Resolving the Puzzle of the Conditional Superiority of In-kind versus Cash Food Assistance: Evidence from Niger

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Abstract

Food assistance in the form of cash has increased in recent years, in part due to proven cost and timeliness advantages relative to food transfers. Moreover, economic theory generally predicts that providing greater choice should be a welfare improvement, which is taken to mean that food consumption and dietary diversity outcomes should be the same or better with cash than with food transfers. Empirical investigations have shown, however, that people sometimes prefer to receive food, and that the marginal propensity to consume food is often greater from food than from cash transfers. The mechanisms and rationale behind the conditional superiority of food transfers is not fully understood. This paper presents a model of household decision-making that integrates frictions (transaction costs) and dynamics (consumption smoothing over time through savings and credit) to generate predictions about the use of cash versus food transfers, in light of the infra- or extra- marginality of different components of the food basket. The model predicts that when food is extra-marginal a food transfer can have negative impacts on dietary diversity, relative to a cash transfer, if the extra-marginal food is an inexpensive staple grain, but positive impacts for higher quality goods. These differences are primarily due to the transaction costs involved in selling food that lower the shadow prices of extra-marginal transferred foods. I find support for this model using data from a randomized cash-food pilot project in Eastern Niger.

Keywords: cash transfers; food assistance; development economics; household models; Niger

I. Introduction

Food assistance in the form of cash, rather than in kind, has increased rapidly over recent years. This trend is due largely to evidence that providing cash is more cost-effective than providing food, and can also be delivered more rapidly (Lentz et al. 2013). Simple economic theory, following Southworth (1945), also predicts equal or greater potential welfare gains to recipients from receiving cash as opposed to food transfers, assuming functional food markets and negligible price impacts of transfers. According to this longstanding logic, if a food transfer is extra-marginal, such that the food provided is more than the household would otherwise consume, households might be compelled to sell food. These transfers constrain the household's choices, and if resale is subject to transactions costs, then recipients would be made strictly better off if given a cash transfer. If transfers are infra-marginal, such that the food provided is less than households would otherwise consume, there should be no difference between the two transfer types as households are unconstrained by the food transfer and merely substitute in-kind for purchased food. In neither case should households prefer, or achieve better outcomes from, an in-kind transfer.

The puzzle, however, is that many households seem to prefer and fare better with in-kind transfers than with cash transfers. While there is some evidence that cash transfers lead to greater dietary diversity in some settings (Hidrobo et al. 2012, Aker et al. 2013, Schwab 2013), other studies find that in-kind transfers lead to greater dietary diversity and are preferred to cash transfers (Hoddinott et al. 2013). The reasons for such heterogeneity in preferences and outcomes are not well understood.

Further probing into microeconomic theory can help us identify several possible avenues that might explain the puzzle of the conditional superiority of in-kind food transfers. First, frictions that the original Southworth model does not capture, such as transaction costs in selling (and/or buying) food may cause in-kind transfers to be worth more to some households (de Janvry et al. 1991). Second, dynamic considerations, such as expectations over future conditions and the desire to smooth consumption over time, may lead a household to spend cash transfers on goods other than food in the interest of longer term welfare (Barrett 2002). Intra-household bargaining may also play a role if different forms of income are controlled by different household members, who have different preferences and propensities to spend on different goods (Haddad et al. 1997).

A randomized cash-food distribution program among rural households in eastern Niger demonstrates an economically intriguing set of outcomes and offers an excellent setting in which to explore these prospective explanations for this puzzle. While the food basket quantity was generally infra-marginal for recipients, the impacts of equivalently-valued cash and food transfers vary in significant ways. Recipients of food transfers consumed more diverse diets and were less likely to resort to food-related coping strategies, particularly in the lean season. Cash transfer recipients purchased more bulk grains, but also spent more on productive purposes (agricultural and livestock expenses) and health (Hoddinott et al. 2013). Respondents also expressed a strong preference for food transfers, with 61% of households expressing a preference to receive only food and only 10% expressing a preference to receive only cash.

Using the Southworth (1945) model as a starting point, I approach this puzzle by developing a model that integrates key frictions and dynamics in order to understand the mechanisms behind the conditional superiority of food over cash transfers among survey respondents in rural Niger. I explore in particular the question of infra- versus extra-marginality and its importance for preferences and outcomes. Past studies focus on the infra- or extra-marginality of a food basket as a whole. It is possible, however, that the infra- or extra-marginality of individual food items, not the overall food basket, most influence food consumption outcomes and determine the relative advantage of food over cash. Cunha (2014) recently examined a randomized food-cash transfer program in Mexico, involving ten different food commodities received, and found that the extra-marginality of individual components of the food basket leads to minor distortions, but recipients tended to substitute away from similar non-transferred items. I here take an approach that focuses explicitly on dietary diversity, and on the possible differential impacts on dietary diversity of providing inexpensive grains versus higher quality foods in light of the infra- or extra-marginality of each. Drawing on established literature, the model I develop integrates preferences over both staple grains and dietary diversity, a transactions cost for the sale of food, and an inter-temporal asset and borrowing constraint.

A few clear predictions emerge from this model. In keeping with Southworth, providing a transfer of either the basic staple or the high quality food should have the same effect on dietary diversity as providing cash if the transfers are infra-marginal. The extra-marginality of one or the other good, however, has different implications, since the transaction cost involved in selling unwanted food to meet other needs lowers its shadow price, leading households to substitute toward consumption of that commodity. While households may, as in the Mexico case (Cunha 2014), substitute away from non-transferred but similar commodities, this model predicts that the substitution between commodities based on their relative status could lead to differences in over-all dietary diversity outcomes. If the staple grain is extra-marginal, providing it will have a negative impact on dietary diversity relative to cash, whereas if the higher quality food is extra-marginal, providing it will have a positive impact on dietary diversity relative to cash. The model predicts additionally that cash recipients would be likely to purchase more non-food items than food recipients when the foods are extra-marginal. There are additional implications for other behaviors, primarily informal credit and gift exchange.[1]

I test these predictions using a rich data set of household surveys collected following a randomized cash/food intervention in Eastern Niger. This context presents an ideal opportunity

[1] The asset and borrowing constraint leads to several key predictions related to the use of cash versus food transfers. These are taken up and tested in a companion paper, Upton et al. 2014.

in a number of ways. First, the population is extremely poor and food insecure, and suffers high chronic rates of undernourishment and malnutrition. A largely politically driven transition to cash-based programming is also actively underway, to some degree globally but particularly in Niger. Given the superior performance of food to cash toward dietary diversity in this setting (Hoddinott et al. 2013), understanding what drives the impacts of these different transfer types on dietary diversity is of utmost importance.

The context and program design also offer a few unique opportunities for empirical investigation. The households surveyed are both agricultural and pastoral, providing an opportunity to understand food insecurity and household decision-making under different livelihood conditions. The surveys take place in turn in two rounds, one during the height of the lean season and the other at the beginning of the harvest, allowing me to examine the impacts of cash and food under different conditions of household production and relative scarcity of cash versus food. Finally, the choice of cash versus food transfers is randomized, enhancing the ability to test the model by identifying the relative impacts of these two transfer types.

On examination of the data, I find firstly some notable consumption patterns in the population at large, which indicate a high degree of extra-marginality less for food generally than for the specific commodities transferred. While the food transfer has a positive impact on dietary diversity overall, as the model predicts, when we divide the food transfer into values of its component parts we see that globally the grain commodity has a negative impact while the legume commodity has a positive impact relative to cash. Since the grain (legume) should have either a negative (positive) impact relative to cash or be the same, depending on whether it is extra-marginal or infra-marginal, these results reflect the extra-marginal nature of the transferred goods. I then develop methods for examining how the impacts differ based on the consumption status of each good, using first the status of each transferred good for food recipients and then a propensity score method for the propensity of each good to be extra-marginal among both cash and food recipients. I find further support for the model's predictions related to dietary diversity. I do not find support, however, for its predictions regarding changes in non-food expenditures.

These findings provide both theoretical and policy relevant contributions. I extend long-standing theory on food assistance impacts using the structure and components of well-established nonseparable dynamic household models to shed more theoretical light on empirical findings that reject the longstanding Southworth hypotheses. The results can in turn inform the design, and targeting, of food assistance programs, particularly to meet dietary diversity objectives. We learn that the commodity choice matters, and that providing extra-marginal staple grains can be less desirable than providing a higher quality food, or cash, if the primary objective is improvements in dietary diversity.

This paper proceeds as follows. The next section reviews the literature on food versus in-kind transfers and the use of nonseparable household models to examine household behavior and dynamic consumption decisions, and then provides some context for the empirical setting examined. Section III then presents the theoretical model and its predictions. Section IV describes the data, empirical strategy, and tests of hypotheses, and Section V the results in light of the model's predictions. Section VI concludes and draws out implications for policy and for future research.

