from the following indirect utility function
\[
lnV = \left\{ \left[ \ln x - \ln \left( a(p) \right) \right] + \lambda(p) \right\}^{-1} - 1 \tag{9}
\]

where \( \lambda(p) = \sum_{i=1}^{N} \lambda_i \ln(p_i) \).

As I will discuss in Section 6, I will use the indirect utility in (9) for the computation of the welfare effects of the program.

**Elasticities**

Given the estimated parameters of the QUAIDS model, income elasticities can be computed from the following equations:
\[
\eta_i = \frac{1}{w_i} \frac{\partial w_i}{\partial x} + 1 = \frac{1}{w_i} \left( \beta_i + \frac{2 \lambda_i}{b(p)} \log \left( \frac{x}{a(p)} \right) \right) + 1. \tag{10}
\]

Uncompensated price elasticities are given by
\[
\eta_{ij}^u = \frac{1}{w_i} \frac{\partial w_i}{\partial \log p_j} - \delta_{ij} = \frac{1}{w_i} \left( \gamma_{ij} - \mu_i \left( \alpha_j + \sum_k \gamma_{jk} \log p_k \right) - \lambda_i \beta_j \left( \log \left( \frac{x}{a(p)} \right) \right)^2 \right) - \delta_{ij} \tag{11}
\]

where \( \delta_{ij} \) is the Kronecker delta. Compensated price elasticities are given by
\[
\eta_{ij}^c = \eta_{ij}^u + \eta_i w_j. \tag{12}
\]

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4.3 Variables construction

4.3.1 Choice of food groups

The PAL survey contains information on the consumption and expenditure of 62 food commodities. I have excluded alcohol from the analysis, since consumption is often subject to under-reporting, and few other goods (soy, goat/lamb meat, wheat tortilla, tomato paste) for which consumption is virtually null in the sample. I have further excluded chocolate drink because consumption data were collected only at follow-up but not at baseline. There are 56 remaining food commodities, of which ten are provided in-kind by the PAL program. Separately modeling the demand for all these goods would be practically and computationally unfeasible, especially for those goods that are consumed infrequently. For these reasons, I have grouped food commodities into eight groups: three for PAL goods and five for non-PAL goods. The three PAL groups are: rice and pulses (rice, beans and lentils), cereals (corn flour, pasta soup, cookies, cereals box), processed foods (canned fish, powdered milk and vegetable oil). The food groups for non-PAL commodities are: fruit and vegetables, corn cereals, wheat cereals, animal products and other foods. Table 2 reports the different commodities included in each food group.

As one can see, the chosen grouping is particularly detailed for grains. The motivation for this stems from two observations. First, grains constitute by far the highest budget share of food expenditure, being on average 34 percent of total food expenditure. However, while some grains (in particular, corn tortillas, beans and rice) are basic staples in the Mexican diet, other types of grains (in particular, wheat cereals) are more aspirational or luxury goods (see Attanasio et al., 2013). Second, the large majority of goods subsidized in-kind by the PAL program is represented by grains (grains represent approximately 70 percent of the total baseline budget share of PAL goods). Since both cash and in-kind transfers determine an increase in household income, which might induce households to move from low to high quality grains, it is important to model the substitutability between grains in order to estimate household demand accurately.

Less than 2% of baseline households reported any consumption of these goods. The exclusion of these goods from the analysis stems also from practical reasons. With such a low consumption of these goods, it would be impossible to construct a village-level unit value for these commodities (see below).
### Table 3: Food groups

| Group          | Food commodities                                                                 | Number of goods |
|----------------|-----------------------------------------------------------------------------------|-----------------|
| 1 PAL rice and pulses | rice, beans, lentils                                                               | 3               |
| 2 PAL cereals    | corn flour, pasta soup, cookies, cereals box                                       | 4               |
| 3 PAL processed  | canned fish, powdered milk, vegetable oil                                          | 3               |
| 4 Fruit and vegetables | tomato, onion, potato, carrot, greens, pumpkin, chayote, nopales, chile, guayaba, mandarin, papaya, orange, banana, apple, lemon, watermelon | 17              |
| 5 Corn cereals   | corn tortilla, corn grain                                                          | 2               |
| 6 Wheat cereals  | white bread, sweet bread, loaf of bread, wheat flour, oats                         | 5               |
| 7 Animal products | chicken, beef/pork, fish, eggs, milk, yogurt, cheese, lard, cold cuts              | 9               |
| 8 Other foods    | snacks, soft drink, coffee, sugar, mixed fry, chocolate, sweets, mayonnaise, fruit juice, consome, powdered soft drink, atole, canned chile | 13              |

#### 4.3.2 Expenditure shares

For each food commodity included in the survey, households had to report the quantity consumed, the quantity purchased, the corresponding expenditure and, if applicable, the quantity self-produced in the last 7 days. Quantities are usually reported in kilos or liters. When other units of measurements have been reported (e.g. piece or packet), I have converted quantities in kilos or liters using conversion factors from the National Institute of Health (INSP). Expenditure is reported in Mexican pesos. Since the survey is based on a seven days recall but the in-kind transfers were delivered monthly, I have converted weekly quantities and expenditure into monthly quantities and expenditure.21

There are several instances in which quantities consumed and quantities purchased might not coincide. Households might produce some goods at home or they might receive them as a gift or as an in-kind payment.22 The PAL data only allows to identify the extent of self-production as this is explicitly recorded in the seven days recall. Since the aim of the paper is to appropriately model household demand to make policy relevant analysis, it is important to take into account the different margins of adjustment (self-production, receipt of in-kind gifts or payments, etc.) that these households might have. Therefore, whenever consumption of a given commodity exceeds the expenditure (either because of self-production or for other unreported reasons), I have imputed the value of the extra-consumption of that commodity using the baseline median price of the commodity in the village (constructed as reported below). I have then added this additional value to that of total food expenditure. Self-production is economically meaningful within the sample, accounting for 21% of total food expenditure.22

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21 A conversion factor equal to 4.3 has been used.
22 In addition, some goods might be bought and stored for future consumption. However, storage is unlikely to be economically meaningful, since the sample is represented by poor households who are generally financially constrained and do not typically hold large stocks of goods. Indeed, in the data, there are no cases in which reported expenditure of a good is higher than reported consumption of that good.
for, on average, 17 percent of total food expenditure. Households mainly self-produce some varieties of vegetables and fruit (in particular lemons, oranges and chili peppers) and corn grains (with self-production of this commodity accounting for more than 30 percent of the corresponding total expenditure), while self-production of animal products is far less frequent (the only notable exception being eggs, approximately 15 percent of total eggs consumption). With respect to PAL goods, the basket is mainly represented by packaged commodities produced outside the villages. While less than 1 percent of the households in the sample self-produced rice and lentils, beans represent the only case for which self-production is relatively important, accounting for approximately 11 percent of the total expenditure in beans.

I have constructed the budget shares of each food group taking the ratio between the sum of the expenditures of the individual items in that food group and the total food expenditure. Table 4 reports the average budget shares (multiplied by 100) of the different commodity groups, separately for each treatment arm. Households spend approximately 20 percent of their budget on PAL goods, with the highest share being the one for rice and pulses (approximately 10 percent of total food expenditure). The budget shares for PAL cereals and processed PAL goods are respectively 4 and 6 percent. Cereals (both PAL and non-PAL) and animal products together represent around half of total food expenditure, while fruit and vegetable constitute around 19 percent of the total food expenditure. Table 4 also shows that budget shares are overall balanced across households in different intervention groups. The only statistically significant difference that can be found is a higher share of processed PAL goods for cash households as compared to control households.

| Budget share                | Control (1) | In-Kind (2) | Cash (3) | Diff. (1)-(2) (4) | Diff. (1)-(3) (5) | Diff. (2)-(3) (6) |
|-----------------------------|-------------|-------------|----------|------------------|------------------|------------------|
| PAL rice and pulses         | 9.42        | 9.94        | 9.86     | 0.51             | 0.43             | 0.08             |
|                            | (7.31)      | (7.82)      | (7.97)   | (0.64)           | (0.76)           | (0.75)           |
| PAL cereals                 | 3.97        | 4.10        | 3.96     | 0.12             | -0.02            | 0.14             |
|                            | (5.05)      | (5.21)      | (4.70)   | (0.36)           | (0.36)           | (0.29)           |
| PAL processed               | 5.45        | 5.88        | 6.25     | 0.43             | 0.80**           | -0.37            |
|                            | (4.33)      | (4.67)      | (5.39)   | (0.31)           | (0.36)           | (0.31)           |
| Fruit and vegetables        | 19.32       | 18.89       | 19.89    | -0.43            | 0.57             | -1.00            |
|                            | (10.35)     | (10.58)     | (11.18)  | (0.69)           | (0.83)           | (0.73)           |
| Corn cereals                | 17.23       | 17.05       | 17.01    | -0.18            | -0.22            | 0.04             |
|                            | (12.70)     | (13.81)     | (13.05)  | (1.27)           | (1.34)           | (1.27)           |
| Wheat cereals               | 3.66        | 3.25        | 3.18     | -0.41            | -0.49            | 0.08             |
|                            | (4.56)      | (4.62)      | (4.42)   | (0.31)           | (0.35)           | (0.27)           |
| Animal products             | 25.36       | 25.86       | 24.78    | 0.50             | -0.57            | 1.08             |
|                            | (14.24)     | (14.96)     | (14.61)  | (1.34)           | (1.44)           | (1.29)           |
| Other foods                 | 15.58       | 15.04       | 15.08    | -0.54            | -0.51            | -0.04            |
|                            | (9.03)      | (8.26)      | (8.97)   | (0.53)           | (0.58)           | (0.42)           |
| N                           | 1278        | 2753        | 1463     |                  |                  |                  |

Notes: Budget shares are multiplied by 100. Numbers in parentheses are standard errors, clustered at the village level, for the differences in columns (4) to (6) and standard deviations elsewhere. *, **, *** denotes significance at the 10, 5, 1 percent level, respectively.

23Consumption in excess of expenditure for unreported reasons accounts for 5 percent of total food expenditure.
24I report in Appendix C the average expenditure share of all the individual goods used in the analysis.
4.3.3 Prices

There are two sources of data on local prices in the PAL survey: unit values and store prices. Unit values can be constructed by dividing the expenditure for a given good by the quantity consumed. Store prices are collected from surveys of local shops. A maximum of three stores in each village was surveyed. In general, the use of store price data seems preferable for at least two reasons. First, measurement error is likely to be more severe for unit values than for store prices. While unit values are constructed from household seven days recall of expenditure and consumption, store prices are obtained from visits of local shops by trained enumerators who were instructed to report listed prices, whenever possible. Second, it is well-known that unit values suffer from “quality effects” (Deaton, 1988; Crawford et al., 2003; McKelvey, 2011). If consumers react to variation in prices by adjusting both quantities and quality, then the observed variation in unit values would be lower than the actual variation in prices. This can lead to spurious correlation between the budget share and the unit value, resulting in exaggerated estimates of own-price elasticities.

Despite these arguments should point to prefer store prices over unit values, there are important differences in the quality of the baseline and follow-up store surveys that should be taken into account. First, prices were not collected in 13 percent of baseline villages, while this percentage is lower for follow-up villages (3 percent). Second, while the follow-up survey collected prices for all the 56 goods included in the analysis, the baseline survey only collected prices for a subset of 32 commodities. Finally, even within villages where local store prices were collected, the number of surveyed shops was higher in follow-up villages than in baseline villages.

For these reasons, I have constructed prices combining different sources of data. Given the lower quality of the baseline store price survey, the baseline price is constructed as the median unit value within a village. If no household purchased a given good in a locality, I have taken the median unit value in the municipality (or, if this is missing, the median unit value within the state). On the contrary, given the better quality of the store data at follow-up, I have computed the price of a given commodity as the median store price in the village. Again, if this is missing for some good in a village, I have imputed it geographically (taking the median store price within the municipality or state).

For some prices collected in the stores, there are differences with respect to the household food consumption survey. First, because of an error in translating the questionnaire, the price of crackers (“galletas saladas”) was collected instead of the price of cookies (“galletas”). Therefore, I have used the median unit value instead of the median store price. Second, in the consumption module two pairs of goods (beef and pork; sardines and tuna) were asked about jointly while they were disaggregated in the price survey. I have used the aggregated category and taken the median of any food price within the pair.

While the assumptions required to use the unit values to estimate the demand system are potentially strong, the fact that store prices were available only for a subset of goods is a major limitation. An alternative approach would be to use store prices for the subset of goods and villages for which store price data are

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25 If posted prices were not available, enumerators were asked to report the lowest available price of a given good to keep consistency.

26 In the baseline, an average of 1.4 stores per village was surveyed, against an average of 1.9 stores per village at follow-up. More details about store price data are presented in Appendix B2.

27 The details of the imputation process are presented in Appendix B3.
available, and impute the prices for the missing goods and villages using the unit values. While it is unclear whether mixing two sources of data would attenuate any potential bias from using the unit values alone, in Appendix 6.3 I present results of this alternative approach as a robustness check.

After constructing the prices of the individual commodities, I compute a price for a food groups as the geometric mean of the prices of the commodities in that food group. The weight for a commodity within a food group is given by the baseline municipality budget share of that commodity within the group. In other words, for each commodity in a given group, I divide the total expenditure in the municipality for that commodity by the total expenditure in the municipality for that food group. If there is no expenditure for a food group in a given municipality, I use baseline state-level weights.

In the first three columns of Table 5 I report the mean and standard deviation of the logarithm of the baseline prices of the food group, separately for each treatment sample. As one can see, there is considerable variation in the prices of food groups, which reflects variation in local prices across localities. In addition, price indices are similar across villages in different treatment arms: the last three columns of the table show that none of the price differences between one treatment group and another is statistically significant.

Table 5: Baseline prices of food groups

| Log prices         | Control (1) | In-Kind (2) | Cash (3) | Diff. (1)-(2) (4) | Diff. (1)-(3) (5) | Diff. (2)-(3) (6) |
|--------------------|-------------|-------------|----------|-------------------|-------------------|-------------------|
| PAL rice and pulses| 2.23        | 2.19        | 2.20     | -0.03             | -0.03             | -0.01             |
|                    | (0.13)      | (0.17)      | (0.13)   | (0.02)            | (0.03)            | (0.03)            |
| PAL cereals        | 2.63        | 2.60        | 2.60     | -0.03             | -0.03             | -0.00             |
|                    | (0.26)      | (0.25)      | (0.23)   | (0.05)            | (0.05)            | (0.04)            |
| PAL processed      | 2.58        | 2.58        | 2.56     | 0.01              | -0.01             | 0.02              |
|                    | (0.09)      | (0.12)      | (0.09)   | (0.02)            | (0.02)            | (0.02)            |
| Fruit and vegetables| 2.06       | 2.07        | 2.08     | 0.01              | 0.02              | -0.01             |
|                    | (0.16)      | (0.20)      | (0.16)   | (0.03)            | (0.03)            | (0.03)            |
| Corn cereals       | 1.44        | 1.36        | 1.37     | -0.08             | -0.07             | -0.01             |
|                    | (0.34)      | (0.40)      | (0.29)   | (0.07)            | (0.06)            | (0.06)            |
| Wheat cereals      | 2.66        | 2.62        | 2.61     | -0.04             | -0.05             | 0.01              |
|                    | (0.26)      | (0.26)      | (0.38)   | (0.05)            | (0.07)            | (0.06)            |
| Animal products    | 3.29        | 3.28        | 3.31     | -0.01             | 0.02              | -0.03             |
|                    | (0.16)      | (0.16)      | (0.15)   | (0.03)            | (0.03)            | (0.03)            |
| Other foods        | 2.84        | 2.83        | 2.94     | -0.01             | 0.09              | -0.10             |
|                    | (0.38)      | (0.36)      | (0.37)   | (0.07)            | (0.08)            | (0.06)            |
| N                  | 1278        | 2753        | 1463     |                   |                   |                   |

Notes: Prices are reported in natural logarithms. The price of a food group is the geometric mean of the prices of the individual commodities within the food group. Weights are given by the municipality-level budget share of the commodity within the food group. Prices of the individual commodities are median unit values within a village. Numbers in parentheses are standard errors, clustered at the village level, for the differences in columns (4) to (6) and standard deviations elsewhere. *, **, *** denotes significance at the 10, 5, 1 percent level, respectively.

Since the number of observations per village is quite small, the expenditure for commodities not frequently purchased is often found to be zero. If weights are constructed at the village level, they would be zero or unit in a substantial number of villages. For this reason, I have used municipality weights instead of village weights. Similarly, since consumption of powdered milk and canned fish is zero in several municipalities, I have used state-level weights to construct the price index for processed PAL goods. See Appendix B3 for further details.