II. Literature and Background

a. Food assistance and household models

The core theory behind the literature on cash versus in-kind transfers dates from Southworth (1945), who provided a simple framework for thinking about the relative impact of these transfers on the budget set and on household utility. If household utility is defined over food and all other goods, a food transfer effectively creates a kink in the household's budget constraint, as show in Figure 1, with the original budget set of the household given by line AB, the budget set after a cash transfer represented by line CD, and the budget set after a food transfer by piecewise linear frontier AFD. If the in-kind transfer can be re-sold, it will be subject to transaction costs, achieving a contracted possibilities set relative to a cash transfer, reflected in the piecewise linear frontier EFD in Figure 1. If a transfer is in the form of food and extra-marginal, providing more food than the household would otherwise prefer to consume, then the household consumes on the upper portion of line AB in Figure 1. In this case the household will consume at the kink in the budget set and/or be compelled to sell food to meet other needs and reach slightly higher utility. The food transfer constrains household choice; it would be made strictly better off by a cash transfer. If the transfer is infra-marginal, providing less food than the household would otherwise consume, then the household consumes on the lower portion of line AB. In this case, the household is unconstrained by the food transfer, and hence food or cash transfer should yield the same change in utility and the impacts should be the same. A testable prediction of the Southworth model is that households should in no case prefer a food transfer relative to a cash transfer of equivalent value. A second testable hypothesis is that the marginal propensity to consume (MPC) food is the same for cash and in-kind transfers for those for whom the food transfer was infra-marginal.

— Figure 1 —

Given that the most common goal of food assistance programming is to increase and/or improve food consumption, a key focus of the empirical literature on food assistance and other transfer programs has been to test these hypotheses by examining the additionality of different forms of transfer, or a household's marginal propensity to consume food (MPC) when given food in-kind versus food stamps, vouchers, or cash (Barrett 2002).

Many empirical investigations have rejected the core Southworth hypotheses, finding that there are differences in consumption from cash versus in-kind or voucher (including food stamp) income, even when in-kind transfers are infra-marginal. A review of 17 studies in the United

States found that the MPC for food out of food stamps was three to ten times larger than the MPC of cash income. While this could be consistent with the theory for households constrained by extra-marginal food transfers, it is inconsistent for unconstrained households (who spend both income and food stamps on food), and yet remains true even in for infra-marginal cases (Fraker 1990). This is the essence of what is called the "cash out" puzzle, or idea that substituting cash (or earned income) for food stamps appears to reduce food purchases even though the theory predicts it should not (Breunig and Dasgupta 2005, Shapiro 2005).

The empirical literature also finds that preferences for cash and/or food are not necessarily consistent with the core theory. Some studies have examined stated or revealed preferences over cash and food transfers directly and have found that, as theory would predict, recipients usually prefer greater flexibility in the use of transfers, frequently preferring cash (Michelson et al. 2012). However, this is by no means universally the case; recipients often express preferences for food, and these preferences can depend on several factors (Upton and Lentz 2011).

Several reasons have been posited for the rejection of the core Southworth hypotheses (Barrett 2002). The first is that the Southworth model ignores the possibility of frictions in the buying and selling of food that may affect the trade-offs households face in different ways. For example, the price for which a household can sell a food transfer once received is likely less than the price for which it can buy that food given the receipt of cash. This creates a 'price band', the size of which (and hence likelihood of selling food) can vary from household to household (de Janvry et al. 1991). This transaction cost may have fixed and/or variable components that can also vary between households. This could make the kink in the budget set even more pronounced and potentially create further behavioral distortions (Key et al. 2000). A combination of household-specific transaction costs and differential household-level valuation of food can make market participation more or less costly for certain households, leading to 'missing' markets for certain goods for certain households (de Janvry et al. 1991). Transactions costs can invalidate the assumed fungibility of food and/or change the costs entailed in receiving cash, somewhat altering the core predictions of the model.

A second key omission in the Southworth theory is that it is static, whereas the household food security problem is inherently dynamic. Inter-temporal relationships between behavior in the current period and food security outcomes in a later period could affect today's demand for food, leading to behaviors that may violate the static model. Preferences for food may for example be explained by expectations over prices. The burden of food price increases falls on recipients of cash transfers, leading some household to prefer food transfers in order to have more confidence over its real value over time (Devereux et al. 2005; Gilligan et al. 2008).

Another dynamic component is consumption smoothing over time, via savings, investment, formal or informal credit, and/or other social insurance mechanisms like reciprocal gift exchange. Households may choose to save money, pay debts, or give gifts in certain periods to increase their access to resources (including through borrowing money or receiving gifts) in other periods when resources may be more scarce. This dynamic has been integrated into a number of nonseparable household models (Deaton 1991; Besley 1995; Behrman et al.1997).

A third key area of analysis surrounds the role of intra-household bargaining. The presence of intra-household bargaining dynamics violates the assumptions of the unitary household model, meaning that different members have different preferences and/or resources between household members are not pooled. This can lead to different, and by definition less optimal, outcomes than would be predicted for a single decision-maker (Haddad et al. 1997; Udry 1996). There is some evidence that these factors play a role in food assistance outcomes. A transfer may be infra-marginal for the household as a unit but extra-marginal for certain household members, which in the presence of bargaining and differential resource control could lead to different impacts with different transfer types. Breunig and Dasgupta (2005) find that the discrepancy between the MPC of food stamps and cash income no longer exists when one examines only single-adult households, suggesting that intra-household bargaining plays a significant role in consumption choices. Villa et al. (2012) show that intra-household bargaining may play a role in, but does not fully explain, the differential impacts of income by source on household food diversity.

There is additional, although primarily anecdotal, evidence of intra-household bargaining dimensions to food assistance preferences in developing countries, often related only to expressed preference for the form of transfer as opposed to measured outcomes. Women are more likely to express preferences for food over cash than are men, and it has been postulated that this is primarily because women are often more responsible for care-giving and hence more likely to control the use of food than cash (Devereux et al. 2005; Adams and Winahu 2006; Khogali and Takhar 2001). In one case, women explicitly expressed a preference for cash if their husbands were away from the home, and for food otherwise (Walsh 1998).

Our understanding is incomplete regarding which of these explanations —frictions, dynamic effects, or intra-household bargaining—best accounts for widespread empirical findings on differential outcomes of food assistance depending on the form of transfer delivered (Barrett 2002). This is particularly true in the case of cash versus food transfers in poor, rural, developing country settings, where it is arguably also most important to understand what drives differential impacts in order to better design and target interventions.

b. Niger, and the intervention in Zinder

Several features of the focus region and intervention make it apt for this analysis. The Mirriah department of Zinder, Eastern Niger, is culturally dominated by the Hausa, an ethnic group that traditionally relies on crop agriculture for its livelihood.[2] While 64% of all villages in

[2] The administrative divisions of Niger are first regions (which include Zinder and 6 others), then departments (within Zinder, including Mirriah and 4 others), then *communes* and villages.

the sample are majority Hausa, the Hausa cohabitate this region with several smaller ethnic groups, including the agro-pastoral Kanuri and the pastoral Fulani, Touareg, and Toubou. The second largest group this region—although a 4% minority nationally—are the Kanuri; 22.5% of all sample villages are Kanuri majority. The remaining groups are the traditionally nomadic pastoralist Touareg (majority in 7.5% of villages), Peulh (majority in 6% of villages) and Toubou (majority in no villages). Villagers throughout the region are agro-pastoralists, mixing crop agriculture with the raising of livestock (primarily small ruminants, such as goats and sheep). Communes are broadly classified however as "agricultural" or "agro-pastoral"; those classified as "agro-pastoral" make up 42% of all villages in the evaluation. This cultural composition allows for analysis across livelihood types.

The region suffers from food insecurity along several of its dimensions. Zinder is well off in terms of food production relative to most of Niger, but all the same is characterized by challenging growing conditions. Most land in the sample villages is allocated to food crops (on average 60% to millet and 17% to sorghum), with the remainder to higher-value crops used primarily as cash crops that can also be consumed as necessary (14% cowpeas, and only 5% peanuts). Yields are typically very low, and highly variable from one year to the next; and climate change and desertification are predicted to pose further threats to yields in coming years (Ben Mohamed et al. 2002). Production capacity is further strained by negligible access to financing. Whether or not annual production suffices for home consumption needs, households commonly sell their grain immediately after the harvest when prices are lowest and subsequently buy grain later at higher prices to meet food needs (Arnould 1985; Miles 1994).[3] There is thus a strong seasonal dimension to households' food availability and access conditions, with food availability highest (and prices lowest) right after the harvest, which is typically in September-October, and then decreasing (and prices increasing) throughout the year. The peak of the lean season, when household stocks are diminished and prices highest, falls in the months prior to harvest, July-August (FEWS 2014).

Availability, however, is less of a problem than access, due primarily to extreme poverty. Zinder is a key commercial hub, in part due to its close proximity (and close cultural ties) to Nigeria, making food imports readily available when needed (Eilerts 2006). Yet the region has frequently been among the hardest hit by food crises, and chronically suffers some of the nation's (and world's) highest rates of malnutrition (Grobler-Tanner 2006). The 2005 emergency mortality rates were higher in Zinder than in any other region, and an estimated 65% of the population had to resort to 'irreversible' coping strategies such as selling large livestock or production tools (Reza et al. 2008). A 2010 survey found that the global acute malnutrition rate in Zinder was 18%; the emergency threshold is 15% and rates throughout most of the country did not reach that threshold (WFP 2011a).

[3] See Barrett (2007) and Stephens and Barrett (2010) for an investigation of this sell-low, buy-high phenomenon.

Niger has been a recipient of international assistance, typically in-kind food aid shipments, for decades (WFP 2011b). However, in part due to Government of Niger (GoN) strategy and in part due to other changing donor practices (Barrett et al. 2012), there is a current transition underway toward cash-based assistance (WFP 2010). Both the World Food Programme (WFP) and the World Bank (WB) are scaling up their use of cash programming. There are still, however, many questions to be addressed regarding the impacts of cash transfers in Niger, as well as which form of transfer is preferred by recipients and why. Households in the sample expressed overwhelming preferences for food versus cash transfers, with 73% (50%) of food (cash) recipients preferring to receive only food, 24% (34%) preferring a mix of food and cash, and only 3% (16%) preferring to receive only cash.

In addition, and potentially related to these preferences, food transfers had larger impacts on dietary diversity than cash transfers, by a difference of 10-12% (Hoddinott et al. 2013). Improving dietary diversity is often the primary goal of food assistance programs. Dietary diversity, measured by dietary diversity scores, has been found to be useful indicators of micronutrient intake in several African contexts, especially for children (Steyn et al. 2006; Moursi et al. 2008). Intake of micronutrients is of fundamental importance in turn for not only long-term health but physical and cognitive ability, and economic well-being more generally (Hetzel 1990; WHO 2009; Schofield 2014; Chen and Zhou 2007; Victoria et al. 2008). These linkages in fact make micronutrient deficiency a plausible driver of poverty and poverty traps (Barrett 2010; Barrett and Carter 2013). Given the extraordinary, and chronic, prevalence of malnutrition in Niger, improving dietary diversity in this context is of utmost importance.

III. Model and Predictions

a. The Model

As Barrett (2002) argues, a useful model of food insecurity must recognize key trade-offs between food and other essential needs, such as education, care-giving, and health. It must take into account the desire to meet both today's and tomorrow's needs, i.e., to smooth consumption over time, and in turn integrate an understanding of risk and uncertainty, in food production, prices, transfers, and effectively all 'inputs' into the household's food availability function. In this section, I develop a model of household-level utility and decision-making that integrates these key components. The model is based as well on several key assumptions that are pertinent for poor, rural households like those in Eastern Niger, order to focus on a few key components of a household's decision-making process around maximizing its food security.

I assume a unitary household model, which is to say that all decision-makers have the same preferences (over the consumption of food and other goods, as well as over debt repayment/initiation and asset investment), and that all resources are pooled.[4] The decision

[4] In the results (Section VI), I test the assumption of the unitary model by checking the results for only single-adult households, following Breunig and Dasgupta (2005).

process is dynamic, such that today's choices are affected by expectations over future income (and hence future prices).

We have hence:

$$\max_{c_{1t},c_{2t},x_t,l_l,l_q,b_t,h_t a_t} E \sum_{t=0}^{\infty} \beta^t u(c_{1t}, c_{2t}, x_t, l_{lt}|Z_t) \tag{1}$$

Where the household derives utility over two food goods – c_{1t}, a low-nutrient staple grain (e.g., millet), which is also the least expensive food available in the market, and c_{2t}, a composite of other foods, which we can think of as representing dietary diversity – as well as other market goods, x, and leisure, l_l. Z_t is a vector of household (and/or community)-specific characteristics, and $1 \geq \beta > 0$ is a time discount preference parameter. The utility function satisfies the usual concavity, Inada and local non-satiation assumptions.

Each household produces just one of these consumption goods, c_{1t}. We assume also, in keeping with what is largely the case in Eastern Niger, that wage labor and other agricultural inputs are not available, so households use only home-labor (l_{qt}) for production, along with a fixed initial amount of land and productive capital, K. The production technology is hence:

$$q_{1t} = g(l_{qt}; K) \tag{2}$$

Income for purchases comes from sales of the produced good (q_{1t}), transfers in the form of c_{1t} (T_{1t}), c_{2t} (T_{2t}), or cash (T_{ct}), and current asset stock (A_t) less each period's net savings or asset investment (s_t). While food transfers are denoted separately for c_{1t} and c_{2t}, the transfers are always received together, as an alternative to a cash transfer. Hence, either $T_{1t}, T_{2t} > 0$ and $T_{ct} = 0$ or $T_{1t}, T_{2t} = 0$ and $T_{ct} > 0$. This gives us the budget constraint:

$$p_{1t}^* c_{1t} + p_{2t}^* c_{2t} + p_{xt} x_t + s_t \leq p_{1t}^*(q_{1t} + T_{1t}) + p_{2t}^* T_{2t} + T_{ct} + A_t \tag{3}$$

However, 'net savings' in this case takes into account other consumption smoothing behavior, including loans and inter-household transfers. Following Behrman et al. (1997), we assume these different forms of consumption smoothing behavior are substitutes. Net savings is hence composed as follows:

$$s_t = h_t - b_t + a_t \tag{4}$$

where h_t is debt repayment and/or gifts given to other households, b_t is debts taken out and/or gifts received from other households, and a_t is other forms of formal and informal savings including investment in livestock and other assets.

Integrating this into (3) yields:

$$p_{1t}^{*}c_{1t} + p_{2t}^{*}c_{2t} + p_{xt}x_t + a_t \leq p_{1t}^{*}(q_{1t} + T_{1t}) + p_{2t}^{*}T_{2t} + T_{ct} + b_t - h_t + A_t \tag{5}$$

The price (per calorie or kilogram) of the high quality food, c_{2t}, is always greater than the price of the cheap grain, c_{1t}, i.e., $p_{1t} < p_{2t}$.[5] These prices are denoted in the budget constraint as $p_{1t}*$ and $p_{2t}*$, which are price functions that reflect a price band due to transaction costs (as per de Janvry et al. 1991).[6] Households can purchase goods at the market price, but are subject to (household-specific, variable) transaction costs when they sell foods. These prices are hence defined by the function:

$$\begin{aligned} p_{jt}^{*} &= p_{jt} \text{ } if \text{ } c_{jt} \geq q_{jt} + T_{jt} \\ &\quad p_{jt} - \theta_t \text{ } if \text{ } c_{jt} < q_{jt} + T_{jt} \text{ } for \text{ } j = 1,2 \end{aligned} \tag{6}$$

This one-sided transaction cost reflects a number of realistic conditions faced by the survey households. First, markets are generally in close proximity, and are culturally-embedded events in which households have numerous reasons to participate, thus the marginal cost of travel to market associated with any given purchase of food is negligible. Second, merchants present at markets will sell goods in all periods, but only purchase goods in certain periods, and/or pay a lower price to purchase goods than the retail price of selling them, hence θ_t represents the margin by which the selling price for households is lower than their buying price. Finally, in areas where markets are further and/or not regularly frequented by households, itinerant merchants travel from village to village (and even household to household) to sell –but not to purchase – key staples, in which case θ_t for such households would be even larger.

The state variable, asset stock (A_t), evolves according to:

$$A_{t+1} = (1 + r_t)(\delta A_t + s_t) \tag{7}$$

[5] Note that, according to nutritiondata.self.com, a kilogram of dry millet has 3,780 kcals, versus dry cowpeas at 3.430 kcals (mature seeds, raw). Given the price ratios, using price per kilogram roughly translates to the relative ratios of price per calorie.

[6] Key, Sadoulet, and de Janvry (2000) use a transaction cost with both a fixed and a variable component. Adding a fixed cost to our model would mean subtracting a constant term from the right hand side of (6) which would be multiplied by one if the household sells, zero otherwise. This has no meaningful impact on our core results so we assume only fixed costs, in the interest of clarity and parsimony.

where r_t is the interest rate, δ is a depreciation rate, s_t is savings, and b_t and h_t are borrowing and repayment, respectively, in time t. The amount that an individual can borrow in any given period is bounded above by:

$$b_t \leq B^{max}(A_t, H(h_t)) \tag{8}$$

where $H(h_t)$ is a prior debt repayment history function. The household can borrow more in each period the greater the value of either A_t, reflecting stock of collateral, or of $H_t(h)$, its past repayments, which is strictly increasing in each period's repayments:

$$\frac{\partial B^{max}}{\partial A_t}, \frac{\partial B^{max}}{\partial H(h_t)}, \frac{\partial H(h_t)}{\partial h_t} > 0 \;\forall\; t \tag{9}$$

This reflects that much credit is informal, hence borrowing limits are related to creditors' willingness to lend, as a function of a prospective borrower's current collateral and its repayment reliability, regardless of the household's overall debt stock, which in most cases is not knowable to the creditor. Similarly, one's likelihood of receiving gifts increases as a function of prior generosity. The implications of the borrowing constraint for the use of cash versus food transfers are taken up in more detail in a companion paper (Upton et al. 2014).