See Appendix C for summary statistics on the unit values of each commodity used in the analysis.
4.4 Estimation

I estimate the demand system presented in the previous section by imposing all restrictions from the theory. The adding-up constraints are satisfied by excluding the equation for the $N$-th commodity (named the reference), estimate the demand system on the remaining $N-1$ commodities, and recovering the estimated parameters for the $N$-th equation from the adding up restrictions. The demand system is invariant to the excluded commodity. In the estimation, other foods are the excluded commodity group.

From equation (5), the budget shares are not linear in explanatory variables and parameters. In order to estimate the parameters of the demand system I use the iterated linear least square estimator described in Blundell and Robin (1999). The main insight of their paper is that, conditional on the price indices $a(p)$ and $b(p)$, the budget shares are linear in explanatory variables and parameters. Therefore, an iterative procedure can be adopted to estimate the system of equations in (5). Starting from an initial guess for the price indices, estimates of the parameters are obtained. These are then used to update the price indices and restimate the model; the procedure is repeated until convergence.

Another attractive characteristics of this estimator is that it allows to correct for endogeneity bias by employing a control function approach. This relies on the assumption that the error term in the budget share equations have an orthogonal decomposition (i.e., $u_i = p_i v_i + \epsilon_i$) and on the existence of an instrument which is uncorrelated with $\epsilon_i$. The correction for endogeneity is then implemented in two stages. In the first stage, the endogenous variables are regressed on the set of available instruments and on the exogenous variables of the demand system, and the residuals $\hat{v}_i$ are computed. In the second stage, the demand system is augmented with the residuals from the first stage and estimation of the model parameters is conducted using the iterated linear least square estimator described above. Following this approach, a test of endogeneity for the suspected endogenous variables is simply given by $t$-tests of the coefficients on the residuals from the first stage regressions.

Correcting for endogeneity is potentially important, since a number of studies show that total expenditure is often endogenous in the estimation of demand systems (Banks et al., 1997; Blundell and Robin, 1999; Attanasio and Lechene, 2010). However, this procedure relies on the existence of an instrument which is correlated with total expenditure but that can be excluded from the budget share equations. Standard instruments used in the literature are household income or wages. Unfortunately, this information is missing in the PAL data. To overcome this issue, I construct a proxy of the household socioeconomic status (SES) by using the first principal component from a Principal Component Analysis (PCA), following the works by Filmer and Pritchett (2001) and Kolenikov and Angeles (2009). The variables used to construct the index are 11 indicators of durable ownership (e.g., television, radio, refrigerator, etc.) and 9 variables about the characteristics of the dwellings (e.g., type of roof material, type of sanitation facility, etc.). Appendix B4 describes the procedure in more detail and show that the measure of SES is internally coherent within the sample of households.

Since the QUAIDS includes both a linear and a quadratic term in total expenditure, I have instrumented both $\ln(x)$ and $[\ln(x)]^2$. The full set of instruments includes the SES index and its square, interaction terms between the (log)prices and the SES index, the (log)prices of all goods and other demographic characteristics (discussed below). In Section 5, I will show that the set of instruments is indeed correlated with household’s
total expenditure. It is harder to prove that it should be excluded from the budget share equations, though. The motivation for this is in the same spirit of the two-stage budgeting hypothesis. As long as SES is more reflective of long-term income rather than transitory income, one could assume that a household would first choose how much of the income is allocated to buy durable goods and then how much is devoted to current consumption. If the assumption of separability between durable from non-durable consumption is satisfied, then the SES should not impact food budget shares but through total expenditure.

The standard errors of the parameters in the demand system have been computed using a clustered robust bootstrap estimator, which takes into account the correlation in the error terms at the village level. The standard errors for the income and price elasticities have been computed, from the clustered robust standard errors of the parameters, by applying the delta method.

In order to allow budget shares to depend on demographics and household characteristics, I have included the following variables within the intercept of the demand system: the number of household members; the number of 0 – 5 years old children; the number of 6 – 17 years old children; the age of the household head; the education of the household head; an indicator for the household being indigenous (which is defined by the presence of at least one household member speaking an indigenous language); an indicator for the head of the household being female; the distance to the closest urban locality; the total population in the village.

The term $\alpha_0$ in the price index $\ln(a(p))$ can be interpreted as the expenditure required for a minimal standard of living when prices are unity (Deaton and Muellbauer, 1980). Therefore, I follow the discussion in their original paper and set it just below the minimum value of $\ln(x)$ from the baseline sample (which is around 3.9).

I have estimated the demand system on the full sample of baseline households. I do not use any data from the follow-up sample in the estimation, but rather use that to validate the model and for the computation of the welfare. In particular, follow-up households receiving the in-kind transfer are excluded from the estimation because, if the transfer is over provided, their consumption patterns are likely to be distorted by the program. Since the aim of the paper is to estimate the welfare effects of the in-kind transfer, it is crucial that the estimated parameters of the demand system reflect genuine response of the demand to prices, expenditure and household characteristics rather than the potential distortion of consumption patterns caused by the program.

Having estimated the demand system on the sample of baseline households, I use the sample of follow-up households in the cash group to test the model fit and to study the over-provision of the program (see Section 5.3). Finally the welfare analysis is conducted on the sample of follow-up control households, according to the procedure detailed in Section 6.

5 Results

5.1 Model parameters and specification

When estimating a demand system, the main interest is often in the implied elasticities rather than in the estimates of the model parameters per se, which are harder to interpret. Therefore, in this section, I only

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30I have used 500 replications for the bootstrap.
report a selection of the estimated parameters, which I use to discuss two specific features of the chosen specification for the demand system: the endogeneity of total food expenditure and the nonlinearity of the budget shares with respect to total food expenditure. Appendix C3 shows the full set of estimated parameters.

As discussed in Section 4.4, it is important to control for the potential endogeneity of food expenditure. To this aim, I have estimated the first stage regressions for $\ln(x)$ and $[\ln(x)]^2$ on the full set of instruments. The results are reported in Appendix C2. The $F$ statistics for the null hypothesis that the coefficients of the instruments are jointly zero is above 17 in each equation, suggesting that the instruments are indeed correlated with the logarithms of total food expenditure and its square. Following the control function approach, I have augmented the demand system with the residuals from the first stage regressions. I have denoted the coefficients on the residual from the first stage regression for $\ln(x)$ and $[\ln(x)]^2$ with, respectively, $\hat{p}_{1i}$ and $\hat{p}_{2i}$, and I have reported them in the second and third rows of Table 6. The index $i = 1, ..., N$ refer to the $i$-th equation of the demand system. A $t$-test of the null hypothesis that the coefficients in each equation is zero can be interpreted as a test of exogeneity of food expenditure. As one can see, the coefficients are significantly different from zero in three equations (PAL cereals, fruit and vegetables, corn cereals). Moreover, joint tests of exogeneity of total food expenditure, performed by separately testing the null hypotheses that $\hat{p}_{1i} = 0$ for all $i$ and $\hat{p}_{2i} = 0$ for all $i$, are strongly rejected (p-values equal to 0.06 and 0.02, respectively).

Taken together, these results imply that it is important to take into account the endogeneity of total food expenditure and, therefore, all the results reported correct for it.

### Table 6: Estimated parameters of the QUAIDS

|                | PAL goods |              | PAL goods |              |              | Non PAL goods |              | Non PAL goods |
|----------------|-----------|--------------|-----------|--------------|--------------|---------------|--------------|---------------|
| PAL rice       | -0.008    | 0.005        | 0.005     | 0.028***     | -0.042***    | 0.004         | 0.002        | 0.006         |
| and pulses     | (0.007)   | (0.003)      | (0.003)   | (0.009)      | (0.012)      | (0.005)       | (0.010)      | (0.008)       |
| PAL cereals    | -0.049    | 0.106**      | 0.034     | 0.327***     | -0.404**     | 0.019         | 0.070        | -0.102        |
| PAL processed  | (0.088)   | (0.042)      | (0.043)   | (0.115)      | (0.185)      | (0.041)       | (0.133)      | (0.111)       |
| Fruit and      |           |              |           |              |              |               |              |               |
| vegetables     |           |              |           |              |              |               |              |               |
| Corn cereals   |           |              |           |              |              |               |              |               |
| Wheat cereals  |           |              |           |              |              |               |              |               |
| Animal         |           |              |           |              |              |               |              |               |
| products       |           |              |           |              |              |               |              |               |
| Other foods    |           |              |           |              |              |               |              |               |

Notes: Homogeneity and symmetry have been imposed throughout. Standard errors are reported in parentheses and are computed using a bootstrap estimator accounting for clustering at the village level. 500 replications of the bootstrap have been used. *, **, *** denote significance at the 10, 5, 1 percent level, respectively.

Table 6 also reports the estimated coefficients on the square of food expenditure, $\hat{\lambda}_i$, for each equation of the demand system. For two out of eight food groups (fruit and vegetables and corn cereals), the coefficient is statistically different from zero, suggesting that the response of the budget shares of these goods to a change in total expenditure is indeed nonlinear. This becomes even more apparent if we look at Figure 2, where I plot the Engel curves for each food group. The Engel curves in Figure 2 have been constructed by fixing the prices and the demographic characteristics of the household to their sample means. They show the response of the budget share to a change in the logarithm of total food expenditure. Clearly, fruit and vegetables and corn cereals exhibit a strong nonlinear response, as confirmed by the results in Table 6. Some nonlinearity can also be seen for PAL cereals, processed PAL foods and wheat, even though, from the coefficients in
Table 6, linearity can not be rejected for these goods. For the remaining food groups (PAL rice and pulses, animal products and other foods), the relationship with total food expenditure is very close to linear.

5.2 Elasticities

After having estimated the parameters of the demand system, I use them to compute income and price elasticities, as described by equations (10)-(12). The results are reported in Table 7. Column 1 shows the estimated income elasticities, computed by setting prices, expenditure and other household demographics at the sample mean. All commodities transferred by the PAL program are necessities, albeit to different degrees: rice and pulses have the lowest income elasticity while PAL cereals the highest. As one would expect, fruit and vegetables and animal products are luxuries. Consistently with what is found in other studies in Mexico (Attanasio et al., 2013), wheat cereals are luxuries, while corn cereals are strong necessities. Indeed, while corn cereals represent more than 40 percent of the average caloric intake among the poor in Mexico, wheat-based products constitute only 3 percent of it (Skoufias et al., 2009). Note that all the results obtained for the income elasticities of demand are consistent with the Engel curves plotted in Figure 2, where the budget shares of luxury goods (fruit and vegetables, wheat and animal products) were increasing with household expenditure while they were decreasing for necessities.
|                                | Income elasticities | Uncompensated Own-price Elasticities | Compensated Own-price Elasticities |
|--------------------------------|---------------------|--------------------------------------|-----------------------------------|
| PAL rice and pulses            | 0.204               | -1.201***                            | -1.179***                         |
|                                | (0.160)             | (0.189)                              | (0.195)                           |
| PAL cereals                    | 0.575**             | -1.481***                            | -1.458***                         |
|                                | (0.191)             | (0.137)                              | (0.135)                           |
| PAL processed                  | 0.453***            | -1.066***                            | -1.039***                         |
|                                | (0.117)             | (0.140)                              | (0.141)                           |
| Fruit and vegetables           | 1.445***            | -0.786***                            | -0.526***                         |
|                                | (0.117)             | (0.099)                              | (0.103)                           |
| Corn cereals                   | 0.487***            | -0.509***                            | -0.418***                         |
|                                | (0.147)             | (0.132)                              | (0.127)                           |
| Wheat cereals                  | 1.279***            | -0.972***                            | -0.931***                         |
|                                | (0.240)             | (0.135)                              | (0.137)                           |
| Animal products                | 1.811***            | -1.430***                            | -0.994***                         |
|                                | (0.100)             | (0.153)                              | (0.147)                           |
| Other foods                    | 0.649***            | -0.841***                            | -0.741***                         |
|                                | (0.099)             | (0.050)                              | (0.051)                           |

Notes: The table shows income elasticities (column 1), uncompensated and compensated own-price elasticities (columns 2 and 3) at the mean of the sample. Elasticities are computed from the estimated parameters of a QUAIDS, imposing symmetry and homogeneity restrictions. Standard errors are computed using the delta method. *, **, *** denote significance at the 10, 5, 1 percent level, respectively.

Turning to the analysis of the price elasticities, consumption theory requires that all compensated own-price elasticities are negative, while uncompensated own-price elasticities must be negative for normal goods. Since, as already discussed, none of the goods in the demand system is inferior (at least at the mean of the sample), we should expect Marshallian own-price elasticities to be negative as well. This is indeed what I have found, as shown in columns 2 and 3 of Table 7. Animal products, PAL cereals and “PAL rice and pulses” are the most price-elastic goods, while corn cereals and other foods are the least elastic. It is worth emphasizing that the fact that the own-price elasticity for the PAL goods are relatively high, as well as precisely estimated, is a useful result for the computation of the virtual prices of these goods. If the demand of PAL goods is quite responsive to price changes, by lowering the price of the extra-marginal PAL goods the demand will converge faster to the subsidized levels of those goods. On the contrary, if the demand was not very price elastic, larger drops in the prices would be required in order to induce the household to consume the bundle subsidized in-kind.

The full set of compensated and uncompensated cross-price elasticities is reported in Appendix C3. As expected, different types of cereals (i.e., PAL cereals, corn and wheat) present some degree of substitutability between each others, even though the cross-price elasticities are often not statistically different from zero.
5.3 Extra-marginality and model fit

In this section, I use the estimates of the demand system to study the extra-marginality of the in-kind subsidy and to check how the model fits the actual data. As already discussed, the extra-marginality of an in-kind transfer is determined by looking at the counterfactual demand upon receiving a cash-equivalent transfer. For this reason, I focus on the demand of the three PAL food groups for the sample of follow-up households in the cash treatment group. Since these households received a cash transfer rather than an in-kind transfer, it is natural to compare their demand for the PAL goods with the amount provided in-kind by the program.

In order to assess how the model fits the data, I compare the actual quantities consumed of each PAL food group with those predicted by the model. This is done in Figure 3, which plots the CDFs of the monthly quantities consumed of each PAL food group. Each plot refers to a different food group. Within each plot, the step green line represents the CDF of the actual quantities consumed of the corresponding food group. The quantities consumed for an aggregate food group have been computed by simply adding up the quantities consumed of each commodity within that group. The smooth red line plots the CDF of the quantities of each group predicted by the model. Given the estimates of the model’s parameters and sample data for follow-up prices, expenditure and demographics, the predicted quantities have been constructed by first using equation (5) to compute the budget shares of each food group; each budget share has then been multiplied by the ratio between the total food expenditure and the corresponding price, in order to convert shares into quantities. Finally, within each plot, the vertical line represents the quantity transferred in-kind by the program, which has been constructed by summing the subsidized quantities of each individual commodity in a food group.

All households to the left of the vertical line consume strictly less of the food group than what is provided in-kind by the PAL program. Therefore, the intersection between the actual CDF of a food group and the corresponding vertical line gives the percentage of households in the cash sample for which the food group would be over provided. The intersection between the predicted CDF and the vertical line gives the corresponding prediction from the estimation of the demand system. The percentage of extra-marginal households, both from the data and from the model predictions, is reported at the bottom of each plot. Figure 3 shows that the model fits the data remarkably well. Not only the CDFs of the predicted quantities are very close to the CDFs of the actual quantities consumed, but also the model predicts accurately the percentage of households for which a food group would be extra-marginal.

31 The shaded areas enclosing the predicted CDFs are 95% confidence bands constructed using Dvoretzky-Kiefer-Wolfowitz inequality.
32 See Table 1 for the details of the subsidized quantities of each PAL good.
Figure 3: Over-provision of PAL food groups
Quantities are expressed in kilos per month. The green lines are the CDFs of the quantities consumed of a food group in the data. The red lines are CDFs of the quantities consumed predicted by the QUAIDS model. The shaded area is a 95% confidence band constructed using Dvoretzky-Kiefer-Wolfowitz inequality. The vertical lines represent the quantity of the food good subsidized in-kind. The empirical CDFs are drawn after trimming the top 1% observations. The sample includes follow-up households in the cash treatment group ($N = 1449$).

The food group for which the extra-marginality is higher is represented by cereals: around 70 percent of households receiving a cash transfer consume less than 5.4 kilos of cereals, according to both the data and the model. Consumption of rice and pulses is instead much higher, consistently with the fact that these goods are stronger necessities: in the data, only 17 percent of households consume less than 5 kilos per month. The same percentage computed from the model predictions is very close to the one from the data (16 percent).