Finally, the household faces a time constraint:

$$l_{lt} + l_{qt} = L_t \tag{10}$$

I solve the household's constrained maximization problem by recovering the first order necessary conditions (FONCs) from the discrete-time present value Hamiltonian. Assuming that the utility function has the necessary properties of concavity and local non-satiation, all constraints bind with equality. With some straightforward substitution and simplification, the Langrangian becomes:

$$\begin{aligned} L = E\sum_{t=0}^{\infty} \beta^t [u(c_{1t}, c_{2t}, x_t, l_l | Z_t) + \beta\lambda_{t+1}[p_{1t}^*(g(L_t - l_{lt}) + T_{1t} - c_{1t}) + p_{2t}^*(T_{2t} - c_{2t}) - p_{xt} \\ + T_{ct} + b_t \; - h_t + A_t - s_t] \\ - \beta\mu_{t+1}[(1 + r_t)(\delta A_t + h_t - b_t + a_t) - A_{t+1}] \end{aligned} \tag{11}$$

Denoting the partial derivative of a function "f" with respect to variable "y" as $f_y(\bullet)$, the FONCs over consumption goods imply:

$$\frac{\partial L}{\partial c_{1t}} = E[\partial u_{c1t}(\bullet)] - \beta\lambda_{t+1}E[p_{1t}^*] = 0 \tag{12}$$

$$\frac{\partial L}{\partial c_{2t}} = E[\partial u_{c2t}(\bullet)] - \beta\lambda_{t+1}E[p_{2t}^*] = 0 \tag{13}$$

$$\frac{\partial L}{\partial x_t} = E[\partial u_x(\bullet)] - \beta\lambda_{t+1}E[p_t^x] = 0 \tag{14}$$

These imply directly that:

$$\beta\lambda_{t+1} = \frac{E[\partial u_{c1t}(\bullet)]}{E[p_{1t}^*]} = \frac{E[\partial u_{c2t}(\bullet)]}{E[p_{2t}^*]} = \frac{E[\partial u_{xt}(\bullet)]}{E[p_{xt}^*]} \tag{15}$$

Households equate the marginal utilities in consumption of each good, as weighted by within-period prices.

These optima imply reduced form expressions for optimal choice functions, for dietary diversity and purchases of non-food goods, of:

$$c_{2t}^* = c_2(p_{1t}, E[p_{1,t+1}], p_{2t}, E[p_{2,t+1}], p_{xt}, E[p_{x,t+1}], r_t, \theta_t, T_1, T_2, T_c, K, A_t, Z_t) \tag{16}$$

$$x_t^* = c_2(p_{1t}, E[p_{1,t+1}], p_{2t}, E[p_{2,t+1}], p_{xt}, E[p_{x,t+1}], r_t, \theta_t, T_1, T_2, T_c, K, A_t, Z_t) \tag{17}$$

b. Predictions: dietary diversity

In relation to the model, the primary outcome we are interested in is the change in c_2*, representing dietary diversity, given the receipt of transfers in different forms, T_{1t}, T_{2t}, *or* T_{ct}; and in particular the difference in impact of receiving a food transfer of T_{1t} and T_{2t} versus a cash transfer of T_{ct}. We can anticipate different responses to receipt of food transfers based on whether or not the transfer of each commodity is infra-marginal, wherein $c_{jt}^* \geq q_{jt}^* + T_{jt}$, or extra-marginal, where $c_{jt}^* \leq q_{jt}^* + T_{jt}$.

The first and most pertinent hypotheses that emerge are driven by the transaction cost, which effectively lowers the shadow price of a commodity for a given household if the transfer of that commodity is extra-marginal. Given the lower shadow price, the household will substitute *toward* consumption of the extra-marginal commodity relative to others. In terms of dietary diversity impacts relative to cash, this leads to three core hypotheses:

H1: If a transfer T_1, the cheapest staple grain, is extra-marginal, households will face a lower shadow price of c_1, and hence will substitute toward consumption of c_1 relative to c_2, or more diverse foods. This means that transfers of T_1 will have a *negative* impact on dietary diversity relative to cash transfers (T_c) for households for whom the transfer is extra-marginal.

H2: If a transfer T_2, a higher-quality (and potentially more scarcely consumed) food, is extra-marginal, households will face a relatively lower shadow-price of c_2, and hence will substitute toward consumption of c_2 away from cheaper staple grains. This means that transfers of T_2 will have a *positive* impact on dietary diversity relative to cash transfers (T_c) for households for whom the transfer is extra-marginal.

H3: If a transfer of either T_1 or T_2 is infra-marginal, the household will face normal market prices with respect to that good. The dietary diversity impact of providing that good will be the *same* as that of providing cash (T_c).

One commodity can, however, be infra-marginal while the other is extra-marginal. There are therefore four potential cases to consider for recipients of food transfers, which lead to a few other predictions and/or nuances in these hypotheses.

Case 1: Both transfers infra-marginal

If both transfers are infra-marginal this implies that:

$$c_{1t}^* \geq q_{1t} + T_{1t} \quad => \quad p_{1t}^* = p_{1t}$$

and

$$c_{2t}^* \geq T_{2t} \quad => \quad p_{2t}^* = p_{2t}$$

In this case only H3 is at play, so we expect that the dietary diversity impacts of a food transfer (T_1 and/or T_2) would be the same for these households as for a cash transfer. Given that $p_{2t} > p_{1t}$, it would buy additional c_1 unless its marginal utility in consumption of c_2 is enough higher than that for c_1 to balance out the difference in prices. If the marginal utility of c_2 is indeed higher, it may purchase some c_2 as well, in order to equate the conditions stated in (15), but this decision would be no different for food recipients than for cash recipients.

Case 2: Both transfers extra-marginal

If both transfers are extra-marginal this implies that:

$$c_{1t}^* < q_{1t} + T_{1t} \quad => \quad p_{1t}^* = p_{1t} - \theta_t$$

and

$$c_{2t}^* < T_{2t} \quad => \quad p_{2t}^* = p_{2t} - \theta_t$$

In this case, the shadow prices of both commodities are lower than they would otherwise be—and lower hence for food recipients than for cash recipients. Per H1 and H2, the transfer of T_1 should decrease dietary diversity and the transfer of T_2 should increase dietary diversity (relative to the cash transfer of T_c). The net impact of the food transfer versus cash transfer on dietary diversity is hence ambiguous and depends on a household's relative marginal utilities. In so far as food is excess, a household may choose to sell the commodity with the higher shadow price and substitute toward the cheaper commodity, which would lead to a net negative impact on dietary diversity. However, if the marginal utility of c_2 is higher, the household may consume more c_2, and this would not be the case.

In so far as the food is in excess and the household sells the food good with the highest shadow price (i.e., $\max\{p_1-\theta, p_2-\theta\}$) in order to purchase x, the transaction cost involved in selling food leads to a corollary hypotheses:

> **H4:** Among households for whom either commodity—but especially both commodities—is extra-marginal, those who receive cash will spend more on non-food needs (x) than food recipients.

Case 3: Good c_1 extra-marginal, good c_2 infra-marginal

This case means that:

$$c_{1t}^{*} < q_{1t} + T_{1t} \quad => \quad p_{1t}^{*} = p_{1t} - \theta_t$$

and

$$c_{2t}^{*} \geq T_{2t} \quad => \quad p_{2t}^{*} = p_{2t}$$

In this case the household's price of c_2 is greater than its price for c_1, as p_2 is not only initially greater but also not subject to a (negative) transaction cost adjustment. The prediction in this case is merely consistent with H1 and H3, which is to say we expect the dietary diversity impact of T_1 to be lower than that of cash, while provision of T_2 should be the same. Hence the over-all dietary diversity impact of food relative to cash should be *negative.*

Case 4: Good c_1 infra-marginal, good c_2 extra-marginal

This case means that:

$$c_{1t}^{*} \geq q_{1t} + T_{1t} \quad => \quad p_{1t}^{*} = p_{1t}$$

and

$$c_{2t}^{*} < T_{2t} \quad => \quad p_{2t}^{*} = p_{2t} - \theta_t$$

In this case, consistent with H2, the household would face a lower relative price of c_2 and hence would substitute toward it relative to c_1, leading to a positive dietary diversity impact for transfers of T_2 relative to cash (T_c). Consistent with H3, the impact of T_1 should be the same as that of cash, meaning that food recipients over all experience greater dietary diversity.

Finally, the main driver in each of these is the transaction cost involved in selling an extra-marginal food transfer. This leads to one final hypothesis, that serves as a corollary to H1, H2, and H4 above:

> **H5:** The degree to which the extra-marginality of T_1 (T_2) has a negative (positive) impact on dietary diversity, and the degree to which cash recipients spend more than food recipients on non-food needs when commodities are extra-marginal, will be increasing in the transaction costs associated with selling food.

In summary, the core predictions of this model are that the impact on dietary diversity of providing food in any form is the same as that of providing cash for households for whom that food good in infra-marginal. When a food good is extra-marginal for any given household, however, the impact on dietary diversity relative to cash will be *negative* for a staple grain that the household would otherwise consume (that is likely extra-marginal primarily because it is otherwise produced or acquired), but *positive* for a higher quality good (that is likely extra-marginal because the household may not otherwise be able to afford it). The extra-marginality of food transfers will also lead to higher purchases of non-food goods for cash recipients, particularly when both food goods are extra-marginal. All of these differential impacts are increasing with the transaction cost associated with selling food.

IV. Data and Estimation

a. Experimental design and balance

The intervention that serves as the focus of this study was undertaken in response to a Government of Niger (GoN) needs assessment in 2010 that identified 13 sub-districts (communes) of Mirriah as the most vulnerable to malnutrition. This pilot was implemented by the WFP in partnership with the International Food Policy Research Institute (IFPRI). In light of the GoN strategy to promote Cash for Work (CFW) and Food for Work (FFW) programs, the first stage of the project provided transfers conditional on work, whereas the second stage provided unconditional transfers to a subset of recipients (the most vulnerable half within each village).