As for processed goods subsidized by PAL, slightly more than 20 percent of the households consume less than the subsidized quantity.\footnote{Since processed PAL foods is a quite heterogeneous group, and since vegetable oil is consumed much more often than the other goods within the group (canned fish and powdered milk), in Section 6.3 and Appendix D I present robustness checks in which I further disaggregate the commodities in the group.}

While the comparison of the model predictions with the observed consumption for the sample of households receiving cash can give useful insights about the extra-marginality of the program, it is worth reminding that the value of the cash transfer was on average lower than the monetary value of the in-kind subsidy. If households were given a cash transfer of exactly the same value of the in-kind subsidy, consumption for each...
food group would have been higher since, according to the estimated income elasticities, none of the groups was found to be inferior. In such a case, the exercise presented in this section is presumably overestimating the percentage of extra-marginal households and the results should then be interpreted as upper bounds to the “true” extra-marginality of the in-kind transfer. However, given that the difference between the value of the in-kind transfer and that of the cash transfer represents approximately 5 percent of the total food budget, it is unlikely that this difference changed substantially the consumption patterns presented above.

Before moving to the welfare analysis, it is important to highlight that the demand system can be a particularly useful tool when studying the over-provision of an in-kind transfers. In this context, one can certainly study the extra-marginality of the transfer simply using the actual data from the sample of follow-up cash households. This was done in the paper by Cunha (2014), where the empirical CDFs of each individual good in the PAL basket were plotted against the corresponding subsidized quantity. However, there are several advantages from using a demand system. First, if the demand system is correctly specified, it can be used to study the extent of the over-provision even in the absence of follow-up data on food expenditure and possibly prices. For example, if one is willing to assume that expenditure and prices are constant, one can simulate the demand under a cash transfer using the estimates of the demand system and the data from the baseline. Second, the demand system can be a very useful tool for ex-ante policy analysis. If policymakers are concerned about the welfare of potential recipients of an in-kind transfer, a demand system can be used to simulate the demand under different food subsidies and determine the levels of extra-marginality of each policy scheme.

6 Welfare analysis

6.1 Procedures

The fact that the QUAIDS is theory consistent and admits the representation of preferences in equation (9) makes it an extremely appealing tool to study the welfare effects of different policies. In principle, the welfare effects of any policy affecting expenditure, \( x \), or prices, \( p \), can be studied by applying equation (9).

However, computing the welfare effects of an in-kind program is a more complex task and depends on whether the subsidy is over-provided or not. As seen in Section 2, an infra-marginal in-kind subsidy only has an income effect and, therefore, the utility under this transfer can be computed from equation (9) by simply adding the cash-equivalent value of the transfer to the total expenditure \( x \). Instead, an extra-marginal in-kind transfer has both income and substitution effects: the transfer increases the household budget but distorts the consumption choices towards the subsidized goods. In such a case, the welfare effects of the transfer can not be directly measured from the indirect utility.

To overcome this issue, I compute the virtual prices of the extra-marginal goods in the in-kind transfer. As seen in Section 2, the utility under an extra-marginal in-kind transfer is the same utility that would result given a price vector for the subsidized goods and income which would make the recipient optimally choose

\[34\] In their original work, Banks et al. (1997) study the welfare loss of introducing a tax reform increasing sales tax on clothing in the UK; Attanasio et al. (2013) used the QUAIDS to estimate the welfare loss of food price increases in Mexico.
the quantities transferred in-kind. Clearly, the virtual price vector for the transferred goods is always lower than the market price if the transfer is extra-marginal; and, as shown in equation (4), the household income would be equal to the sum between the pre-transfer income and the “virtual value” of the in-kind transfer (i.e., the in-kind bundle valued at the virtual prices). After obtaining the virtual price for the subsidized goods, the welfare effects of the in-kind transfer can be computed by replacing the virtual prices and the household income inside equation (9).

The procedure that I use is based on a simulation exercise: using the estimates of the demand system from the baseline sample, I compute household demand and the virtual prices for the sample of households in the control group. I focus on this sample in order to take out the effects of that the PAL program had on the explanatory variables in the demand system (e.g., income and prices) for cash and in-kind recipients. The fact that the sample was balanced at baseline (see Tables 2−4) suggests that, in the absence of the program, households in in-kind and control villages should have had similar consumption patterns at follow-up. Moreover, as the out-of-sample fit of the demand model suggest, household preferences are stable over time.

In my analysis, I assume no reselling of PAL goods. This assumption is necessary in that the computation of the virtual prices requires setting the quantities of the subsidized goods to the transfer level. While reselling was not officially prohibited under the program’s rule, there is no credible anecdotal evidence on whether it occurred or not. If recipients were able to resell the PAL goods, then the welfare effects computed in this section would represent lower bounds to the “true” welfare effects: as shown in Figure 1a, reselling allows the consumer to expand his consumption set and, therefore, to achieve higher utility levels.

In order to describe the details of the procedure, I introduce some notation. Let $x_0$ be the household pre-transfer total food expenditure. Let $J$ be the set of goods subsidized by PAL. Let $p_j$ be the market prices of PAL good $j$, $j \in J$, and $p_j^*$ the virtual price of good $j$. Finally, I denote with $\bar{q}_j$ the quantity of good $j$ subsidized by the program. The following steps detail the procedure, which is repeated for every household (I suppress the index for the household for expositional clarity).

1. Using the estimated parameters of the demand system, I compute the counterfactual demand of the household upon receiving a cash transfer $\bar{x}$ equal to the cost of buying the in-kind subsidy, i.e. $\bar{x} = \sum_{j \in J} \bar{q}_j p_j$. As prices of the subsidized commodities vary across villages, $\bar{x}$ varies at the village level as well. Using equation (5) I compute the budget shares of all goods in the demand system, $\hat{\nu}_i$, $i = 1, \ldots, N$, given the income level $x_0 + \bar{x}$ and convert shares into quantities, i.e. $\hat{q}_i = \frac{\hat{\nu}_i (x_0 + \bar{x})}{p_i}$.

2. I compare the predicted quantities of PAL goods, $\hat{q}_j$, $j \in J$, with the quantities transferred in-kind, $\bar{q}_j$. If $\hat{q}_j \geq \bar{q}_j$ for all $j \in J$ then the transfer is infra-marginal. If instead $\hat{q}_j < \bar{q}_j$ for at least one $j \in J$, then the transfer is extra-marginal. Let $K \subseteq J$ be the subset of extra-marginal PAL goods.

3. For infra-marginal goods, the virtual price is trivially equal to the market price. For all extra-marginal goods $k \in K$, I compute the virtual prices by using the system of equations in (5) and fixing the quantity of the goods to the subsidy level

$$w_k = \frac{p_k \bar{q}_k}{x^*} = \alpha_k + \sum_{i \in K} \gamma_{ki} \log(p_i) + \sum_{l \in K} \gamma_{kl} \log(p_l^*) + \beta_k \log \left( \frac{x^*}{a(p^*)} \right) + \frac{\lambda_k}{b(p^*)} \left( \log \left( \frac{x^*}{a(p^*)} \right) \right)^2 + \rho_k \tilde{\nu}.$$ (13)
where \( x^* = x_0 + \sum_{j \in J} p_j^* \bar{q}_j \) is the sum of the pre-transfer income and of the virtual value of the in-kind subsidy. The price indices have been denoted with \( a(p^*) \) and \( b(p^*) \) in order to highlight the fact that some of the prices within the indices are virtual prices rather than market prices. Note that, if there is more than one extra-marginal good, a system of simultaneous nonlinear equations must be solved in order to find virtual prices for all extra-marginal goods.\(^{35}\)

4. After finding the virtual prices in step 3, I recompute the quantities consumed of all goods in the demand system using the virtual prices instead of the market prices and check again that \( \hat{q}_j \geq \bar{q}_j \) for all \( j \in J \). As demand would readjust after changing the prices, it is possible that this condition is violated for some transferred good. For example, suppose that PAL cereals were extra-marginal in step 2 but rice and pulses were not and suppose that, for a given household, they are substitutes between each other. Since the virtual price is always lower than the market price, by lowering the price of PAL cereals the quantity of rice and pulses might fall below the subsidized quantity. When this occurs, I repeat step 3 by simultaneously solving equation (13) for both goods.

5. Steps 1 to 4 provide a solution for the virtual prices and for the follow-up expenditure under an in-kind subsidy, \( x^* \). Given this, the utility from an in-kind transfer, \( \ln V_k \), can be computed using equation (9). If the transfer is infra-marginal, then the utility is equal to

\[
\ln V_k = \left\{ \left[ \frac{\ln(x_0 + \bar{x}) - \ln(a(p))}{b(p)} \right]^{-1} + \lambda(p) \right\}^{-1}
\]

(14)

while if the transfer is extra-marginal we have

\[
\ln V_k = \left\{ \left[ \frac{\ln(x^*) - \ln(a(p^*))}{b(p^*)} \right]^{-1} + \lambda(p^*) \right\}^{-1}
\]

(15)

6. In order to find a money metric measure of the utility from the in-kind transfer, I compute \( x_k \), i.e. the income for which the household should be compensated in order to be as well off as with the in-kind transfer, given the vector of market prices \( p \). In other words, I find \( x_k \) using equation (9) and setting it equal to (14) - for an infra-marginal transfer - or to (15) - for an extra-marginal transfer,

\[
\left[ \left( \frac{\log(x_k) - \log(a(p))}{b(p)} \right)^{-1} + \lambda(p) \right]^{-1} = \ln V_k.
\]

(16)

7. Finally, I use as a measure of welfare the equivalent variation, which is given by \( EV = x_k - x_0 \). The equivalent variation can be interpreted as a measure of the recipient’s willingness to pay for the in-kind transfer.

\(^{35}\)I have used the routine “lsqnonlin” in MATLAB to solve the system of simultaneous nonlinear equations.
The procedure described in this section is applied to each household in the sample in order to construct a
distribution of the welfare effects for the whole sample. Since households differ in their pre-transfer income
and in their demographic characteristics (as well as in the prices that they pay), they might have different
virtual prices for the same subsidized goods and therefore they will differ in their willingness to pay for the
in-kind subsidy.

6.2 Results: no price change

This subsection shows the main results of the paper. Following the procedure described above, I have first
estimated the demand of the PAL goods under a cash-equivalent transfer. As there is variation across villages
in the prices of the subsidized goods, the value of the cash-equivalent transfer varies at the locality level. This
first step reveals that the in-kind transfer is infra-marginal for approximately 20 percent of the households:
when given a cash equivalent transfer, these households consume more of each food group than what is
transferred in-kind by the program. Of course, the value of the in-kind transfer to these households will be
equal to the value of the cash-equivalent transfer. For the remaining 80 percent of households, I compute
the virtual price of each extra-marginal goods by solving the system of nonlinear equations described by
(13). For some values of the estimated parameters and of the data, a solution to this system might not exist.
However, in this context, virtual prices can be obtained for 93 percent of the sample.

Having obtained virtual prices for each extra-marginal household, I compute the value of the in-kind
subsidy, as detailed by steps 5 and 6 in the previous subsection. Figure 4 plots the distribution of the equiva-
lent variation, $EV$, which is reported in pesos. The dashed green line represents the median of $EV$, while the
red solid line indicates the mean. In order to contrast the welfare of households receiving the in-kind subsidy
with that of households receiving the cash transfer, I have indicated with the orange solid line the value of
the in-cash transfer, which was fixed for each household and equal to 150 pesos.

The median equivalent variation is 164 pesos, while the mean is slightly lower (163 pesos). This implies
that, on average, households valued more the in-kind transfer than a 150 pesos cash transfer. For approxi-
mately 27 percent of the households, the equivalent variation is lower than 150 pesos and, therefore, these
households would be better off with the cash program rather than with the in-kind program. However, it
should be noted that, despite the fact that households would prefer on average the in-kind transfer to the cash
transfer, the former was highly distorting. The PAL basket was valued approximately 210 pesos at follow-up
prices, which implies that approximately 45 pesos of the total value of the transfer were extra-marginal. In
other words, recipients valued the in-kind benefits at approximately 78 percent of its face value. Given this
relatively large distorting effect of the transfer, much of the potential efficiency that could be achieved with
the in-kind transfer is swept away.

\footnote{I have dropped from the analysis households for which a solution for the virtual prices does not exist. In general, these
households are outliers for some explanatory variable (e.g., food expenditure) or they live in villages in which the price of some
food group is an outlier in the corresponding distribution. It should be noted that, for most of these households, the demand system
already delivered results that are not coherent with standard consumer theory, such as a budget share of a food group outside the
unit interval, or positive (and imprecisely measured) values for the own-price elasticities.}
6.2.1 Robustness of results

In this subsection, I check the robustness of the results in two ways. First, I use both store prices and unit values to construct the baseline prices. As discussed in Section 4.3, the store survey only collected prices of a subset of the commodities in the household survey. It is possible that unit values might be correlated with individual unobserved household tastes, potentially resulting in endogeneity bias. To address this concern, I use an alternative approach for the construction of prices. For those commodities for which store price data are available, I take the median store price in a village and I impute the prices of missing commodities using the median unit value in a village (see Appendix B2 for further details). The price for the aggregate food group is constructed as before. Using this alternative measure for the baseline price, I reestimate the demand model and recompute the welfare effects of the program.

In this section, I focus on the welfare analysis only and report additional results in Appendix D. Results suggest that there is very little change in the welfare effects as compared to the main specification: the value of the in-kind transfer is indeed very close to the one presented in the previous subsection, with a median of 168 pesos and a mean of 167 pesos (see Figure 5a).

As a second robustness check, I have estimated the demand system using a different grouping for PAL goods. One might wonder whether the group of processed PAL goods is too heterogeneous to be aggregated, with vegetable oil being a more basic good than powdered milk or canned fish. In the alternative model of demand I have grouped PAL goods in four groups: rice and pulses (rice, beans and lentils), vegetable oil, cereals (corn flour, pasta soup, cookies, breakfast cereals), proteins (canned fish, powdered milk). The grouping for the commodities not subsidized by PAL is as before. Before presenting the results it should be stressed that, while in theory a finer disaggregation of commodities might better capture the extra-marginality
of each subsidized commodity, working with smaller groups of commodities might result in larger estimation bias due to the higher number of zeros for food groups that are less frequently consumed, which is particularly high for the PAL protein group. Results for this alternative specification should therefore be interpreted taking into account this potential concern.

Figure 5b shows the histogram of the equivalent variation, computed as in the standard case. The distribution seems to be more dispersed, but both the median and mean (respectively 161 and 163 pesos) are very close to the ones of the standard demand model. This suggest that the results in the welfare analysis are robust to alternative specifications of the demand system.

6.3 Results: change in the prices of PAL goods

One of the most cited arguments in favor of the provision of in-kind transfers is the potential effect that they could generate on local prices. By pushing up the supply of subsidized goods, a government can lower the corresponding prices, thus generating potential welfare gains for both beneficiaries and non-beneficiaries alike (Coate et al., 1994). Cash transfers, on the other hand, can not achieve the same objective. On the contrary, if the injection of money is sufficiently high relative to the size of the local economy, cash transfers might generate the opposite effect of increasing the prices of both subsidized and non-subsidized goods.

In the context of the PAL program, Cunha et al. (2014) have found that prices of PAL goods drop by approximately 4 percent in in-kind villages as compared to cash villages. The effect is driven by the reduction of prices in in-kind villages, while the effect of injecting money into cash villages turns out to be negligible.

In order to account for this effect, I simulate a 4 percent reduction in the prices of PAL goods and recompute the welfare effects of the in-kind transfer under this alternative scenario. In principle, a reduction in the prices has two opposite effects on household welfare as compared to the scenario with constant prices.

\[^{37}\text{In their paper, Cunha et al. (2014) also study the effect of the program on the prices of non-PAL goods. As other goods are mainly substitutes with PAL goods (see Appendix C), the in-kind transfer might reduce the price of non PAL goods by lowering the demand. Since their results do not show a significant change on the prices of these goods, I have assumed them constant in the simulation exercise.}\]
On one hand, by reducing the face value of the basket household welfare should decrease as the income effect from the transfer is now lower. On the other hand, the reduction in the price implies that recipients can pay less for each additional purchase of the subsidized good, which would increase household welfare. The results in Figure 6 suggest that the latter effect was larger than the former: the reduction in the prices of PAL goods generated an additional welfare gain as compared to the scenario with constant prices. The median value of the in-kind subsidy is 178 pesos, while the mean is 179 pesos, which represents a 10 percent increase over the average willingness to pay without the price change.

![Figure 6: Distribution of the willingness to pay for the in-kind transfer under a change in PAL prices](image)

It should be noted that the change in the prices of PAL goods might imply very different welfare effects for producers and consumers of PAL goods. While the reduction in prices translates into additional welfare gains for consumers, producers might incur in some welfare loss as a result of lower profits. Studying the effect of the PAL program on the supply side of the market would require information on the type of plantation, as the negative effects of the reduction in prices would be borne by those households producing some of the PAL goods (or close substitutes of PAL goods). As this information is not available in the data, I do not address this issue in the present paper. However, two observations are in order. First, most of the goods transferred in-kind are packaged commodities produced outside the villages. Second, while food production is not observed, the household survey reveals some information about consumption from self-production. For the three commodities that might be produced locally (i.e., rice, beans, lentils), the only one for which self-production is meaningful is represented by beans: while 10 percent of baseline households consumed beans from self-production, less than 1 percent of households self-produced rice or lentils. These

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38 Cunha et al. (2014) present some evidence about the effect of the program on total profits from agricultural production but, as the authors admit, “the quality of the data on agricultural production is not ideal”. While there seems to be a larger increase in producer’s profits under a cash transfer, the difference with respect to in-kind transfers is not statistically significant.
two observations suggest that PAL recipients might be, on average, net consumers of the transferred goods and therefore the welfare losses among recipients might be relatively small.

### 6.4 Heterogeneity in the welfare effects

The distributions of the willingness to pay for the in-kind transfer reported in Figures 4 and 6 exhibit substantial variation. Hence, it is interesting to study which households benefited the most from the in-kind program. The main objective of this section is to study how the welfare effects vary across the income distribution. To do so, I run local polynomial regressions of the willingness to pay against household total monthly expenditure, which is used as a proxy for the unobserved household income. Results are shown in Figure 7. The red line uses the measure for the willingness to pay from the simulation with constant prices, while the green line refers to the simulation with the price change.

The figure shows that the welfare effects of the in-kind transfer are increasing across the total expenditure distribution. This suggests a regressive effect of the in-kind transfer. As the estimated income elasticities in Table 7 suggest, none of the PAL goods is found to be inferior. Hence, richer households will have on average larger consumption levels of the subsidized goods than poorer households. As a result, the food transfer would benefit them proportionally more as compared to households with lower levels of consumption. Note that, when price changes are taken into account, the regressivity of the in-kind transfer becomes even more pronounced. This is not surprising since, again, a change in the prices of PAL goods is more beneficial to recipients with higher consumption levels for those goods.

In order to check the robustness of these results, I present additional analysis from a reduced form approach. One possible concern is that richer households might live in villages where prices for the subsidized
goods are higher. To control for this, I have estimated the following OLS regression

\[ EV_{hv} = \alpha_0 + \alpha_1 e_{hv} + \alpha_2 e_{hv}^2 + \alpha_3 vbasket_v + \delta' p_v + \theta' z_{hv} + \varepsilon_{hv}, \]  

(17)

where \( EV_{hv} \) is the equivalent variation for household \( h \) in village \( v \); \( e_{hv} \) is the total expenditure; \( z_{hv} \) are the household and village characteristics included in the estimation of the demand system; \( vbasket_v \) is the market value of the in-kind transfer in village \( v \); and \( p_v \) is a vector of prices for the other non-subsidized food groups. As always, standard errors are clustered at the village level.

Table 8: Heterogeneity of welfare effects

|                                | Constant prices | Price change |
|--------------------------------|-----------------|--------------|
| Total expenditure              | 0.003***        | 0.010***     |
|                                | (0.001)         | (0.001)      |
| Total expenditure squared      | -1.84e-7***     | -4.52e-7***  |
|                                | (0.000)         | (0.000)      |
| Value PAL box                  | 0.637***        | 0.650***     |
|                                | (0.094)         | (0.093)      |
| Number household members       | 2.550***        | 4.245***     |
|                                | (0.699)         | (0.718)      |
| Number children 0-5            | -0.473          | -0.577       |
|                                | (0.837)         | (0.930)      |
| Number children 6-17           | -1.319*         | -0.581       |
|                                | (0.755)         | (0.728)      |
| Age head                       | -0.167***       | -0.172***    |
|                                | (0.043)         | (0.048)      |
| Education head                 | 0.164           | -0.129       |
|                                | (0.187)         | (0.211)      |
| Indigenous                     | 1.437           | 0.791        |
|                                | (3.930)         | (3.905)      |
| Female head                    | 2.535*          | 0.804        |
|                                | (1.395)         | (1.524)      |
| Distance urban center          | -0.164          | 0.025        |
|                                | (0.272)         | (0.283)      |
| Village population             | -0.002          | -0.003       |
|                                | (0.004)         | (0.004)      |
| Constant                       | -19.002         | -34.147      |
|                                | (33.739)        | (34.603)     |
| Other prices                   | YES             | YES          |
| \( R \)-squared                | 0.610           | 0.679        |
| \( N \)                        | 1022            | 1022         |

Notes: OLS estimates of equation (17). The dependent variable is the equivalent variation, computed as described in Section 6. Standard errors are clustered at the village level. *, **, *** denote significance at the 10, 5, 1 percent level, respectively.

The results of the regression are reported in Table 8. The first column computes the equivalent variation from the simulation with constant prices, while the second refer to the simulation accounting for the price change. As one would expect, villages in which the value of the PAL box is higher are also those in which
households value more the in-kind transfer. Moreover, even when controlling for the value of the basket and demographic characteristics, total expenditure is positive and significantly different from zero, which suggests that indeed richer households have a larger willingness to pay for the in-kind transfer. The magnitude of the estimated coefficient is larger when accounting for the change in the prices, which is consistent with the results in Figure 7. Not surprisingly, the number of household members is positively correlated with the value of the in-kind transfer, suggesting that larger households, which have higher levels of total consumption, assign a greater value to the in-kind subsidy.

The results presented in this section are important from the perspective of policy makers. If the main objective of a social protection program is to assist the poorest households in a given population, in-kind subsidy might not be well-targeted. Moreover, it is often claimed that in-kind transfers might be an efficient way to screen potential beneficiaries because richer households might be more likely to self-select out of an in-kind transfer scheme (Nichols and Zeckhauser, 1982; Blackorby and Donaldson, 1988; Gahvari and Mattos, 2007). While this argument might be true for more developed countries or for larger municipalities and urban areas in developing countries, in the context of small rural villages, in which the income inequality might not be very high and the existence of large stigma effects is unlikely, an in-kind transfer might benefit proportionally more those households that are relatively better off.

6.5 Discussion and cost-efficiency

The results of the welfare analysis suggest that in-kind recipients were on average better off than cash recipients: the distorting effect of the in-kind transfer was not large enough to compensate for the wedge in the values of the two transfer schemes. However, in order to determine which policy was more cost-efficient, the administrative costs of the two transfer modalities must be taken into account. An evaluation report of the program has estimated that the per-transfer cost of the baskets was approximately 30 pesos (CIDE, 2006). Official estimates for the costs of administering the cash transfer are not available. However, as Cunha (2014) suggests, the implementation of the cash program was identical to the one of the Oportunidades program, for which administrative costs have been estimated to be 2.4 percent of the transfer amount. This would imply that the administrative costs of the cash transfer are approximately 3.6 pesos. Hence, there is a 26.4 pesos difference in the per-transfer cost of the two transfers.

If we assume that the government wants to evaluate the welfare gains generated by the two policies at a given cost, we can fix this cost to the total procurement cost of the food basket (i.e., 180 pesos) and compare the average willingness to pay for the in-kind transfer against a cash transfer of 176 pesos (since the administrative costs of a 180 pesos transfer would be roughly 4 pesos). The analysis is complicated by the indirect effects of the program on local prices, which has redistributive implications. In the scenario with constant prices, the average willingness to pay for the in-kind transfer was 163 pesos. This implies that cash would represent a more cost-efficient policy in such a case. Looking at Figure 4, 76 percent of recipients would prefer to receive a 176 pesos cash transfer rather than the food basket. Considering the indirect effects

39 The age of the household head seems to be negatively correlated with the value of the in-kind transfer, which might reflect different dietary habits in older households. Inspections of the data reveal that older households have lower budget shares for PAL cereals as compared to younger households. This descriptive evidence is consistent with the fact that these types of households have a lower valuation of the in-kind transfer.
of the change in prices, as the average willingness to pay for the transfer is 179 pesos, the in-kind and cash
transfers would generate on average the same welfare gains among recipients. This suggests that the two
policies were approximately equally cost-efficient. However, as already pointed out above, this analysis
does not take into account the welfare loss on the supply side of the market, due to the lower profits of
producers (and, potentially, of local shopkeepers). Whether it is desirable to use in-kind transfers to achieve
redistribution from producers to consumers might depend on the particular objective of policy makers.

Finally, it is worth noting that, despite the two policies were on average equally cost-efficient, the in-
kind transfer had a regressive effect. As one of the most important objectives of social assistance programs
is to protect the most vulnerable households, transfers in-kind might not be as well-targeted as cash. Policy
makers implementing in-kind programs might limit the regressivity of the transfer by choosing to transfer
basic commodities which are frequently consumed by the poor.

7 Conclusions

In this paper, I have computed the welfare effects of PAL, a governmental program which provided assistance
to poor rural Mexican households, either in-cash or in-kind. In order to evaluate the program’s impact, a large
experimental trial was conducted in which villages were randomly assigned to receive a cash subsidy, a food
basket or to a control group. The cash transfer was set equal to the cost to the government of purchasing
the food basket in the wholesale market. However, since the cost to the government of providing the in-kind
transfer was significantly lower than the purchasing cost of the same basket in local markets, the program
created a sizable wedge between the values of the two transfer schemes. In such a setting, the determination
of the more cost-efficient policy is not trivial and requires computing the distorting effect of the in-kind
transfer.

I have computed a measure for the willingness to pay for the in-kind benefits by combining the estimation
of a QUAIDS model of demand with the theory of virtual prices developed by Neary and Roberts (1980).
Virtual prices (i.e. the prices that would make the household optimally choose the subsidized bundle) are
an extremely useful tool in welfare analysis, since they allow to use standard demand models even in non-
standard consumer’s problems in which choices are restricted. The procedure that I use is different from the
one of other studies from the Food Stamp Program (Moffit, 1983; Whitmore, 2002) and it is a generalization
of the one presented by Schwab (1985). By applying it to study the welfare effects of PAL, my work is the
first, to my knowledge, to compute the value of in-kind benefits in a developing country and, more generally,
the first to address this issue in the context of a food assistance program.

My results suggest that the average willingness to pay for the in-kind transfers was higher than the mone-
tary value of the cash transfer. However, the in-kind transfer was highly distorting: recipients valued the food
basket at approximately 78 percent of its face value. This distorting effect significantly reduced the potential
higher welfare that a more infra-marginal transfer could have generated. In addition, the administrative costs
of in-kind transfers were significantly higher than those of cash transfers. Indeed, once one takes into ac-
count the higher administrative costs of the in-kind transfer, there is no justification for providing subsidies
in-kind rather than in-cash within the present context.
As the procedure that I have presented allows the computation of the entire distribution for the values of the in-kind subsidy within the sample, I have explored which types of households had the largest welfare gains under the in-kind scheme. My results suggest that richer households valued significantly more the in-kind benefits as compared to poorer households: as these households have higher consumption levels, the distorting effect of the transfer is likely to be smaller. This is a relevant result for policy making since it shows that an in-kind transfer might be more valuable to those groups that are usually less prioritized. It is often claimed that subsidies in-kind would induce the non-poor to self-select out of the program because they are perceived as second-best policies or because of stigma effects (Nichols and Zeckhauser, 1982; Moffit, 1983; Blackorby and Donaldson, 1988; Gahvari and Mattos, 2007). However, within the present context in which communities are small and marginalized and the take-up of the program is high, these effects are presumably very small and, as a result, the transfer has a regressive effect.

Previous estimates from the literature have found that the injection of in-kind subsidies into PAL villages decreased the prices of subsidized goods by pushing up the supply (Cunha et al., 2014). To study how this price change might have had an impact on the welfare of the households in the sample, I have run an additional simulation exercise using the estimates in Cunha et al. (2014). My results suggest that the average welfare effect would increase by approximately 10 percent over the counterfactual scenario with no price change. However, my estimates refer only to the demand side of the market. If some households are producers of some of the PAL goods, their welfare might reduce as a result of lower profits.

A part from studying which transfer was more cost-efficient in the context of the PAL program, this paper makes an additional contribution. In fact, it shows a simple framework that can be used to estimate the welfare effects and the size of the distorting effect of an in-kind subsidy. While this approach is either different or more general than those used in other studies (Schwab, 1985; Moffit, 1989; Whitmore, 2002), it is also a useful instrument for policy makers. Since the procedure only requires estimating a demand system before the introduction of the program, it can be used to compute ex-ante the welfare effects of different types of policies. If policy makers are interested in knowing the welfare effects that different in-kind transfers could generate, the present framework can be used to simulate the impact of different policies and determine the one which is more cost-efficient.

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Appendix A: Program take-up and attrition

Appendix A1 discusses the program take-up and the contamination of the education component. Appendix A2 presents descriptive statistics about the level of attrition within the sample.

Appendix A1: Program take-up and contamination of the education component

In this section, I document the take-up of the program and the extent of contamination of the education component using self-reported data on the receipt of the transfers from the household survey. No administrative data exist on the receipt of the transfers nor on household eligibility. All households were first asked if they received any transfer from the PAL program. If their answer was affirmative, they were asked about the periodicity of the delivery and the number of benefits they received. Moreover, conditional on having received at least one transfer, households were asked about their attendance of the education sessions, the total number of classes attended and the topics covered among five possibilities: organization of the PAL program, health, nutrition, hygiene, other topics. According to the program rules, classes about the organization of the PAL program should have been given to all recipient households from any treated village, including those receiving the “in-kind without education” treatment. Instead, the remaining topics should have been instructed only to households receiving the “cash plus education” or the “in-kind plus education” treatments. To distinguish these classes from the one about the organization of the program, I will refer to them as “core” classes. The program’s rules required households to attend one session per month. However, as already mentioned in the paper, self-reported data reveal several departures from the original rules.

The first column of Table A1 shows that the percentage of households receiving at least one transfer was very high for all the three treatment types (i.e. cash plus education - denoted with CE; in-kind plus education - denoted with KE; and in-kind without education- denoted with K). However, as reported in the last two rows of the table, program take-up was significantly higher for the in-kind sample than for the cash sample. Take-up among households receiving the cash treatment is around 87%, while it is above 92% for households in in-kind villages. Moreover, in-kind households also received significantly more transfers. On average, in-kind households received thirteen transfers since the start of the program, while cash households received on average twelve (see column 2). The variability in the number of transfers received is due to the different timing of implementation of the program. The two survey waves were taken two years apart and PAL started to be phased in after the completion of the baseline survey, reaching full coverage of eligible villages within a year. No administrative data exist on the date in which villages started to receive the transfers. However, as one can see in the table, household data confirm different lengths of exposure to the program.

The next columns show the extent of contamination of the educational component. Column 3 reports the percentage of households attending at least one education class, irrespective of the topic covered (among the five possibilities listed above). Column 4 shows the percentage of households attending at least one “core” class. Column 5 reports the average number of classes attended (irrespective of the topic). A few comments are in order. First, focusing on “core” classes only, 70% of households in the “in-kind without education” group attended at least one session, suggesting that the treatment was indeed confounded. While this percentage is significantly higher for households in the “in-kind plus education” group (around 85%), it
is not significantly different from that of cash households, despite the fact that for the latter households the education component was a mandatory requirement of the program. Second, the program rules envisaged compulsory attendance to monthly classes. However, the average number of sessions attended was very low, being around four in all treatment groups. The fact that the average number of benefits received was significantly higher than the number of classes attended suggests that, in practice, the conditionality requirement was not enforced.

Table A1: Program Take-Up and Contamination

|                      | At least one transfer | Number of transfers | At least one class | At least one “core” class | Number of classes |
|----------------------|----------------------|--------------------|--------------------|---------------------------|------------------|
| Cash+Education (CE)  | 0.871                | 12.021             | 0.841              | 0.709                     | 4.305            |
|                      | (0.018)              | (0.425)            | (0.037)            | (0.044)                   | (0.404)          |
| Kind+Education (KE)  | 0.948                | 13.448             | 0.925              | 0.857                     | 4.946            |
|                      | (0.012)              | (0.382)            | (0.018)            | (0.024)                   | (0.315)          |
| Kind (K)             | 0.924                | 13.259             | 0.822              | 0.705                     | 4.185            |
|                      | (0.015)              | (0.278)            | (0.033)            | (0.040)                   | (0.421)          |
| H0: CE = K, p-value  | 0.001                | 0.014              | 0.041              | 0.004                     | 0.212            |
| H0: CE = KE, p-value | 0.024                | 0.016              | 0.695              | 0.936                     | 0.838            |
| H0: K = KE, p-value  | 0.214                | 0.690              | 0.007              | 0.001                     | 0.150            |

Notes: Data are from the household survey and are self-reported. Columns 3 and 5 include all classes irrespective of the topic (organization of PAL, health, nutrition, hygiene, other topic). Core classes in column 4 are classes covering topics in health, nutrition and hygiene. Standard errors are reported in parenthesis and are clustered at the village level.

Appendix A2: Attrition

This section shows some descriptive statistics about the attrition in the sample. Table A2 shows the attrition rates at the household and at the individual level by treatment group. While household attrition was around 14 percent in the control group, it was significantly lower for households in the three treatment groups, and approximately equal to 10 percent. There are no statistically significant differences in the attrition rates of the three treatment groups (as reported at the bottom of Table A2, where I test for differential attrition between one treatment group and another).