The first and most important feature of these data is that the form of transfer was randomized. Within the selected sub-districts there were approximately 112 villages (10,900 households). Of these, 79 (6,800 households) were suitable for randomization.[7] Worksites for the first phase of the project were designated by district, and randomization had to occur at the worksite level as it was not feasible to provide different forms of transfer to participants at the same worksite. Randomization was done after first stratifying by livelihood zone as locally

[7] Cash transfers were deemed by the WFP to be inappropriate in several villages, and a few others refused to participate in the evaluation. These villages were retained in the program but dropped from the evaluation.

defined, agricultural or agro-pastoral. This led to 52 worksites, 29 agricultural and 23 agro-pastoral. While all households could participate in the public works from April to June, the most vulnerable half in each village (2,300 households) were selected to receive unconditional transfers—of the same transfer type—from July through September.[8] The first survey round was undertaken after the public works phase in early July, at the height of the lean season with food prices still rising, with a more extensive survey and food consumption model undertaken only with those pre-selected for unconditional transfers. The second survey round followed, with only the unconditional transfer recipients, at the conclusion of the second phase in early October, as the harvest season was underway and food prices were stable or falling. Of the 2268 unconditional transfer recipients interviewed in the first round, we were able to follow up with 2209, an attrition rate of only 2.6%.[9]

Table 1 shows un-weighted descriptive statistics for important pre-intervention household and village-level characteristics, first at the household level and then clustered at the randomization unit level.[10] At the clustered level there are no significant differences between cash and food recipients, indicating that the randomization was successfully implemented. At the household level, however, there are a few characteristics that are significantly different. These differences appear to be driven by a chance draw of more Hausa-dominant worksites for food transfers in the randomization, as the primary significant differences are ethnicity and the nature of assets, which would be highly related to each other. That a few characteristics do not balance is not striking, however, as given the sample size and number of covariates we would expect that a subset of characteristic would not balance between groups (Bruhn and McKenzie 2009). The primary characteristics that do not balance at the household level, including ethnicity, assets, and some access measures, are controlled for in the analysis.[11]

— Table 1 —

b. Variable construction

i. Outcome variables

The primary outcome of interest is dietary diversity, which we measure using a 7-day recall module on food consumption with 25 food items.[12] From this we first divide foods into

[8] Participation in public works was virtually 100%; households without labor capacity received unconditional transfers.

[9] The most common causes for attrition were dissolution of households due to marriage or migration, and fictitious households, who claimed transfers in the first round but were discovered to be sub-sets of other households (providing false information) on follow-up. There is little reason to believe that this attrition would lead to bias; analysis of attritors and non-attritors showed only minor significant differences between groups.

[10] Including sampling weights has no significant effect on the results.

[11] See Hoddinott et al. 2013 for more detail on the experimental design and balance.

[12] Households were asked whether or not they consumed an item, and if so for how many days of the past seven. The question was asked separately if the item was consumed as merely as a condiment, and consumption of condiments was not factored into the dietary diversity score.

appropriate food groups, and then construct the food consumption score (FCS), which is a weighted sum of the number of days that each of eight food groups is consumed, weighted as a function of dietary importance. The FCS as constructed can range between 0 and 112, and the WFP considers an FCS of 35 to be "acceptable" (Weismann et al. 2009). The FCS is very commonly used by the WFP and others to measure food security impacts, and has been found to be a good indicator of dietary diversity and micronutrient intake in several developing countries (Kennedy 2009). Purchases of non-food items were solicited directly across a relatively comprehensive list of items and categories, and were then averaged for each month in order to construct a measure of total monthly non-food expenditure.

ii. Treatment variables

Previous work on these data has utilized as a treatment variable a dummy indicating that a household received food as opposed to cash (Hoddinott et al. 2013). For this analysis I use also the value of the transfer received in each form, either cash, core staples (grains), or other higher quality foods (legumes and oil). The food basket contained either maize or sorghum, vegetable oil, salt, and either lentils, cowpeas, or red beans.

The community level survey solicited the local price in each village for millet and maize only. Millet and sorghum have the same price and price pattern in this region, hence the millet price is applied for the sorghum transfers. The cowpea price was available at a regional, but not a village, level. As cowpeas are also locally produced and consumed, we expect the price to exhibit a similar spread between villages and dynamic over time as the millet price. I hence construct a regression using village-level fixed effects and household-level distances from villages to project the distribution of cowpea prices. As lentils and red beans are not available locally, I apply the cowpea price, taking into account the different weights of these commodities to convert unit prices to kilogram prices.[13] Prices for salt and oil are the same throughout the region, and are converted from local units to kilograms.[14] The over-all value of the transfer is then calculated using the price at the time of the transfer and the intended ration quantities, hence an intent-to-treat effect.[15]

iii. Other controls and characteristics

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[13] See Appendix I for further detail on the price projection procedure, including comparisons with alternative approaches. Estimations were run using each of four candidate cowpea price projections, with no resulting differences in the sign or significance of the final results.

[14] As the only available salt and oil prices were international prices, I utilize a price obtained through key informant interviews.

[15] The daily ration was: 3.5 kgs of grain, .72 kgs of legumes, .14 kgs of vegetable oil, and .035 kgs of salt. The monthly ration was based on work-days for the public works, hence was for 25 days per month. Quality data on actual quantities received by households is unavailable, I hence cannot estimate the average treatment effect on the treated.

Aside the transfer type, a number of other covariates enter into the reduced form equations I am estimating. These include household-level transaction costs, prices and price expectations, interest rates, land, assets and other potentially preference-shifting household characteristics.

I use household-level distances from the center of the village as a proxy for household-level transaction costs. Distance per se has been found to be a relatively imprecise measure of market access, and does not highly correlate with other market access measures. It does potentially capture some important features, however, of not only the physical and time costs of transportation but also the ways in which remoteness more generally may affect household choices and outcomes (Chamberlin and Jayne 2013). In this case, several aspects of market access are captured at the village or community level, through commune-level fixed effects (which would capture several market characteristics, as markets are generally few and similar within each commune), whether or not there is a market in the village, minutes of travel to the nearest market if there is not one, distance from the village to the main (paved) road, and whether or not there is cell phone service in the village, which has specifically been found to affect agricultural markets and price dispersion in Nigerien agricultural markets (Aker 2010). The specific transaction cost of interest for the model at the household level pertains to its cost in selling food received, and how its particular context might affect its decisions to do so. While imperfect, the household-level distance from the village center may be the best available proxy for these particular transaction costs.[16]

I control for prices using current prices of millet, cowpeas, and livestock (a lactating cow and a young male goat). While it is not straightforward to include price expectations, I include firstly the changes in these prices over the period as a proxy. Food price trends are a known and important phenomenon in the region; Figure 2 shows the price trends for millet and maize over the period, relative to the average over ten prior years. The somewhat predictable nature of these seasonal trends gives households reasonable expectations over price changes, and hence the village-level price change over the prior three months would give households a reasonable idea of how prices his year will behave in relation to prior years. Other things that would affect price expectations are factors like production conditions, such as rainfall, and these would not vary more than at the commune-level. I hence include commune-level fixed effects.

The price changes also capture interest rates, due to the features of assets and credit in the local economy. The seasonal food price change serves as an effective interest rate on loans, both due to displaced distortions (Barrett 2007), and due to the fact that loans are often taken out in the form of food and must then be repaid when food prices have fallen. Since livestock are the

[16] See Appendix II for detail on the construction of the household-level village-center distance, using household-level GPS coordinates and spatial techniques.

primary asset, livestock price changes are effectively the interest rates on investment. See Upton et al. (2014) for further detail on local credit markets and interest rates.

— Figure 2 —

Land is measured by area cultivated in this growing season. A scalar measure of total assets is constructed using principal component analysis (PCA) over all durable assets. The other primary asset held by households is livestock, which is measured using tropical livestock units (TLU), a measure constructed using animal weight and associated basal metabolic rate to standardize value across different animals (FAO 2014).[17] Finally, household-level characteristics that might shift preferences include gender, age, and education of household head, household size, whether the household is polygamous, and ethnicity. This set of variables effective captures the right hand side of the reduced form equations, (16) and (17).

iv. Infra- versus extra-marginality of commodities

The model yields predictions in light of the infra- versus extra-marginality of different food types for the population. The extra-marginality of different food items, a result of both available resources and household preferences, cannot be directly observed, so I approximate this in a few different ways for the analysis and hypothesis testing. The food consumption module asks the primary source of each food consumed in the past seven days (e.g., home-produced, purchased, received as a transfer). For most households the reference period fell toward the end of the transfer month, between two weeks and one month after having received the last food transfer. Hence, for food recipients, if a household purchased a food item (or category) that was received in the transfer, we can infer that the transfer was infra-marginal. If the food item (or category) was not purchased, whether or not it was consumed, we can infer that the transfer was extra-marginal.[18]

We can consider either two over-lapping groups, just the extra-marginality of each commodity without regard to the other, or four distinct groups, based on the status of each commodity for that household. That is to say that we have either:

Grain (c_1) extra-marginal (legumes (c_2) either infra- or extra-marginal)

Legumes (c_2) extra-marginal (grain (c_1) either infra- or extra-marginal)

OR

Group 1 – Neither grain (c_1) nor legumes (c_2) extra-marginal

[17] Including livestock in other ways, such as by numbers of different separate categories, does not affect the results.

[18] For c_1, I consider households who purchased any staple grain (millet, sorghum, maize, or rice) infra-marginal in the grain transfer, taking all staple grains as roughly substitutable with the transferred good. For c_2, I consider all households who purchased any type of legume or non-grain staple food, namely manioc and other tubers, infra-marginal in the legume transfer, taking all of these higher quality (but still staple/semi-storable) foods to be substitutes. Excluding tubers for only legumes and/or only cowpeas results in some differences in the numbers of households that fall into each category, but does not significantly affect the results for each group. More detail on the group construction and results for different configurations is available upon request.