Attrition also caused some change in household composition. In Table A3 I report the means of demographic characteristics of the household among attriters and non-attriters. Non-attrited households are larger and have a higher number of 12-17 years old children. Among non-attriters, the household head is on average two years older and it is less likely that the household is headed by a woman. Other variables, such as an indicator for the household being indigenous, the number of younger children and the total food expenditure (net of self-production), do not present statistically significant differences.
### Table A2: Attrition rates by treatment group

| Treatment          | Households | Individuals |
|--------------------|------------|-------------|
| Cash+Education (CE)| -0.039**   | -0.029      |
|                    | (0.019)    | (0.018)     |
| Kind+Education (KE)| -0.047**   | -0.045**    |
|                    | (0.018)    | (0.016)     |
| Kind (K)           | -0.044**   | -0.042**    |
|                    | (0.021)    | (0.021)     |
| Control            | 0.146***   | 0.199***    |
|                    | (0.015)    | (0.013)     |

N = 6625 30362

H0: CE=K, p value 0.813 0.531
H0: CE=KE, p value 0.598 0.288
H0: K=KE, p value 0.843 0.850

Notes: The table shows attrition rates at the household (column 1) and at the individual level (column 2) by treatment groups (CE=cash plus education; KE=in-kind plus education; K=in-kind without education). Standard errors are reported in parentheses and are clustered at the village level. *, **, *** denote significance at the 10, 5, 1 percent level, respectively.

### Table A3: Means of selected demographic characteristics for attriters and non-attriters

|                      | Non attriters | Attriters | Difference | N   |
|----------------------|---------------|-----------|------------|-----|
| Number of household members | 4.656         | 4.137     | -0.519***  | 6691|
|                      | (2.159)       | (2.037)   | (0.120)    |     |
| Number of children 0-5 years old | 0.709         | 0.723     | 0.014      | 6691|
|                      | (0.893)       | (0.890)   | (0.039)    |     |
| Number of children 6-11 years old | 0.757         | 0.690     | -0.067     | 6691|
|                      | (0.949)       | (0.944)   | (0.049)    |     |
| Number of children 12-17 years old | 0.660         | 0.565     | -0.095**   | 6691|
|                      | (0.931)       | (0.877)   | (0.038)    |     |
| Age of the household head | 45.207        | 42.901    | -2.307**   | 6667|
|                      | (15.488)      | (16.482)  | (0.772)    |     |
| Indigenous household | 0.180         | 0.232     | 0.051      | 6691|
|                      | (0.385)       | (0.422)   | (0.052)    |     |
| Female head          | 0.140         | 0.202     | 0.062**    | 6691|
|                      | (0.347)       | (0.402)   | (0.020)    |     |
| Food expenditure     | 943.531       | 924.217   | -19.314    | 6691|
|                      | (648.745)     | (654.832) | (50.217)   |     |

Notes: The table shows the mean and standard deviations (in parentheses) of demographic household characteristics for attriters and non-attriters (columns 1 and 2). Column 3 reports the mean difference between the two groups and, in parentheses, the corresponding standard errors (clustered at the village level). "Indigenous household" is a dummy equal to one if any member of the household speaks an indigenous language. Food expenditure does not include the value of self-production. *, **, *** denote significance at the 10, 5, 1 percent level, respectively.
Appendix B: Sample and variables construction

Appendix B1: Sample construction

The original sample includes 6,707 baseline and 6,063 follow-up households in 208 villages. Two villages were excluded from the program because of violence in the community, which could have risked enumerators’ safety. As discussed in the paper, I have further excluded ten villages for various reasons: two localities were excluded because households started to receive PAL prior to the baseline survey; two villages (one control and one in-kind) are geographically contiguous, which could result into some spillover of the treatment; two villages refused to participate in the PAL program; two localities were dropped because all households in these villages received Oportunidades, instead of PAL; one control locality was excluded because it received in-kind transfers. Finally, as documented in Section 4.3 and in Appendix B2, the construction of commodity prices requires geographical imputation of missing prices at the municipality or state level. Since, in the sample, there is only one village from the state of Quintana Roo, it is infeasible to construct prices for this village, and it is thus dropped from the analysis.

Within the remaining 196 sample villages, I have excluded 17 baseline and 4 follow-up households with incomplete surveys, plus 4 follow-up surveys in which the household head could not be identified. Among follow-up households, 209 of them were classified as “split-off”, i.e. they were formed by separation from an original baseline household. Whenever possible, both the “original” household and the “split-off” household were surveyed at follow-up. Since the survey of the latter had many missing modules, I have dropped the split-off households from the sample, while I do keep the corresponding “original” households. I have also dropped attrited households and surveys with incomplete food module. Few households were excluded because they had inconsistent or non-existing information on the household roster. I have also excluded 80 households with null food expenditure at baseline or at follow-up. The final sample includes 5,494 households, observed in both waves. Since there are missing values for the expenditure of some commodities, the sample used in the estimation includes less households.

Appendix B2: Store price survey

Out of the 196 sample villages, store prices were collected in 171 baseline villages and in 191 follow-up villages. A maximum of three stores in each village was surveyed. At baseline, in 67 percent of villages one store was surveyed; in 24 percent of villages two stores were surveyed; and in 9 percent of villages three stores were surveyed. At follow-up, in 37 percent of villages one store was surveyed; in 46 percent of villages two stores were surveyed; and in 17 percent of villages three stores were surveyed. On average, 1.4 and 1.8 stores were surveyed at baseline and at follow-up, respectively.

The follow-up survey collected prices for all the 56 goods included in the analysis, while the baseline survey only collected prices of 32 goods. Even for surveyed stores, there are considerable missing values: the baseline survey lacks information on 22 percent of total village-good observations; the follow-up survey

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40 While information on the reason for separation is not reported, inspection of the data reveals that the most common case consists of adult children leaving the parental household to live independently.

41 I considered a store to have been surveyed if the price of at least one commodity was collected.
lacks information on 20 percent of total village-good observations.

Prices were generally reported for fixed quantities (e.g., 200 grams of pasta soup). When unconventional units were used (e.g., piece of white bread), I have converted them into kilograms (or liters, for liquids) using the conversion factors from the INSP.

Appendix B3: Variables construction

Budget shares  Data are from household’s seven days recall. For each good in the analysis, households had to report the quantity consumed, the quantity purchased, the corresponding expenditure and, if applicable, the quantity self-produced in the last 7 days. Quantities are usually reported in kilos or liters. When other units of measurements have been reported (e.g. piece or packet), I have converted quantities in kilos or liters using conversion factors from the INSP. Expenditure is reported in Mexican pesos. I have converted weekly quantities and expenditure into monthly quantities and expenditure, using a conversion factor equal to 4.3.

If the quantity consumed and the quantity purchased of a given commodity coincide, expenditure is equal to the reported expenditure. If the quantity consumed is higher than the quantity purchased (because of self-production or other unreported reasons) I have imputed the value of the extra-consumption using the median village price of that commodity, and I have added it to the reported expenditure.

To construct the expenditure for a food group I have summed the expenditure of all individual commodities in that group. The budget share for the group is computed as the ratio between the budget share of the food group and the total food expenditure (see below).

Total expenditure  Total expenditure is the sum of the expenditure on all the 56 commodities considered in the analysis. As described above, the expenditure for a commodity includes the value of self-production and the value of any consumption in excess of the reported purchase; of course, this additional value is also included in the total food expenditure.

Baseline Prices for individual commodities  Baseline prices are constructed from unit values. A unit value is obtained taking the ratio between the expenditure for a commodity and the quantity consumed of the commodity. Baseline prices are equal to the median unit value in a village. If there is no expenditure on a given commodity in a village, I have imputed the price using the median unit value in the municipality or, if this is missing, the median unit value in the state. Table B1 shows, for each commodity included in the analysis, the imputation process, i.e. the percentage of villages in which the price was equal to the median within the village (columns 2 and 6), or the median within the municipality (columns 3 and 7), or the median within the state (columns 4 and 8).

An alternative measure for the commodity prices is the median store price in a village, collected from surveys of local stores. However, there are considerable missing values in the baseline survey (see Appendix B2). I have used this as an alternative measure in the robustness checks presented in Section 6.3. The construction of the baseline store price depends on data availability, as baseline store prices were collected only for 32 out of 56 commodities and in 171 out of 196 villages. For the 32 commodities for which prices

42The list of these goods is reported in Table B1.
were collected in local stores, I take the median price within the village. If no store was surveyed in the village, I take the municipality or state median price. For the remaining 24 commodities, I have imputed prices using the median unit values (constructed as detailed above). In addition, for the 25 baselines villages in which store prices were not collected, I have imputed prices using the median unit values.

**Follow-up prices for individual commodities**  Follow-up prices are constructed from surveys of local stores (see Appendix B2). The price of a given commodity is equal to the median store price within the village. If the price of a commodity was missing within a village, I have imputed it using the median price within the municipality or the median within the state. Table B2 shows, for each commodity included in the analysis, the imputation process, i.e. the percentage of villages in which the price was equal to the median within the village (columns 2 and 6), or the median within the municipality (columns 3 and 7), or the median within the state (columns 4 and 8). Local store prices were not collected for 5 out of 196 follow-up villages. I have not imputed a price for these villages and consider them as missing in the analysis.

Some goods present some differences with respect to the household food consumption survey. First, because of an error in translating the questionnaire, the price of crackers (“galletas saladas”) was collected instead of the price of biscuits (“galletas”). I have used the median unit value (constructed as detailed above) instead of the store price for this commodity. Second, in the consumption module two pairs of goods (beef and pork; sardines and tuna) were asked about jointly while they were disaggregated in the price survey. I have used the aggregated category and taken the median of any food price within the pair.

**Prices of food groups**  The price of a food group (e.g., fruit and vegetables; animal products; etc.) was constructed as the geometric mean of the prices of the individual commodities in that food group. Let $P_J$ be the price for food group $J$. Let $p_k, k = 1, ..., K$ be the price of the $k$-th individual commodity in food group $J$. The price index for food group $J$ is $ln(P_J) = \sum_{k=1}^{K} w_k \ln(p_k)$, where $w_k$ is the weight of the $k$-th commodity. The weight for commodity $k$ is constructed taking the baseline municipality-level budget share of good $k$ within food group $J$. In other words, for each commodity in a given food group, I divide the total expenditure in the municipality for that commodity by the total expenditure in the municipality for that food category. Since consumption of powdered milk and canned fish is zero in several municipalities, I have used state-level weights to construct the price index for processed PAL goods.

**Demographics**  Demographics included in the estimation of the demand system are: the number of household members, the number of children 0 to 5 years old, the number of children 6 to 17 years old, the age of the household head, the education level (in years) of the household head, an indicator for the household head being female, an indicator for the household being indigenous. All variables are self-explanatory except the last three. I have defined a household to be indigenous if at least one household member reported to speak an indigenous language. In the estimation of the demand system I have also included the distance of the village to the closest urban locality and the total population in the village (see below).
SES index  I have constructed an index of socioeconomic status (SES) using Principal Component Analysis (PCA) and self-reported data about characteristics of the dwellings and ownership of durables. See Appendix B4 for a list of the variables and for some evidence about the internal coherence of this measure.

Distance from urban area and village population  The distance from an urban area has been constructed from geographical location data from INEGI (the Mexican national institute of statistics). For each village in Mexico, the dataset reports the geographical coordinates (longitude and latitude) of all Mexican villages and municipalities and the total population in the village. I have merged this data with the PAL sample (all PAL villages could be located in the INEGI dataset). For each village in the PAL sample, I have constructed the geodetic distance between the PAL village and any urban locality in the INEGI dataset which was either in the same state of the PAL village or in an adjoining state. INEGI classifies a locality to be urban if it has a population of least 2500 inhabitants. I have then taken the minimum distance to any urban areas as a measure of the distance. The geodetic distance was computed using the “geodist” STATA command.
Table B1: Imputation of baseline prices

| Good                  | Price equal to median unit value in the village (% of villages) | Price equal to median unit value in the municipality (% of villages) | Price equal to median unit value in the state (% of villages) | Good                  | Price equal to median unit value in the village (% of villages) | Price equal to median unit value in the municipality (% of villages) | Price equal to median unit value in the state (% of villages) |
|-----------------------|---------------------------------------------------------------|------------------------------------------------------------------|----------------------------------------------------------------|-----------------------|---------------------------------------------------------------|------------------------------------------------------------------|----------------------------------------------------------------|
| Tomatoes              | 1                                                             | 0                                                                | 0                                                              | Beans PAL            | 0.980                                                        | 0.015                                                            | 0.005                                                           |
| Onions                | 0.995                                                         | 0.005                                                            | 0                                                              | Lentils PAL         | 0.719                                                        | 0.102                                                            | 0.179                                                           |
| Potatoes              | 0.990                                                         | 0.005                                                            | 0.005                                                          | Oats                 | 0.786                                                        | 0.066                                                            | 0.148                                                           |
| Carrots               | 0.852                                                         | 0.066                                                            | 0.082                                                          | Chicken             | 0.974                                                        | 0.026                                                            | 0                                                                |
| Lettuce and greens    | 0.811                                                         | 0.061                                                            | 0.128                                                          | Pork/beef meat       | 0.969                                                        | 0.010                                                            | 0.020                                                           |
| Pumpkin               | 0.883                                                         | 0.061                                                            | 0.056                                                          | Fish                | 0.714                                                        | 0.133                                                            | 0.153                                                           |
| Chayote               | 0.929                                                         | 0.020                                                            | 0.051                                                          | Canned fish PAL     | 0.949                                                        | 0.036                                                            | 0.015                                                           |
| Nopales               | 0.464                                                         | 0.158                                                            | 0.378                                                          | Eggs                | 1                                                            | 0                                                                | 0                                                                |
| Chili peppers         | 0.954                                                         | 0.020                                                            | 0.026                                                          | Milk                | 0.949                                                        | 0.036                                                            | 0.015                                                           |
| Guayaba               | 0.398                                                         | 0.214                                                            | 0.388                                                          | Yogurt              | 0.770                                                        | 0.128                                                            | 0.102                                                           |
| Mandarin              | 0.602                                                         | 0.189                                                            | 0.209                                                          | Cheese              | 0.944                                                        | 0.026                                                            | 0.031                                                           |
| Papaya                | 0.617                                                         | 0.148                                                            | 0.235                                                          | Lard                | 0.724                                                        | 0.128                                                            | 0.148                                                           |
| Oranges               | 0.827                                                         | 0.102                                                            | 0.071                                                          | Processed meats     | 0.735                                                        | 0.117                                                            | 0.148                                                           |
| Banana                | 0.969                                                         | 0.020                                                            | 0.010                                                          | Powdered milk PAL   | 0.469                                                        | 0.189                                                            | 0.342                                                           |
| Apples                | 0.898                                                         | 0.066                                                            | 0.036                                                          | Snacks              | 0.526                                                        | 0.189                                                            | 0.286                                                           |
| Lemons                | 0.684                                                         | 0.102                                                            | 0.214                                                          | Soft drink          | 0.985                                                        | 0.015                                                            | 0                                                                |
| Watermelon            | 0.321                                                         | 0.224                                                            | 0.454                                                          | coffee              | 0.985                                                        | 0.005                                                            | 0.010                                                           |
| Corn tortilla         | 0.745                                                         | 0.071                                                            | 0.184                                                          | Sugar               | 1                                                            | 0                                                                | 0                                                                |
| Corn grain            | 0.903                                                         | 0.056                                                            | 0.041                                                          | Vegetable oil PAL   | 0.995                                                        | 0                                                                | 0.005                                                           |
| Corn flour PAL        | 0.735                                                         | 0.097                                                            | 0.168                                                          | Fries               | 0.689                                                        | 0.133                                                            | 0.179                                                           |
| White bread           | 0.832                                                         | 0.066                                                            | 0.102                                                          | Chocolate           | 0.531                                                        | 0.199                                                            | 0.270                                                           |
| Sweet bread           | 0.980                                                         | 0.015                                                            | 0.005                                                          | Sweets              | 0.903                                                        | 0.061                                                            | 0.036                                                           |
| Loaf of bread         | 0.612                                                         | 0.133                                                            | 0.255                                                          | Mayonnaise          | 0.867                                                        | 0.056                                                            | 0.077                                                           |
| Wheat flour           | 0.500                                                         | 0.189                                                            | 0.311                                                          | Fruit juice         | 0.510                                                        | 0.184                                                            | 0.306                                                           |
| Pasta soup PAL        | 1                                                             | 0                                                                | 0                                                              | Consome             | 0.857                                                        | 0.077                                                            | 0.066                                                           |
| Rice PAL              | 1                                                             | 0                                                                | 0                                                              | Soft drink powder   | 0.939                                                        | 0.020                                                            | 0.041                                                           |
| Cookies PAL           | 1                                                             | 0                                                                | 0                                                              | Atole               | 0.480                                                        | 0.168                                                            | 0.352                                                           |
| Cereals box PAL       | 0.520                                                         | 0.173                                                            | 0.306                                                          | Canned chili        | 0.929                                                        | 0.041                                                            | 0.031                                                           |