Group 2 – Both grain (c_1) and legumes (c_2) extra-marginal

Group 3 – Just grain (c_1) extra-marginal, legumes (c_2) infra-marginal

Group 4 – Just legumes (c_2) extra-marginal, grain (c_1) infra-marginal

While we can hypothesize as to the influence of extra-marginality of a commodity, no clear hypotheses can be drawn over the first two groups given the confounding effect of possible extra-marginality in the other commodity. I hence focus for the predictions and results on the four distinct groups of food recipients.

The next issue for the analysis is that I must compare these defined groups of food recipients against all cash recipients. In the absence of a food transfer, I cannot sub-divide cash recipients based on the infra-marginality or extra-marginality of commodities to assess the impacts of different transfer types within like groups, as I would ideally do. To attempt to overcome this constraint, I develop a mechanism for approximating the groups of interest using a propensity score method. Following the relatively transparent approach of Dehejia and Wahba (2002), I construct a logit regression of the observed extra-marginality of each commodity among food recipients on a series of characteristics that could affect both the availability of and preferences for foods. I include food production, assets, and accessibility, as well as potential preference-shifters like ethnicity and other household-level characteristics. I then project the results of this regression, among food recipients, across all households. I do this process for each commodity, to obtain two propensity scores, the predicted propensity of being extra-marginal in consumption of c_1, or of c_2, relative to the transfer in that commodity. The histograms shown in Figure 3 provide as an example the propensities of being extra-marginal in consumption of each commodity in July and then in October, divided by transfer type.[19]

— Figure 3 —

c. Estimation procedures

In order to test the hypotheses of the model, I estimate the reduced form equations (16) and (17) on dietary diversity and non-food expenditures, respectively, with the primary focus on the former (equation (16)). These each represent the marginal propensities to consume, either a more diverse diet or non-food goods, given a transfer in the form of a staple-grain, a higher-quality staple, or cash. Because my hypotheses all relate to food or cash transfers otherwise commonly subject to selection effects and other forms of unobserved heterogeneity that might otherwise bias key parameter estimates, the strength of identification through randomization of the form of transfer is central to the estimation strategy.

[19] Further detail on the process of constructing these propensity scores, and comparisons across several versions that are constructed using different estimators and covariates, are provided in Appendix III. I turn attempt the propensity scores on each specific unique group, as here described. A table of results is included as Appendix IV. The results are substantively similar to what I obtain using the propensities over two groups.

First I look at a model over all households that examines the impact of receiving a food transfer on the outcomes of interest, and then divides the food transfer into its component parts to look at the relative impact of receiving T_1 *or* T_2 relative to T_c. For each endogenous choice variable "*Y*," c_2 or *x*, and for each time period,[20] we have:

$$Y_i = \alpha + T_{fi}\left(\beta_f + \rho_f \theta_i\right) + \rho_0 \theta_i + \delta P_v + \pi A_i + \phi Z_{vi} + \lambda FE + \varepsilon_i \tag{18}$$

Here *Pv* is a set of prices and price changes, which vary at the village level (v). Transaction cost, θ_i, varies at the household level, and is also examined as it affects the relative impacts of the different transfer types. A household has assets A_i, and the vector Z_{vi} represents several other households and village-level characteristics as described above. Z_{vi} also includes the stratification variable (pastoral / agro-pastoral) to take into account the randomization. *FE* stands for the commune-level fixed effects, and is an i.i.d. error term that satisfied the necessary assumptions.

In this simplified case, the food transfer, T_f, is the combination of all food goods received and can, as with the cash transfer (T_c), be included either as a dummy variable or as a cash value (in local currency, West Africa Francs (CFA)). Since the transfer received is either in cash or in food, one of these will zero out; I hence include only the food transfer in the specification, and focus in this case on the food transfer coefficient, β_f, the impact of receiving food as opposed to cash (or in value, the impact of an additional 1000 CFA received in food as opposed to in cash).

This specification, however, provides no information on the relative impacts of separate commodities, so with the food transfer divided into the values of the component parts I then estimate:

$$Y_i = \alpha + T_{1i}(\beta_1 + \rho_1 \theta_i) + T_{2i}(\beta_2 + \rho_2 \theta_i) + \rho_0 \theta_i + \delta P_v + \pi A_i + \phi Z_i + \lambda FE + \varepsilon_i \tag{19}$$

In this case, T_c is omitted, T_1 is the value of the food transfer of staple grain, and T_2 is the value of more diverse foods (legumes, oil, and salt). The results for all households, as opposed to for separate groups, can inform the hypotheses in light of the general consumption trends in the population.

I then allow the impacts to vary for each sub-group of recipients, classified based on whether the food basket components were infra- or extra-marginal. First I take the groups as defined among food recipients, and estimate these groups against *all* cash recipients (regardless

[20] Time sub-scripts are dropped for the sake of simplicity. All variables reflect time *t* except prices, which represent price expectations in time *t* over next period prices.

of their unknown status in each commodity). In this case I effectively estimate equations (18) and (19) separately for each group *j,* where *j* can be either the two over-lapping groups or the four distinct groups as defined above:

$$Y_i = \alpha_j + T_{ci}(\beta_{cj} + \rho_{cj}\theta_i) + T_{fi}(\beta_{fj} + \rho_{fj}\theta_i) + \rho_{0j}\theta_i + \delta_j P_v + \pi_j A_i + \phi_j Z_{vi} + \lambda_j FE + \varepsilon_i \tag{20}$$

and

$$Y_i = \alpha_j + T_{1i}(\beta_{1j} + \rho_{1j}\theta_i) + T_{2i}(\beta_{2j} + \rho_{2j}\theta_i) + \rho_{0j}\theta_i + \delta_j P_v + \pi_j A_i + \phi_j Z_i + \lambda_j FE + \varepsilon_i \tag{21}$$

Finally, using the propensities to be extra-marginal in each commodity as defined above, I run the combined specification across all households, first for the food treatment variable (versus cash) as a whole and then for each separate commodity, as follows:

$$\begin{aligned} Y_i = \alpha + T_{fi}(\beta_f + \gamma_{f1}\widehat{\Omega}_{1i} + \gamma_{f2}\widehat{\Omega}_{2i} + \rho_f\theta_i + \rho_{f1}\theta_i \times \widehat{\Omega}_{1i} + \rho_{f2}\theta_i \times \widehat{\Omega}_{2i}) + \gamma_1\widehat{\Omega}_1 + \gamma_2\widehat{\Omega}_2 + \rho_0\theta_i \\ + \delta P_v + \pi A_i + \phi Z_{vi} + \lambda FE + \varepsilon_i \end{aligned} \tag{22}$$

and

$$\begin{aligned} Y_i = \alpha + T_{1i}(\beta_1 + \gamma_{11}\widehat{\Omega}_{1i} + \gamma_{12}\widehat{\Omega}_{2i} + \rho_1\theta_i + \rho_{11}\theta_i \times \widehat{\Omega}_{1i} + \rho_{12}\theta_i \times \widehat{\Omega}_{2i}) \\ + T_{2i}(\beta_2 + \gamma_{21}\widehat{\Omega}_{1i} + \gamma_{22}\widehat{\Omega}_{2i} + \rho_2\theta_i + \rho_{21}\theta_i \times \widehat{\Omega}_{1i} + \rho_{22}\theta_i \times \widehat{\Omega}_{2i}) + \gamma_1\widehat{\Omega}_1 + \gamma_2\widehat{\Omega}_2 \\ + \rho_0\theta_i + \delta P_v + \pi A_i + \phi Z_{vi} + \lambda FE + \varepsilon_i \end{aligned} \tag{23}$$

Here $\widehat{\Omega}_{1i}$ ($\widehat{\Omega}_{2i}$) is the household's predicted propensity to be extra-marginal in consumption of c_1 (c_2) relative to the transfer of T_1 (T_2). These are interacted with the values of each transfer (the over-all transfer in (20), or the values of each in (21)), as well as with the household-level transaction costs. All other variables and controls are the same as in equation (18).

The hypotheses can now be re-stated in terms of the parameters of equations (18)-(23). For each of Hypotheses 1, 2, and 4, the predictions of Hypothesis 5, regarding the additional influence of the household-level transaction costs, can be included as a corollary.

> H1: If a transfer T_1 is extra-marginal, households will substitute toward consumption of c_1 relative to c_2. Transfers of T_1 will hence have a *negative* impact on dietary diversity relative to cash transfers (T_c) for households for whom the transfer is extra-marginal. Taking $Y_i = c_2^*$:

For Equation (19), all households, for the separate transfers of T_1 and T_2 versus T_c (omitted):

$$H_0: \beta_1 = 0 \; [vs. H_A: \beta_1 < 0]$$

H5 corollary:

$$H_0: \rho_1 = 0 \; [vs. H_A: \rho_1 < 0]$$

For Equation (20), by groups, for the combined transfers of T_f versus T_c (omitted):

$$H_0: \beta_{fj} = 0 \; \left[vs. H_A: \beta_{fj} < 0\right]$$

H5 corollary:

$$H_0: \rho_{fj} = 0 \; [vs. H_A: \rho_{fj} < 0]$$

$$for \;\; j = G3 \; (c_1 \; extra - marginal, c_2 \; infra - marginal)$$

For Equation (21), by groups, for the separate transfers of T_1 and T_2 versus T_c (omitted):

$$H_0: \beta_{1j} = 0 \; \left[vs. H_A: \beta_{1j} < 0\right]$$

H5 corollary:

$$H_0: \rho_{1j} = 0 \; [vs. H_A: \rho_{1j} < 0]$$

$$for \; j = G2 \; and \; G3 \; (c_1 \; extra - marginal)$$

For Equation (23), propensity scores on extra-marginality of c_1, for the separate transfers of T_1 and T_2 versus T_c (omitted):

$$H_0: \beta_1 + \gamma_{11} = 0 \; [vs. H_A: \beta_1 + \gamma_{11} < 0]$$

H5 corollary:

$$H_0: \rho_{11} = 0 \; [vs. H_A: \rho_{11} < 0]$$

Note that the H5 corollary hypotheses follow suit in the following, and also as regards H4, in that the corollary is that the impact discussed will be increasing in transaction costs, or the sign on ρ will follow the sign on the beta coefficients of interest. I omit these additions for simplicity.

H2: If a transfer T_2 is extra-marginal, households will substitute toward consumption of c_2 away from c_1. This means that transfers of T_2 will have a *positive* impact on dietary diversity relative to T_c.

Taking $Y_i = c_2^*$:

For Equation (19), all households, for the separate transfers of T_1 and T_2 versus T_c (omitted):

$$H_0: \beta_2 = 0 \; [vs. H_A: \beta_2 > 0]$$

For Equation (20), by groups, for the combined transfer of T_f versus T_c (omitted):

$$H_0: \beta_{fj} = 0 \; \left[vs. H_A: \beta_{fj} > 0\right]$$

$$for \; j = G4 \; (c_2 \; extra - marginal, c_1 \; infra - marginal)$$

For Equation (21), by groups, for the separate transfers of T_1 and T_2 versus T_c (omitted):

$$H_0: \beta_{2j} = 0 \left[vs. H_A: \beta_{2j} > 0\right]$$
$$for\ j = G2\ and\ G4\ (c_2\ extra - marginal)$$

For Equation (23), propensity scores on extra-marginality of c_2, for the separate transfers of T_1 and T_2 versus T_c (omitted):

$$H_0: \beta_2 + \gamma_{22} = 0\ [vs. H_A: \beta_2 + \gamma_{22} > 0]$$

H3: If a transfer of either T_1 or T_2 is infra-marginal, the dietary diversity impact of providing that good will be the *same* as that of providing cash (T_c).

Taking $Y_i = c_2^*$:

For Equation (20), by groups, for the combined transfer of T_f versus T_c (omitted):

$$H_0: \beta_{fj} = 0 \left[vs. H_A: \beta_{fj} \neq 0\right]$$
$$for\ j = G1\ (both\ goods\ infra - marginal)$$

For Equation (21), by groups, for the separate transfers of T_1 and T_2 versus T_c (omitted):

$$H_0: \beta_{1j} = 0\ \left[vs. H_A: \beta_{2j} \neq 0\right]$$
$$for\ j = G1\ and\ G4\ (c_1\ infra - marginal)$$
$$H_0: \beta_{2j} = 0\ \left[vs. H_A: \beta_{2j} \neq 0\right]$$
$$for\ j = G1\ and\ G3\ (c_2\ infra - marginal)$$

For Equation (23), propensity scores on extra-marginality of c_1 and c_2, for the separate transfers of T_1 and T_2 versus T_c (omitted):

$$H_0: \beta_1 = 0 \mid \widehat{\Omega}_1 = 0\ [vs. H_A: \beta_1 \neq 0 \mid \widehat{\Omega}_1 = 0]$$
$$H_0: \beta_2 = 0 \mid \widehat{\Omega}_2 = 0\ [vs. H_A: \beta_2 \neq 0 \mid \widehat{\Omega}_2 = 0]$$

H4: Among households for whom a food transfer is extra-marginal, those who receive cash will spend more on non-food needs (x) than food recipients.

Taking $Y_i = x^*$:

For Equations (18) and (19), all households, for the combined transfer of T_f versus T_c (omitted):

$$H_0: \beta_{fj} = 0\ and\ \beta_1, \beta_2 = 0\left[vs. H_A: \beta_{fj} < 0, \beta_1, \beta_2 < 0\right]$$

For Equation (20), by groups, for the combined transfer of T_f versus T_c (omitted):

$$H_0: \beta_{fj} = \beta_{cj} \left[vs. H_A: \beta_{fj} < \beta_{cj}\right]$$
$$for\ j = G2\ (both\ commodities\ extra - marginal)$$

For Equation (21), by groups, for the separate transfers of T_1 and T_2 versus T_c (omitted):

$$H_0: \beta_{1j} = 0 \left[vs. H_A: \beta_{1j} < 0\right]$$
$$for\ j = G2\ and\ G4\ (c_1 extra - marginal)$$

$$H_0: \beta_{2j} = 0 \; [vs. H_A: \beta_{2j} < 0]$$
$$for\ j = G2\ and\ G3\ (c_2 extra - marginal)$$

For Equation (22), propensity scores on extra-marginality of food, for the separate transfers of T_1 and T_2 versus T_c (omitted):

$$H_0: \beta_f + \gamma_{f1} + \gamma_{f2} = 0 \; [vs. H_A: \beta_f + \gamma_{f1} + \gamma_{f2} < 0]$$

For Equation (23), propensity scores on extra-marginality of c_1 and c_2, for the separate transfers of T_1 and T_2 versus T_c (omitted):

$$H_0: \beta_1 + \gamma_{11} = 0 \; |\widehat{\Omega}_1 > 0 \; [vs. H_A: \beta_1 + \gamma_{11} < 0 \; |\widehat{\Omega}_1 > 0]$$
$$H_0: \beta_2 + \gamma_{22} = 0 \; |\widehat{\Omega}_2 > 0 \; [vs. H_A: \beta_2 + \gamma_{22} < 0 \; |\widehat{\Omega}_2 > 0]$$

For simplicity, Table 2 summarizes the expected signs on the parameters that would be associated with rejecting the null hypotheses, for the food transfer as a whole as well as for its component parts, and for each sub-group as well as for all households.

— Table 2 —

V. Results

a. Consumption patterns and characteristics of all households and groups

The first aspect of the results that bears discussion is the implications of examining all households versus the sub-divided groups based on the infra- or extra-marginality of transfers, in light of underlying consumption patterns for cash versus food recipients and the nature of the extra-marginality of transfers between seasons. While the model's predictions can be tested in part by looking at the results for all households, the consumption patterns of the population at large can help us to better understand these results and further inform the predictions. These patterns also reveal difference in the nature and causes of extra-marginality of each transfer type in each season, which informs how we might expect results to differ over time.

Food consumption patterns in each period for the main grains (c_1) and non-grain staples (c_2), separated by period and then by cash and food recipients, are shown in Table 3. The numbers under each food type represent first whether or not the food was consumed, and the number of days in the past seven, then the source, or what percentage of households claimed each source as "primary" for that food and period. We see clearly, first of all, that in the absence of a food transfer the primary grain commodity consumed is millet, followed by sorghum and then maize, with 96%, 60%, and 18% (100%, 36%, and 6%) of cash recipients consuming each commodity in July (October), respectively. With respect to non-grain staples, cash-recipient households are likely to consume a mix of cowpeas (60% and 6%, in July and October, respectively) and tubers (31% and 33%, likewise), nearly all of them purchased, and virtually only consume any other bean if it was received as a transfer. When all home-produced food is scarce, then, cash recipients purchase a mix of foods, including cowpeas; however, when home-produced millet is available, in October, we see that cash recipients substitute toward millet consumption and purchase significantly less of any other food.

These observations can inform us about the degree to which different forms of transferred goods are broadly extra-marginal for this population. Food recipients are nearly as likely (albeit for fewer days on average) to consume millet as cash recipients, even when it is primarily purchased in July. However, they switch from being more likely to consume maize to more likely to consume sorghum between periods, with 41% consuming sorghum and 88% maize in July, versus 88% and 17%, respectively, in October. This trend is consistent with the form of grain transfer received, shown in Table 4, which was in the form of maize for roughly half of all households in July, but was in the form of sorghum for over 90% in October. Maize is effectively only consumed if it was received as a transfer, whereas sorghum is consumed significantly more when received as a transfer (in October) but also consumed to some degree when not (in July). Hence both of these commodities are largely extra-marginal, but maize more so. These trends support Cunha's (2014) findings in Mexico of substitution toward extra-marginal commodities away from similar commodities, albeit this happens little in the case of millet, which is purchased and consumed by nearly all households even when it is not transferred. In this case also, however, there is substitution away from relatively dissimilar commodities—in the sense that households are so liquidity constrained that they choose to substitute toward cheaper grain when it is available and away from higher quality foods.

— Table 3 —

— Table 4 —

The inter-period differences in other food consumption consumption exhibit a rather different pattern. Consumption of cowpeas, other legumes, and tubers by food recipients remains relatively constant between periods, with 76%, 8%, and 21% consuming each (respectively) in July and 68%, 10%, and 28% consuming each (respectively) in October. With respect to legumes, cowpea transfers would appear to be retained and consumed (and additionally purchased by some), whereas other beans, received by about 69% and 72% of households in July and October (respectively), are hardly consumed in either case.