Notes: The table shows, for each commodity included in the analysis, the percentage of villages in which the price was equal to the median unit value within the village (columns 2 and 6), or the median unit value within the municipality (columns 3 and 7), or the median unit value within the state (columns 4 and 8). Columns 1 and 5 reports the goods in the PAL subsidy.
## Table B2: Imputation of follow-up prices

| Good             | Price equal to median store price in the village (% of villages) | Price equal to median store price in the municipality (% of villages) | Price equal to median store price in the state (% of villages) | Good             | Price equal to median store price in the village (% of villages) | Price equal to median store price in the municipality (% of villages) | Price equal to median store price in the state (% of villages) |
|------------------|---------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------|------------------|---------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------|
| Tomatoes         | 0.921                                                         | 0.047                                                          | 0.031                                                          | Beans            | 0.963                                                         | 0.016                                                          | 0.021                                                          |
| Onions           | 0.937                                                         | 0.031                                                          | 0.031                                                          | Lentils          | 0.738                                                         | 0.110                                                          | 0.152                                                          |
| Potatoes         | 0.911                                                         | 0.047                                                          | 0.042                                                          | Oats             | 0.869                                                         | 0.063                                                          | 0.068                                                          |
| Carrots          | 0.770                                                         | 0.131                                                          | 0.099                                                          | Chicken          | 0.785                                                         | 0.131                                                          | 0.084                                                          |
| Lettuce and greens | 0.665                                                        | 0.188                                                          | 0.147                                                          | Pork/beef meat   | 0.780                                                         | 0.120                                                          | 0.099                                                          |
| Pumpkin          | 0.665                                                         | 0.168                                                          | 0.168                                                          | Fish             | 0.586                                                         | 0.204                                                          | 0.209                                                          |
| Chayote          | 0.743                                                         | 0.152                                                          | 0.105                                                          | Canned fish      | 0.990                                                         | 0.005                                                          | 0.005                                                          |
| Nopales          | 0.556                                                         | 0.215                                                          | 0.429                                                          | Eggs             | 0.974                                                         | 0.016                                                          | 0.010                                                          |
| Chili peppers    | 0.843                                                         | 0.089                                                          | 0.068                                                          | Milk             | 0.901                                                         | 0.042                                                          | 0.058                                                          |
| Guayaba          | 0.440                                                         | 0.230                                                          | 0.330                                                          | Yogurt           | 0.827                                                         | 0.084                                                          | 0.089                                                          |
| Mandarin         | 0.586                                                         | 0.236                                                          | 0.178                                                          | Cheese           | 0.796                                                         | 0.099                                                          | 0.105                                                          |
| Papaya           | 0.534                                                         | 0.230                                                          | 0.236                                                          | Lard             | 0.654                                                         | 0.168                                                          | 0.178                                                          |
| Oranges          | 0.592                                                         | 0.204                                                          | 0.204                                                          | Processed meats | 0.733                                                         | 0.126                                                          | 0.141                                                          |
| Banana           | 0.812                                                         | 0.131                                                          | 0.058                                                          | Powdered milk    | 0.461                                                         | 0.220                                                          | 0.319                                                          |
| Apples           | 0.770                                                         | 0.152                                                          | 0.079                                                          | Snacks           | 0.764                                                         | 0.110                                                          | 0.126                                                          |
| Lemons           | 0.717                                                         | 0.173                                                          | 0.110                                                          | Soft drink       | 0.916                                                         | 0.026                                                          | 0.058                                                          |
| Watermelon       | 0.487                                                         | 0.230                                                          | 0.283                                                          | Coffee           | 0.942                                                         | 0.021                                                          | 0.037                                                          |
| Corn tortilla    | 0.764                                                         | 0.115                                                          | 0.120                                                          | Sugar            | 0.979                                                         | 0.021                                                          | 0.000                                                          |
| Corn grain       | 0.796                                                         | 0.099                                                          | 0.105                                                          | Vegetable oil    | 0.990                                                         | 0.000                                                          | 0.010                                                          |
| Corn flour       | 0.817                                                         | 0.105                                                          | 0.079                                                          | Fries            | 0.890                                                         | 0.058                                                          | 0.052                                                          |
| White bread      | 0.691                                                         | 0.157                                                          | 0.152                                                          | Chocolate        | 0.791                                                         | 0.105                                                          | 0.105                                                          |
| Sweet bread      | 0.791                                                         | 0.110                                                          | 0.099                                                          | Sweets           | 0.948                                                         | 0.016                                                          | 0.037                                                          |
| Loaf of bread    | 0.764                                                         | 0.120                                                          | 0.115                                                          | Mayonaise        | 0.901                                                         | 0.063                                                          | 0.037                                                          |
| Wheat flour      | 0.822                                                         | 0.079                                                          | 0.099                                                          | Fruit juice      | 0.885                                                         | 0.084                                                          | 0.031                                                          |
| Pasta soup       | 1                                                             | 0                                                              | 0                                                              | Consome          | 0.953                                                         | 0.037                                                          | 0.010                                                          |
| Rice             | 0.995                                                         | 0.005                                                          | 0.000                                                          | Soft drink powder| 0.942                                                         | 0.047                                                          | 0.010                                                          |
| Cookies          | 0.944                                                         | 0.020                                                          | 0.036                                                          | Atole            | 0.848                                                         | 0.084                                                          | 0.068                                                          |
| Cereals box      | 0.754                                                         | 0.147                                                          | 0.099                                                          | Canned chili     | 0.963                                                         | 0.026                                                          | 0.010                                                          |

Notes: The table shows, for each commodity included in the analysis, the percentage of villages in which the price was equal to the median store price within the village (columns 2 and 6), or the median store price within the municipality (columns 3 and 7), or the median store price within the state (columns 4 and 8). Columns 1 and 5 reports the goods in the PAL subsidy. For cookies (good 27) median unit values were used instead of median store prices.
Appendix B4: Principal Component Analysis

The PAL survey collected information about the characteristics of the dwellings in which households live and about the ownership of durables. Following Filmer and Pritchett (2001) and Kolenikov and Angeles (2009), I have used these data to construct a proxy for household’s Socio-Economic Status (henceforth, SES). The methodology is an application of Principal Component Analysis (PCA).

In economics, one of the first applications of PCA is due to Filmer and Pritchett (2001, henceforth FP). Using data from the Demographic and Health Surveys (DHS) for India, Nepal, Indonesia and Pakistan, FP select several indicators for the ownership of assets and for the characteristics of the dwellings and construct an index of household’s welfare taking the first principal component from the PCA. They show this index is a good proxy for household’s socio-economic status. Despite its popularity, the PCA method used by FP suffers from some drawbacks. As Kolenikov and Angeles (2009, henceforth KA) pointed out, one of the biggest limitations of FP’s method is the reduction of ordinal variables to a set of dummy variables, one for each category. Although the FP method might be appealing in that it does not make any assumption on the ordering of the categories, additional information about the ordering of the categories provides higher efficiency. As KA showed through a simulation study, using PCA with ordinal variables usually performs better than the FP approach. This is true in many cases, possibly also when the ordering of the categories is misspecified. Therefore, in my application, I will follow the “PCA ordinal approach” suggested by KA. The first part of this appendix describes the variables used in the construction of the SES index. The second part provides some evidence about the internal coherence of this measure as a proxy for household income.

Selection of initial variables  The full list of variables used in the PCA is reported in Table B3. Characteristics of the dwelling include the material of the floor, walls and roof, the source of water, the type of sanitation facility, the presence of a kitchen, the number of rooms and bedrooms and the availability of electricity. The list of durables is represented by indicators for ownership of radio, television, video player, phone, computer, fridge, washing machine, stove, water heater, motorbike and car. All the variables related to characteristics of the dwelling are ordinal and, as pointed out by KA, the ordering of the categories conveys information. Therefore, following their advice, I have kept the order between the categories. In some instances, when a clear ordering cannot be easily established or when there are very low frequencies for some of the categories, I have grouped two or more categories together. For variables related to durable’s ownership the survey also asked if the durable owned by the household was working or not. Even though this information might be combined to create ordinal variables, I do not use it in this application since, in practice, the percentage of households owning a non-working durable is lower than 2% for all but two durables. The final configuration of the variables is presented in the last two columns of Table B3, which report the number of categories, as well as the coding of the categories for each variable.

Results and internal coherence  Results of the PCA are presented in the first column of Table B4, which reports the scoring factors for the first principal component. Baseline mean and standard deviation of each variable are reported in the next two columns. In order to ease the interpretability, instead of reporting the mean and standard deviations of ordinal variables I have reported the mean of indicators corresponding to
each subcategory of the ordinal variable. All the scores on the first principal component have the expected sign: better quality materials in the dwelling and possession of durables determine a higher score and therefore, in this application, a higher SES index. Note that, consistently with the reverse scale for water source and sanitation facility, the scores for these two variables are negative. The score has a mean of zero and a standard deviation of 2.66 (see fourth to last row of Table B4). To check the internal coherence of the SES index I have used the empirical distribution of the index across households and assigned each household to a SES quantile. The last five columns of Table B4 report, for each SES quantile, the mean of each variable used in the PCA. As one moves from the poorest to the richest quantile, ownership of durables increases and households can afford better quality materials. For example, among the poorest households in the sample, the percentage of those owning a television is 21 percent, while only 2 percent owns a fridge. The corresponding figures for the richest quintile are, respectively, 98 and 96 percent. It is also interesting to see that, for some variables, the relationship with SES is highly nonlinear. For example, the percentage of households with water piped inside the compound is increasing from the lowest to the middle quantile, but then declines for households in the top two quintiles as these households have access to better facilities (water piped directly in the dwelling). Finally, the SES index, reported in the fourth to last row of Table B4, ranges from an average of −3.21 for households in the poorest quantile to 3.12 for households in the richest quantile. As a further check of the internal coherence of the SES index I report the average values of other variables in the data which are likely to be related to the household SES: monthly per capita food expenditure, monthly per capita total expenditure and the education of the household head. As can be seen at the bottom of Table B4, average per capita food expenditure for the richest quantile is almost two times higher than the average for the poorest quantile, while average per capita total expenditure is about 2.3 times higher. The years of education of the household head ranges from an average of 2.75 for the poorest group to an average of 5.36 for the richest quantile.
Table B3: List of variables used in the PCA

| Variable                  | Type       | Number of categories | Categories                                                                 |
|---------------------------|------------|----------------------|-----------------------------------------------------------------------------|
| Floor material            | categorical| 3                    | 1=soil; 2=concrete; 3=tiles or wood                                          |
| Walls material            | categorical| 4                    | 1=cardboard/bamboo/mud/asbestos/other; 2=wood; 3=sun-dried bricks; 4=bricks, cement |
| Roof material             | categorical| 4                    | 1=cardboard/other; 2=bamboo/wood; 3=asbestos; 4=tiles/cement                 |
| Water source              | categorical| 5                    | 1=piped inside dwelling; 2=piped inside compound; 3=piped outside compound; 4=well; 5=river; 5=other source |
| Sanitation Facility       | categorical| 5                    | 1=toilet; 2=septic tank; 3=latrine; 4=open latrine; 5=none                  |
| Kitchen                   | ordinal    | 3                    | 0=no; 1=also used as sleeping room; 2=separate kitchen                      |
| Number of rooms           | count      |                      |                                                                             |
| Number of bedrooms        | count      |                      |                                                                             |
| Has electricity           | binary     |                      |                                                                             |
| Owns Radio                | binary     |                      |                                                                             |
| Owns television           | binary     |                      |                                                                             |
| Owns video-player         | binary     |                      |                                                                             |
| Owns phone                | binary     |                      |                                                                             |
| Owns computer             | binary     |                      |                                                                             |
| Owns fridge               | binary     |                      |                                                                             |
| Owns washing machine      | binary     |                      |                                                                             |
| Owns gas heating          | binary     |                      |                                                                             |
| Owns boiler               | binary     |                      |                                                                             |
| Owns motorcycle           | binary     |                      |                                                                             |
| Owns car                  | binary     |                      |                                                                             |
Table B4: Scoring factors and descriptive statistics for variables used in the PCA

| Floor material | Score | Mean | SD  | Poorest | Second | Middle | Fourth | Richest |
|----------------|-------|------|-----|---------|--------|--------|--------|---------|
| Soil (1)       | 0.300 | 0.308| 0.462| 0.860   | 0.438  | 0.172  | 0.060  | 0.010   |
| Concrete (2)   |       | 0.651| 0.477| 0.139   | 0.556  | 0.819  | 0.924  | 0.818   |
| Tiles/wood (3) |       | 0.041| 0.198| 0.001   | 0.006  | 0.008  | 0.016  | 0.172   |

| Walls material | Score | Mean | SD  | Poorest | Second | Middle | Fourth | Richest |
|----------------|-------|------|-----|---------|--------|--------|--------|---------|
| Cardboard/Bamboo/mud/other (1) | 0.089 | 0.285| 0.275| 0.109   | 0.042  | 0.016  | 0.003  |         |
| Wood (2)       |       | 0.240| 0.427| 0.552   | 0.390  | 0.190  | 0.057  | 0.010   |
| Sun-dried bricks (3) |       | 0.082| 0.275| 0.103   | 0.151  | 0.094  | 0.035  | 0.027   |
| Bricks/cement (4) |       | 0.589| 0.492| 0.070   | 0.349  | 0.674  | 0.891  | 0.961   |

| Roof material | Score | Mean | SD  | Poorest | Second | Middle | Fourth | Richest |
|---------------|-------|------|-----|---------|--------|--------|--------|---------|
| Cardboard/other (1) | 0.077 | 0.267| 0.257| 0.081   | 0.038  | 0.008  | 0.000  |         |
| Palma/wood (2) |       | 0.067| 0.250| 0.202   | 0.075  | 0.039  | 0.015  | 0.005   |
| Asbaste board (3) |       | 0.578| 0.494| 0.494   | 0.668  | 0.659  | 0.630  | 0.440   |
| Tiles/cement (4) |       | 0.278| 0.448| 0.047   | 0.176  | 0.264  | 0.348  | 0.556   |

| Water source | Score | Mean | SD  | Poorest | Second | Middle | Fourth | Richest |
|--------------|-------|------|-----|---------|--------|--------|--------|---------|
| Piped inside dwelling (1) | 0.128 | 0.334| 0.010| 0.025   | 0.072  | 0.139  | 0.395  |         |
| Piped inside compound (2) | 0.452 | 0.498| 0.288| 0.505   | 0.560  | 0.511  | 0.392  |         |
| Piped outside compound (3) | 0.028 | 0.166| 0.033| 0.027   | 0.022  | 0.035  | 0.026  |         |
| Well (4) |       | 0.263| 0.440| 0.326   | 0.301  | 0.264  | 0.263  | 0.159   |
| River/Other (5) |       | 0.129| 0.336| 0.343   | 0.141  | 0.082  | 0.052  | 0.028   |

| Sanitation facility | Score | Mean | SD  | Poorest | Second | Middle | Fourth | Richest |
|---------------------|-------|------|-----|---------|--------|--------|--------|---------|
| Toilet (1) |       | 0.391| 0.488| 0.067   | 0.247  | 0.411  | 0.558  | 0.674   |
| Septic tank (2) |       | 0.251| 0.433| 0.170   | 0.243  | 0.286  | 0.288  | 0.266   |
| Latrine (3) |       | 0.220| 0.414| 0.335   | 0.349  | 0.233  | 0.127  | 0.055   |
| Open latrine (4) |       | 0.019| 0.136| 0.050   | 0.022  | 0.014  | 0.006  | 0.002   |
| None (5) |       | 0.120| 0.325| 0.379   | 0.140  | 0.057  | 0.020  | 0.004   |

| Kitchen | Score | Mean | SD  | Poorest | Second | Middle | Fourth | Richest |
|---------|-------|------|-----|---------|--------|--------|--------|---------|
| None (1) |       | 0.157| 0.364| 0.300   | 0.224  | 0.165  | 0.076  | 0.020   |
| Also used to sleep (2) |       | 0.075| 0.264| 0.145   | 0.099  | 0.068  | 0.047  | 0.018   |
| Separate kitchen (3) |       | 0.768| 0.422| 0.555   | 0.678  | 0.767  | 0.877  | 0.962   |
| Number of rooms |       | 0.296| 2.779| 1.264   | 1.766  | 2.161  | 2.642  | 3.234   |
| Number of bedrooms |       | 0.230| 1.572| 0.748   | 1.120  | 1.298  | 1.491  | 1.742   |
| Has electricity |       | 0.210| 0.883| 0.322   | 0.554  | 0.895  | 0.969  | 1.000   |
| Has radio |       | 0.186| 0.661| 0.473   | 0.334  | 0.588  | 0.682  | 0.802   |
| Has tv |       | 0.269| 0.687| 0.464   | 0.208  | 0.525  | 0.787  | 0.933   |
| Has video-player |       | 0.166| 0.091| 0.288   | 0.002  | 0.014  | 0.050  | 0.086   |
| Has phone |       | 0.197| 0.124| 0.330   | 0.004  | 0.023  | 0.050  | 0.110   |
| Has pc |       | 0.073| 0.009| 0.094   | 0.000  | 0.000  | 0.002  | 0.008   |
| Has fridge |       | 0.304| 0.462| 0.499   | 0.018  | 0.166  | 0.403  | 0.760   |
| Has washing machine |       | 0.238| 0.216| 0.411   | 0.005  | 0.036  | 0.102  | 0.287   |
| Has stove |       | 0.295| 0.581| 0.493   | 0.088  | 0.302  | 0.652  | 0.892   |
| Has water heater |       | 0.120| 0.025| 0.157   | 0.001  | 0.001  | 0.004  | 0.009   |
| Has motorbike |       | 0.061| 0.008| 0.087   | 0.000  | 0.001  | 0.002  | 0.004   |
| Has car |       | 0.162| 0.063| 0.243   | 0.004  | 0.006  | 0.016  | 0.034   |

| SES index | Score | Mean | SD  | Poorest | Second | Middle | Fourth | Richest |
|-----------|-------|------|-----|---------|--------|--------|--------|---------|
| Per capita food expenditure |       | 236.87| 175.98| 155.82  | 203.60 | 238.56 | 263.70 | 322.90  |
| Per capita total expenditure |       | 428.76| 363.18| 261.91  | 345.96 | 431.31 | 487.23 | 617.91  |
| Head’s education (Years) |       | 4.16 | 3.64 | 2.75   | 3.62  | 4.42  | 4.64  | 5.36    |
Appendix C: Additional Results

Appendix C1: Additional summary statistics

In this section of the appendix I report: the average baseline budget share for each commodity used in the analysis (Table C1); the average baseline price of each commodity used in the analysis, constructed as the median unit value in the village (Table C2); the budget shares of nonfood commodities, computed as the ratio between the expenditure for a given nonfood commodity and total nonfood expenditure (Table C3). Data for nonfood expenditure are elicited through household recalls with different periodicities (past week, past month, past six months). I have converted expenditures in the past week and in the past six months into monthly expenditure. I have excluded from the computation of total nonfood expenditure costs for ceremonies and hospitalization as these are not representative of standard consumption.

Table C1: Mean and standard deviation of baseline budget shares

| Good         | Mean | SD  | Good        | Mean  | SD  |
|--------------|------|-----|-------------|-------|-----|
| 1 Tomatoes   | 0.039| 0.034| 29 Beans    | PAL 0.064| 0.064|
| 2 Onions     | 0.021| 0.021| 30 Lentils  | PAL 0.003| 0.010|
| 3 Potatoes   | 0.012| 0.020| 31 Oats     | 0.004| 0.012|
| 4 Carrots    | 0.003| 0.010| 32 Chicken  | 0.077| 0.078|
| 5 Lettuce and greens | 0.005| 0.017| 33 Pork/beef meat | 0.039| 0.066|
| 6 Pumpkin    | 0.008| 0.023| 34 Fish     | 0.027| 0.065|
| 7 Chayote    | 0.010| 0.022| 35 Canned fish | PAL 0.009| 0.021|
| 8 Nopales    | 0.003| 0.014| 36 Eggs     | 0.036| 0.040|
| 9 Chili peppers | 0.014| 0.024| 37 Milk     | 0.042| 0.073|
| 10 Guayaba   | 0.004| 0.015| 38 Yogurt   | 0.006| 0.023|
| 11 Mandarin  | 0.010| 0.031| 39 Cheese   | 0.018| 0.033|
| 12 Papaya    | 0.004| 0.019| 40 Lard     | 0.005| 0.019|
| 13 Oranges   | 0.023| 0.047| 41 Processed meats | 0.005| 0.018|
| 14 Banana    | 0.016| 0.033| 42 Powdered milk | PAL 0.021| 0.060|
| 15 Apples    | 0.008| 0.021| 43 Snacks   | 0.001| 0.008|
| 16 Lemons    | 0.012| 0.025| 44 Soft drink | 0.029| 0.049|
| 17 Watermelon| 0.001| 0.011| 45 coffee   | 0.040| 0.052|
| 18 Corn tortilla | 0.067| 0.101| 46 Sugar    | 0.052| 0.041|
| 19 Corn grain | 0.084| 0.121| 47 Vegetable oil | PAL 0.043| 0.034|
| 20 Corn flour | PAL 0.012| 0.036| 48 Fries    | 0.003| 0.012|
| 21 White bread | 0.008| 0.021| 49 Chocolate | 0.004| 0.018|
| 22 Sweet bread | 0.019| 0.035| 50 Sweets   | 0.004| 0.017|
| 23 Loaf of bread | 0.003| 0.013| 51 Mayonnaise | 0.004| 0.014|
| 24 Wheat flour | 0.002| 0.010| 52 Fruit juice | 0.002| 0.011|
| 25 Pasta soup | PAL 0.016| 0.018| 53 Consome  | 0.003| 0.010|
| 26 Rice      | PAL 0.020| 0.022| 54 Soft drink powder | 0.005| 0.014|
| 27 Cookies   | PAL 0.017| 0.030| 55 Atole    | 0.001| 0.009|
| 28 Cereals box | PAL 0.005| 0.019| 56 Canned chili | 0.003| 0.008|

Notes: The table shows, for each commodity included in the analysis, the average baseline budget share and its standard deviation. The budget share is obtained as the ratio between the expenditure for the commodity and the total expenditure in food.
Table C2: Mean and standard deviation of baseline prices

| Good               | Mean  | SD   | Good              | Mean  | SD   |
|--------------------|-------|------|-------------------|-------|------|
| Tomatos            | 9.29  | 2.23 | Beans PAL         | 10.35 | 1.97 |
| Onions             | 9.09  | 1.41 | Lentils PAL       | 10.68 | 4.95 |
| Potatoes           | 9.78  | 2.12 | Oats              | 13.83 | 7.09 |
| Carrots            | 9.12  | 4.60 | Chicken           | 29.92 | 33.47|
| Lettuce and greens | 13.21 | 6.93 | Pork/beef meat PAL| 39.46 | 11.08|
| Pumpkin            | 9.06  | 3.92 | Fish              | 32.02 | 14.36|
| Chayote            | 8.49  | 3.47 | Canned fish PAL   | 30.35 | 17.78|
| Nopales            | 9.90  | 3.58 | Eggs              | 13.85 | 2.36 |
| Chili peppers      | 20.21 | 59.94| Milk              | 55.51 | 28.06|
| Guayaba            | 10.41 | 4.58 | Yogurt            | 27.18 | 12.36|
| Mandarin           | 6.34  | 2.34 | Cheese            | 41.22 | 13.52|
| Papaya             | 12.69 | 14.97| Lard              | 15.21 | 13.97|
| Oranges            | 4.01  | 2.74 | Processed meats   | 38.88 | 12.60|
| Banana             | 5.60  | 2.41 | Powdered milk PAL | 39.67 | 23.66|
| Apples             | 13.37 | 3.73 | Snacks            | 53.12 | 37.25|
| Lemons             | 7.40  | 4.10 | Soft drink        | 7.08  | 1.44 |
| Watermelon         | 9.91  | 14.25| coffee            | 103.07| 77.31|
| Corn tortilla      | 6.49  | 1.33 | Sugar             | 7.26  | 0.52 |
| Corn grain         | 3.25  | 5.41 | Vegetable oil PAL | 11.27 | 1.30 |
| Corn flour PAL     | 5.67  | 4.06 | Fries             | 100.65| 96.16|
| White bread        | 14.36 | 4.88 | Chocolate         | 51.55 | 39.26|
| Sweet bread        | 17.36 | 7.70 | Sweets            | 33.02 | 70.78|
| Loaf of bread      | 22.55 | 13.60| Mayonnaise        | 57.79 | 28.92|
| Wheat flour        | 6.24  | 3.74 | Fruit juice       | 15.83 | 21.39|
| Pasta soup PAL     | 14.26 | 2.07 | Consome           | 131.02| 101.70|
| Rice               | 6.87  | 1.85 | Soft drink powder | 133.86| 99.14 |
| Cookies PAL        | 19.32 | 5.73 | Atole             | 49.83 | 41.25|
| Cereals box PAL    | 41.02 | 15.82| Canned chili      | 28.01 | 15.00|

Notes: The table shows, for each commodity included in the analysis, the average baseline price and its standard deviation. The baseline price is obtained taking the median unit value in a village (or, if missing, the median unit value in the municipality or in the state). The unit value is constructed from self-reported household consumption data and is the ratio between the expenditure for a commodity and the quantity consumed.
Table C3: Mean and standard deviation of baseline budget shares of nonfood commodities

| Good                          | Mean   | SD    |
|-------------------------------|--------|-------|
| Hygiene/housekeeping products | 0.232  | 0.209 |
| Clothing                      | 0.097  | 0.135 |
| Fuel and electricity          | 0.206  | 0.211 |
| Medicines and medical visits  | 0.141  | 0.220 |
| House-ware (utensils, bad sheets, etc.) | 0.020 | 0.054 |
| Rent                          | 0.004  | 0.040 |
| Schooling (fees, uniforms, material, etc.) | 0.118 | 0.157 |
| Tobacco                       | 0.010  | 0.054 |
| Toys                          | 0.004  | 0.021 |
| Transport                     | 0.167  | 0.229 |

The table shows the mean baseline budget share of nonfood commodities and its standard deviation. Expenditures are from household self-recalls for different time periods (past week, past month, past six months). All expenditures are converted into monthly values.

Appendix C2: First stage regressions

This subsection shows the results of the first stage regressions for the logs of total food expenditure and its square. Estimation is performed by OLS and the results are reported in Table C4. The set of instruments includes: a socioeconomic status (SES) index computed applying principal component analysis (see Appendix B4 for details); the square of the SES index; interaction terms between the SES index and the natural logarithms of the prices of the food groups in the demand system. The regression also includes all the demographic characteristics of the household used to estimate the demand system and the logarithms of the prices of the food groups (estimated coefficients not shown). The bottom of the table shows the $F$ statistics from testing the joint significance of the set of instruments, separately for each equation, and the corresponding p-values.
### Table C4: First stage regression results

|                      | $\ln(x)$ | $[\ln(x)]^2$ |
|----------------------|----------|--------------|
| $SES$                | -0.030   | -0.689       |
|                      | (0.196)  | (2.673)      |
| $SES^2$              | 0.006**  | 0.089**      |
|                      | (0.002)  | (0.031)      |
| $\ln(p_{rp}) \ast SES$ | -0.045   | -0.617       |
|                      | (0.040)  | (0.534)      |
| $\ln(p_{ce}) \ast SES$ | 0.002    | 0.019        |
|                      | (0.021)  | (0.287)      |
| $\ln(p_{pp}) \ast SES$ | 0.013    | 0.208        |
|                      | (0.060)  | (0.831)      |
| $\ln(p_{fv}) \ast SES$ | -0.004   | -0.038       |
|                      | (0.034)  | (0.466)      |
| $\ln(p_{co}) \ast SES$ | -0.019   | -0.309       |
|                      | (0.018)  | (0.259)      |
| $\ln(p_{wh}) \ast SES$ | 0.063*** | 0.895***     |
|                      | (0.018)  | (0.247)      |
| $\ln(p_{ap}) \ast SES$ | -0.000   | 0.025        |
|                      | (0.048)  | (0.665)      |
| $\ln(p_{of}) \ast SES$ | 0.005    | 0.098        |
|                      | (0.016)  | (0.228)      |
| Number household members | 0.120*** | 1.664***     |
|                      | (0.008)  | (0.114)      |
| Number children 0-5 | -0.073*** | -1.011***    |
|                      | (0.013)  | (0.178)      |
| Number children 6-17 | -0.014   | -0.210       |
|                      | (0.010)  | (0.137)      |
| Age head             | -0.002**  | -0.021**     |
|                      | (0.001)  | (0.010)      |
| Education head       | 0.008**   | 0.111**      |
|                      | (0.003)  | (0.036)      |
| Indigenous household | -0.006   | -0.030       |
|                      | (0.049)  | (0.668)      |
| Female head          | -0.080*** | -1.012***    |
|                      | (0.023)  | (0.313)      |
| Distance urban center | 0.007**  | 0.097***     |
|                      | (0.002)  | (0.029)      |
| Village population   | -0.000**  | -0.001**     |
|                      | (0.000)  | (0.000)      |
| Constant             | 4.373***  | 12.086**     |
|                      | (0.435)  | (6.035)      |
| Logprices            | YES      | YES          |

$SES$ denotes an index of socioeconomic status computed with principal component analysis (see Appendix B4). $\ln(p_i)$ is the natural logarithm of the price of food group $i$; $rp$=rice and pulses, $ce$=PAL cereals, $pp$=processed PAL goods, $fv$=fruit and vegetables, $co$=corn cereals, $wh$=wheat cereals, $ap$=animal products, $of$=other foods. Prices of the food groups are geometric means of the commodities prices within the food group. Weights are given by the baseline expenditure share on the good in the municipality. "Indigenous household" is equal to one if at least one household member speaks an indigenous language, and zero otherwise. Standard errors are reported in parantheses and are clustered at the village level. *, **, *** denote significance at the 10, 5, 1 percent level, respectively.
Appendix C3: Parameter estimates and elasticities

Table C5 shows the estimated parameters of the QUAIDS model - see equations (5) in the paper. The demand system includes the following demographics characteristics of the household: the number of household members; the number of children 0-5 and 6-17 years old children; the age of the household head; the education of the household head (in years); an indicator for the household being indigenous (which is defined by the presence of at least one household member speaking an indigenous language); and an indicator for the head of the household being female; the distance of the village from the closest urban locality; the total population in the village. At the bottom of the table the terms $v_1$ and $v_2$ indicate the residuals from the first stage regression of, respectively, $\ln(x)$ and $[\ln(x)]^2$ on the set of instruments (see Appendix C3). Standard errors have been computed using a bootstrap estimator which accounts for the clustering of the errors at the village level.

Tables C6 and C7 reports the full set of estimated Marshallian and Hicksian price elasticities, respectively. Price elasticities have been computed using equations (10) and (12) from the paper. Given the estimated standard errors for the model parameters, which account for clustering at the village level, standard errors for the elasticities have been computed using the delta method.
Table C5: Estimated parameters of the QUAIDS

|                         | PAL rice and pulses | PAL cereals | PAL processed | Fruit and vegetables | Corn cereals | Wheat cereals | Animal products | Other foods |
|-------------------------|---------------------|-------------|---------------|----------------------|--------------|---------------|-----------------|------------|
| ln(p_{rp})              | -0.036* (0.022)     | 0.001       | 0.017*        | 0.040***             | -0.015*      | -0.003        | 0.019           | -0.022***   |
| ln(p_{ce})              | 0.001 (-0.008)      | -0.021***   | 0.007         | -0.002               | 0.002        | 0.003         | 0.006           | 0.004       |
| ln(p_{pp})              | 0.017* (0.008)      | -0.007      | -0.004        | -0.007               | -0.003       | 0.003         | 0.006           | 0.004       |
| ln(p_{fv})              | 0.040*** (0.014)    | -0.002      | -0.004        | 0.049***             | -0.011       | -0.012**      | -0.052**        | -0.008      |
| ln(p_{co})              | -0.015* (0.008)     | 0.002       | -0.007        | -0.111               | 0.069***     | -0.008*       | 0.022           | -0.051***    |
| ln(p_{wh})              | -0.003 (0.008)      | 0.003       | -0.003        | -0.012**             | -0.008*      | 0.001         | 0.030***        | -0.008**     |
| ln(p_{ap})              | 0.019 (0.011)       | 0.006       | -0.005        | -0.052**             | 0.022        | 0.030***      | -0.090**        | 0.070***     |
| ln(p_{of})              | -0.022*** (0.007)   | 0.004       | 0.003         | -0.008               | -0.051***    | -0.008**      | 0.070***        | 0.013       |
| ln(x)                   | -0.073*** (0.018)   | -0.025***   | -0.041***     | 0.038*               | -0.033       | 0.003         | 0.193***        | -0.063***    |
| [ln(x)]^2               | -0.008 (0.007)      | 0.005       | 0.005         | 0.028***             | -0.042**     | 0.004         | 0.002           | 0.006       |
| N. household members    | 0.019*** (0.005)    | 0.003*      | 0.006***      | -0.019***            | 0.025***     | -0.001        | -0.043***       | 0.011***     |
| N. children 0-5         | -0.007* (0.004)     | -0.000      | -0.002        | 0.004                | -0.014**     | 0.000         | 0.029***        | -0.010***    |
| N. children 6-17        | -0.001 (0.002)      | 0.000       | -0.002**      | 0.002                | 0.003        | -0.001        | 0.001           | -0.001      |
| Age head                | -0.000** (0.000)    | -0.000***   | -0.000**      | 0.000                | -0.000       | 0.000***      | -0.000**        | -0.000      |
| Education head          | -0.002*** (0.000)   | 0.000       | -0.000        | 0.001*               | -0.004***    | 0.001***      | 0.004***        | 0.000       |
| Indigenous household    | 0.018** (0.009)     | -0.010***   | -0.010***     | 0.011                | 0.068***     | -0.011***     | -0.057***       | -0.009      |
| Female head             | -0.011*** (0.004)   | 0.001       | 0.000         | 0.009*               | -0.018***    | 0.005**       | 0.023**         | -0.008**     |
| Distance urban center   | 0.001*** (0.000)    | 0.000**     | 0.000***      | -0.001*              | 0.000        | -0.000**      | -0.002***       | 0.001       |
| Village population      | 0.000              | 0.000       | 0.000         | 0.000**              | 0.000**      | 0.000**       | 0.000           | 0.000       |
| Constant                | 0.084*** (0.031)    | 0.049***    | 0.079***      | 0.269***             | 0.224***     | -0.015        | 0.270***        | 0.041**     |
| v1                      | -0.049 (0.088)      | 0.106**     | 0.034         | 0.327***             | -0.404**     | 0.019         | 0.070           | -0.102      |
| v2                      | 0.006 (0.000)       | -0.007**    | -0.002        | -0.028**             | 0.032**      | -0.001        | -0.012          | 0.011       |

Notes: Homogeneity and symmetry have been imposed throughout. ln(p_{ri}) is the natural logarithm of the price of food group i; rf=rice and pulses, ce=PAL cereals, pp=processed PAL goods, fv=fruit and vegetables, co=corn cereals, wh=wheat cereals, ap=animal products, of=other foods. Prices of the food groups are geometric means of the commodities prices within the food group. Weights are given by the baseline expenditure share on the good in the municipality. “Indigenous household” is equal to one if at least one household member speaks an indigenous language, and zero otherwise. Standard errors are reported in parantheses and are computed using a bootstrap estimator accounting for clustering at the village level. 500 replications of the bootstrap have been used. *, **, *** denote significance at the 10, 5, 1 percent level, respectively. The sample includes 5224 baseline households.
Table C6: Uncompensated price elasticities

|       | RP     | CE     | PP     | FV     | CO     | WH     | AP     | OG     |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|
| RP    | -1.201***| 0.054  | 0.232**| 0.477***| 0.046  | -0.007 | 0.242  | -0.049 |
|       | (0.189) | (0.075) | (0.094) | (0.127) | (0.085) | (0.072) | (0.196) | (0.054) |
| CE    | 0.102  | -1.481***| 0.204* | 0.011  | 0.156  | 0.077  | 0.174  | 0.184**|
|       | (0.191) | (0.137) | (0.108) | (0.141) | (0.173) | (0.089) | (0.280) | (0.087) |
| PP    | 0.381**| 0.143* | -1.066***| 0.007  | 0.013  | -0.032 | -0.062 | 0.163**|
|       | (0.159) | (0.074) | (0.140) | (0.113) | (0.102) | (0.063) | (0.171) | (0.058) |
| FV    | 0.150* | -0.033 | -0.058 | -0.786***| -0.167**| -0.081**| -0.342**| -0.128**|
|       | (0.078) | (0.032) | (0.038) | (0.099) | (0.064) | (0.034) | (0.127) | (0.043) |
| CO    | -0.004 | 0.038  | 0.002  | 0.010  | -0.509***| -0.028 | 0.183**| -0.180***|
|       | (0.052) | (0.038) | (0.033) | (0.060) | (0.132) | (0.023) | (0.082) | (0.051) |
| WH    | -0.136 | 0.070  | -0.111 | -0.432**| -0.311**| -0.972***| 0.926**| -0.314***|
|       | (0.233) | (0.119) | (0.126) | (0.170) | (0.146) | (0.135) | (0.293) | (0.102) |
| AP    | -0.064 | -0.021 | -0.098**| -0.320***| -0.105* | 0.105**| -1.430***| 0.123**|
|       | (0.080) | (0.046) | (0.040) | (0.086) | (0.063) | (0.035) | (0.153) | (0.047) |
| OG    | -0.081*| 0.046* | 0.052**| -0.005 | -0.247***| -0.044 | 0.472**| -0.841***|
|       | (0.043) | (0.024) | (0.023) | (0.056) | (0.058) | (0.022) | (0.082) | (0.050) |

Notes: The table shows uncompensated price elasticities at the midpoint of the sample. Elasticities are computed from the estimated parameters of a QUAIDS, imposing symmetry and homogeneity restrictions. Standard errors are computed using the delta method. *, **, *** denote significance at the 10, 5, 1 percent level, respectively. RP=PAL rice and pulses; CE=PAL cereals; PP=processed PAL goods; FV=fruit and vegetables; CO=corn cereals; WH=wheat cereals; AP=animal products; OG=other goods.
Table C7: Compensated price elasticities

|     | RP    | CE    | PP    | FV    | CO    | WH    | AP    | OG    |
|-----|-------|-------|-------|-------|-------|-------|-------|-------|
| RP  | -1.179*** | 0.063 | 0.245** | 0.514*** | 0.084 | -0.000 | 0.291 | -0.017 |
|     | (0.195) | (0.074) | (0.092) | (0.078) | (0.070) | (0.181) | (0.059) |
| CE  | 0.163 | -1.458*** | 0.238** | 0.114 | 0.263 | 0.095 | 0.312 | 0.272** |
|     | (0.194) | (0.135) | (0.109) | (0.137) | (0.167) | (0.090) | (0.268) | (0.090) |
| PP  | 0.429** | 0.161** | -1.039*** | 0.089 | 0.097 | -0.018 | 0.048 | 0.233*** |
|     | (0.160) | (0.073) | (0.141) | (0.112) | (0.095) | (0.064) | (0.160) | (0.058) |
| FV  | 0.303*** | 0.026 | 0.030 | -0.526*** | 0.101* | -0.036 | 0.006 | 0.096* |
|     | (0.078) | (0.032) | (0.038) | (0.103) | (0.060) | (0.032) | (0.120) | (0.049) |
| CO  | 0.048 | 0.058 | 0.032 | 0.098* | -0.418*** | -0.013 | 0.301*** | -0.105** |
|     | (0.045) | (0.037) | (0.031) | (0.058) | (0.127) | (0.023) | (0.081) | (0.045) |
| WH  | -0.000 | 0.123 | -0.034 | -0.202 | -0.074 | -0.931*** | 1.235*** | -0.117 |
|     | (0.234) | (0.116) | (0.122) | (0.184) | (0.133) | (0.137) | (0.270) | (0.106) |
| AP  | 0.128 | 0.053 | 0.012 | 0.005 | 0.232*** | 0.162*** | -0.994*** | 0.402*** |
|     | (0.081) | (0.045) | (0.040) | (0.090) | (0.060) | (0.035) | (0.147) | (0.048) |
| OG  | -0.012 | 0.072*** | 0.091*** | 0.111** | -0.126** | -0.024 | 0.628*** | -0.741*** |
|     | (0.041) | (0.023) | (0.022) | (0.056) | (0.056) | (0.022) | (0.071) | (0.051) |

Notes: The table shows compensated price elasticities at the midpoint of the sample. Elasticities are computed from the estimated parameters of a QUAIDS, imposing symmetry and homogeneity restrictions. Standard errors are computed using the delta method. *, **, *** denote significance at the 10, 5, 1 percent level, respectively. RP=PAL rice and pulses; CE=PAL cereals; PP=processed PAL goods; FV=fruit and vegetables; CO=corn cereals; WH=wheat cereals; AP=animal products; OG=other goods.
Appendix D: Robustness checks

This appendix reports additional results for the robustness checks presented in Section 6.3. Appendix D1 shows the results when the demand system is estimated using an alternative measure of baseline prices, combining both store prices data and unit values. Appendix D2 discusses and reports the results for an alternative specification of the demand system.

Appendix D1: Store price data

For this robustness check, I estimate the demand system using, as an alternative measure for the baseline commodity prices, the median store prices in a village, collected from surveys of local stores. However, there are considerable missing values in the baseline survey (see Appendix B2). For the 32 out of 56 commodities for which prices were collected in local stores, I take the median price within the village. If no store was surveyed in the village, I take the municipality or state median store price. For the remaining 24 commodities, I have imputed prices using the median unit values (constructed as in the main specification). In addition, for the 25 baselines villages in which store prices were not collected, I have imputed prices using the median unit values.

The income and own price elasticities are reported in Table D1. As one can see, there is no change in the qualitative results, and estimates do not vary much quantitatively. The fit of the model, as represented by the CDFs plotted in the Figure D1, is worse than when unit values are used to estimate the demand system. This might reflect the poor quality of the baseline store data or to the measurement error due to fact that different sources have been combined to construct the prices. This is particularly true for rice and pulses, for which the model seems to overestimate the demand. The results of the welfare analysis are reported and discussed in Section 6.3.
Figure D1: Actual and estimated CDFs of PAL food groups
Quantities are expressed in kilos per month. The green lines are the CDFs of the quantities consumed of a food group in the data. The red lines are CDFs of the quantities consumed predicted by the QUAIDS model. The shaded area is a 95% confidence band constructed using Dvoretzky-Kiefer-Wolfowith inequality. The vertical lines represent the quantity of the food good subsidized in-kind. The empirical CDFs are drawn after trimming the top 1% observations. The sample includes follow-up households in the cash treatment group ($N = 1449$).
|                          | Income elasticities | Uncompensated Own-price Elasticities | Compensated Own-price Elasticities |
|--------------------------|---------------------|-------------------------------------|-----------------------------------|
| PAL rice and pulses      | 0.308***            | -1.058***                           | -1.025***                         |
|                         | (0.145)             | (0.104)                             | (0.101)                           |
| PAL cereals              | 0.683***            | -1.591***                           | -1.562***                         |
|                         | (0.177)             | (0.109)                             | (0.106)                           |
| PAL processed            | 0.437***            | -0.831***                           | -0.804***                         |
|                         | (0.097)             | (0.154)                             | (0.156)                           |
| Fruit and vegetables     | 1.493***            | -0.847***                           | -0.594***                         |
|                         | (0.116)             | (0.114)                             | (0.114)                           |
| Corn cereals             | 0.468***            | -0.678***                           | -0.593***                         |
|                         | (0.122)             | (0.122)                             | (0.113)                           |
| Wheat cereals            | 1.435***            | -0.846***                           | -0.804***                         |
|                         | (0.213)             | (0.158)                             | (0.158)                           |
| Animal products          | 1.624***            | -1.351***                           | -0.969***                         |
|                         | (0.113)             | (0.094)                             | (0.092)                           |
| Other foods              | 0.865***            | -0.638***                           | -0.490***                         |
|                         | (0.092)             | (0.069)                             | (0.070)                           |

Notes: The table shows income elasticities (column 1), uncompensated and compensated own-price elasticities (columns 2 and 3) at the mean of the sample. Elasticities are computed from the estimated parameters of a QUAIDS, imposing symmetry and homogeneity restrictions. Standard errors are computed using the delta method. *, **, *** denote significance at the 10, 5, 1 percent level, respectively.

**Appendix D2: Alternative model of demand**

In this robustness check, I estimate the demand system using an alternative model of demand in which PAL goods have been aggregated into more detailed groups. The full list of both PAL and non PAL food groups is reported in Table D2. With respect to the main specification, vegetable oil has been disaggregated from canned fish and powdered milk.
### Table D2: Food groups

| Group | Group name             | Food commodities                                                                 | Number of goods |
|-------|------------------------|-----------------------------------------------------------------------------------|-----------------|
| 1     | PAL rice and pulses    | rice, beans, lentils                                                               | 3               |
| 2     | PAL vegetable oil      | vegetable oil                                                                     | 1               |
| 3     | PAL cereals            | corn flour, pasta soup, cookies, cereals box                                      | 4               |
| 4     | PAL protein            | canned fish, powdered milk                                                        | 3               |
| 5     | Fruit and vegetables   | tomato, onion, potato, carrot, greens, pumpkin, chayote, nopales, chile, guayaba, mandarin, papaya, orange, banana, apple, lemon, watermelon | 17              |
| 6     | Corn cereals           | corn tortilla, corn grain                                                         | 2               |
| 7     | Wheat cereals          | white bread, sweet bread, loaf of bread, wheat flour, oats                         | 5               |
| 8     | Animal products        | chicken, beef/pork, fish, eggs, milk, yogurt, cheese, lard, cold cuts             | 9               |
| 9     | Other foods            | snacks, soft drink, coffee, sugar, mixed fry, chocolate, sweets, mayonnaise, fruit juice, consome, powdered soft drink, atole, canned chile | 13              |

The income and own price elasticities of the new model are reported in Table D3. Qualitatively, the results are in line with those in the main specification. Rice and pulses are necessities, as it is vegetable oil. The income elasticity for PAL protein subsidy is low but imprecisely estimated. This is due to the fact that there is a large number of zeros in the consumption data for this group, which can cause the estimated parameters and elasticities to be biased. As for non PAL foods, the estimates confirm that corn cereals and other foods are necessities while fruit and vegetables, wheat, animal products are luxuries. All PAL goods are relatively price elastic, with PAL goods and animal products showing the highest values for the own price elasticities.

Figure D2 shows the fit of the model plotting the CDFs of the actual quantities consumed of each food group against the quantities predicted by the demand system. As always, this is done for the sample of follow-up households receiving the cash transfer. The vertical line in each plot shows the subsidized quantity of the corresponding food group. In terms of model fit, the predicted CDFs of rice and pulses, and PAL cereals is quite close to the ones from the data, while it seems that the demand system generally over-predicts the demand of vegetable oil. As for “PAL protein”, the large number of zeros is apparent from Figure D2. Despite the CDF from the model can not capture this feature of the data, it correctly predicts that this food group is extra-marginal for the majority of the households. Looking at the extra-marginality of other food groups, rice and pulses are extra-marginal for 10 percent of the households in the model, and for 17 percent of the households from the data; vegetable oil is extra-marginal for less than 10 percent of the households, while approximately 70 percent of the households would consume less than 5.4 kilos of PAL cereals.
|                                | Income elasticities | Uncompensated Own-price Elasticities | Compensated Own-price Elasticities |
|--------------------------------|---------------------|-------------------------------------|------------------------------------|
| PAL rice and pulses           | 0.312*              | -1.158***                           | -1.123***                          |
|                               | (0.162)             | (0.180)                             | (0.184)                            |
| PAL vegetable oil             | 0.525***            | -1.095***                           | -1.068***                          |
|                               | (0.126)             | (0.151)                             | (0.152)                            |
| PAL cereals                   | 0.542**             | -1.467***                           | -1.444***                          |
|                               | (0.174)             | (0.130)                             | (0.128)                            |
| PAL protein                   | 0.322               | -1.075***                           | -1.071***                          |
|                               | (0.362)             | (0.157)                             | (0.157)                            |
| Fruit and vegetables          | 1.477***            | -0.779***                           | -0.523***                          |
|                               | (0.128)             | (0.101)                             | (0.105)                            |
| Corn cereals                  | 0.590***            | -0.559***                           | -0.447***                          |
|                               | (0.159)             | (0.127)                             | (0.123)                            |
| Wheat cereals                 | 1.085***            | -0.997***                           | -0.962***                          |
|                               | (0.242)             | (0.134)                             | (0.135)                            |
| Animal products               | 1.799***            | -1.422***                           | -1.010***                          |
|                               | (0.128)             | (0.168)                             | (0.158)                            |
| Other foods                   | 0.607***            | -0.843***                           | -0.746***                          |
|                               | (0.089)             | (0.049)                             | (0.050)                            |

Notes: The table shows income elasticities (column 1), uncompensated and compensated own-price elasticities (columns 2 and 3) at the mean of the sample. Elasticities are computed from the estimated parameters of a QUAIDS, imposing symmetry and homogeneity restrictions. Standard errors are computed using the delta method. *, **, *** denote significance at the 10, 5, 1 percent level, respectively.
Figure D2: Actual and estimated CDfs of PAL food groups
Quantities are expressed in kilos per month. The green lines are the CDFs of the quantities consumed of a food group in the data. The red lines are CDFs of the quantities consumed predicted by the QUAIDS model. The shaded area is a 95% confidence band constructed using Dvoretzky-Kiefer-Wolfowith inequality. The vertical lines represent the quantity of the food good subsidized in-kind. The empirical CDFs are drawn after trimming the top 1% observations. The sample includes follow-up households in the cash treatment group (N = 1449).