The large degree of increased consumption with the transfer of certain commodities is consistent with a degree of extra-marginality. By this logic, we may suspect that for the population at large, even if grain per se was not extra-marginal, the commodities provided (primarily maize, but for many also sorghum) were extra-marginal for these households.

The legume commodity in any form was also per this evidence extra-marginal, in part because household would in the absence of the food transfer consume almost exclusively less expensive (and otherwise more available, via home production) staple grains. The degree of extra-marginality of legumes was more pronounced in October, when the local grain (millet) was more available due to the harvest.

This leads to the realization that the degree of, and reasons for, extra-marginality for any given household varies between seasons based on seasonal conditions and household characteristics. Table 5 shows the transition matrix between groups between periods, including also the average food consumption scores in each period for each group. By looking at the diagonal we see first off that a minority of households—a total of 32.5% across groups—retain the same status between periods. The movement between groups over time, taking into account consumption levels, reflects that the extra-marginality of any given commodity is a function of choices under constrained circumstances, which change inter-seasonally. There may be different implications of being extra-marginal in a commodity under different conditions, i.e. it may be a matter of resorting to an available substitute out of desperation in one period but rather a matter of choosing an available substitute by preference in another. Those for whom the transfer was extra-marginal in both commodities in October (G2, 422 households), and also just in grain (G3, 95 households), have lower FCS scores on average in both periods than those for whom both commodities (G2, 158 households) or just grain (G3, 62 households) were extra-marginal in July. This reflects, in light of the evidence in Table 3, that the extra-marginality of grain in July and October are different in nature; in July, households who do not buy additional grain are likely to be using those resources to purchase a more diverse diet, whereas in October, those households are more likely producing sufficient grain and hence substituting more toward it, leading to a less diverse diet. The bean commodities are extra-marginal (Groups 2 and 4) for the largest number of households in both periods (563 households in July and 711 in October). Putting this together with the descriptive information in Table 3, however, we know that this extra-marginality is much more distorting in October, when cash recipients almost all forego legume consumption for that of cheaper (home-produced) grains.

— Table 5 —

These trends would be expected to impact the results of hypothesis tests in each period. In particular, we would expect the extra-marginality of both commodities to make the differential impacts of each food transfer type stronger in October. The effect of providing grain on dietary diversity should be more negative because grain—in particular the sorghum provided—is extra-marginal for more households given the millet harvest. The effect of providing the legume on dietary diversity should be more positive because of the strong tendency otherwise to substitute toward the less-diverse diet of home-produced millet.

b. Testing Hypotheses 1 and 2

Tables 6 and 7 show the results of equations (18) and (19), for all households, with the outcome variable of FCS. Three versions of the treatment variable are shown: the dummy for receipt of a food (versus cash) transfer, the over-all value of food (versus cash) received, and then the separate values of T_1 and T_2, or grain versus legumes, oil, and salt. For each treatment variable I show here first the uncontrolled regression results, then those with household controls, then with household and village controls, then with all controls and fixed effects, in order to explore the strength of the randomization and model. Columns (4) hence represent the specifications described in equations (18) and (19), the preferred specification, which I expect to be more precise. The results for July, during the lean period and following the conditional transfers (Table 6), and for October, during the early part of the harvest and following the unconditional transfers (Table 7), are shown separately.

— Tables 6 and 7 —

The results are first off fundamentally consistent with Hoddinott et al. (2013), in that the food transfer on the whole has a greater impact on dietary diversity than the cash transfer. Keeping in mind that the second treatment variable used represents the value of the transfer (in 1000s of CFA) as opposed to the dummy, and the transfer value was roughly 25,000 CFA, these two sets of results are similar in magnitude. The magnitudes represent a 8% (7%) difference in July and a 10% (8%) difference in October, looking at the food as a dummy variable (value), relative to over-all averages in each period.

I begin the tests of Hypotheses 1 and 2 by looking at the transfer separated into its two components. The impact of providing T_1 is broadly negative relative to cash over-all, whereas that of providing T_2 is positive. There is some support for this relationship in July, but the significance disappears with addition of village controls and fixed effects (see the final two columns of Table 6). Both outcomes remain significant in October (Table 7). The magnitudes are in turn much larger, with a roughly 80% negative difference in FCS for T_1 and a 90% positive difference in FCS for T_2 relative to the October average FCS (of about 47). For all households, hence, I can *reject* hypotheses 1 and 2, the nulls of which state that T_1 and T_2 would have no impact on FCS relative to cash, in favor of the respective one-sided alternatives.

This result is in turn consistent with the assessment of consumption patterns, that within the over-all sample both food transfer types are extra-marginal at all times for many, but had a greater (more distorting) degree of extra-marginality in October than in July. To further explore this claim, I break the transfer values apart by individual commodities, as shown in Table 8. In July, there is weak evidence (not robust to inclusion of fixed effects) that both sorghum and maize have negative impacts, and a dominating positive effect of providing cowpeas. In October, however, these impacts are stronger in both directions, as one would suspect give the greater degrees of extra-marginality of each commodity. The impact is strongest for cowpeas in particular, which were consumed by almost no cash recipients, which is consistent with the degree to which most households were extra-marginal in cowpea consumption in October.

In summary, taking into account the general extra-marginality of the commodities provided in this population, I can *reject* the null hypotheses in favor of the alternatives:

$$H1:\ H_0: \beta_1 = 0\ [vs. H_A: \beta_1 < 0]$$

$$and$$

$$H2: H_0: \beta_2 = 0\ [vs. H_A: \beta_2 > 0]$$

While I only reject with 95% confidence and without controls and fixed effects in July, I reject with confidence ($p < 0.01$) in October.

Evidence related to the corollary regarding transaction costs, Hypothesis 5, is mixed between seasons. In July, even while the impacts of each commodity are not robust to fixed effects, the degree to which the grain (legume) transfer has a negative (positive) impact on dietary diversity is increasing with a household's distance from the village center. In October, however, the impacts of each food commodity are attenuated by the transaction costs. Hence I *reject* the corollary hypothesis ($p < 0.01$) in July, but fail to reject in October. This finding could reflect implications of remoteness, or other unobservables other than the transaction cost associated with the model, that differ between seasons and are captured by the households' distance from the village center.

I now turn to analysis within separate groups of food recipients based on the extra-marginality of each transfer type. Rejection of hypothesis 1 would imply that we find negative coefficients on the beta parameters for the food transfer over-all among those for whom the grain is extra-marginal and the legume is not, which is group 3 in Tables 9 (July) and 10 (October). As seen in Columns (5), this coefficient is positive but not significant in July and October. For divided commodities, results are stronger, in that the coefficient on transfers of T_1, in Columns (6), is negative and significant in both periods. In October (Table 10) the impact of T_1 is negative and significant for all groups for whom the grain is extra-marginal, and these results are more pronounced than in July as expected.

In looking finally at the propensity scores, Table 11, I fail to reject Hypothesis 1 in July (columns (1) and (2)). In October, however, the impact of food generally is negative for those extra-marginal in c_1 (net effect of -0.585, column (3)), but particularly decreasing for transfers of T_1 (net effect of -6.488, column (4)). I can say then on the whole that I *reject* hypothesis 1 in favor of the alternative, that the *T1* transfer has negative impacts on dietary diversity. This evidence is present in both seasons, but more pronounced and consistent in October.

Hypothesis 2 is even more strongly rejected in the sub-groups and propensity score estimations. The impact off food and of T_2 on the sub-groups for whom it is extra-marginal, G2 and G4 (columns (3)-(4) and (7)-(8) of Tables 9 and 10), is positive, although only significant in October for G4 for the food transfer (column (7)), and for the divided commodities. Using the propensity scores (Table 11), evidence related to Hypothesis 2 is mixed. There is similar to the above no supporting evidence in July, whereas in October the impact of the food transfer is positive in the propensity to be extra-marginal in c_2 (column (3)). The effect is not shown to be specific to T_2, however (column (4)). Again, while evidence is somewhat mixed, and more definitive in October, I across metrics can *reject* Hypothesis 2 in favor of the alternative that transfers of T_2 have positive impacts on dietary diversity.

That both Hypotheses are more firmly rejected in October is on the whole consistent with the different conditions between seasons (Table 3). It is possible also that the propensity score approach is more able to capture the characteristics that drive the extra-marginality of transfers in

October, when conditions are less strained so differences between households are more driven by household-level characteristics.

Similar to the case for all households, evidence related to the corollary transaction cost hypothesis is mixed. In July, we see that the transaction cost strengthens the separate impacts of each commodity for groups for whom legumes only are extra-marginal (G4, column (8) of Table 9), and these results are significant ($p < 0.01$). In October, however, evidence fails to reject the hypothesis for all groups.

c. Testing Hypothesis 3

A rejection of hypothesis 3 would mean that, across estimation procedures, a transfer has an impact on dietary diversity relative to cash even when that transfer in infra-marginal. A failure to reject, in this case, provides some support for the model's prediction, that food transfers have no impact relative to cash transfers for those for whom they are infra-marginal. In the first instance I test whether for those for whom both goods are infra-marginal, G1, the beta coefficients for food transfers is not equal to zero. As shown in Column (2) of Tables 9 and 10, while the over-all impact of the food transfer is still weakly positive in both periods, in October each separate commodity has no impact of dietary diversity relative to cash; in July the impact of grain is weakly positive, as opposed to negative for all other groups. It is only in the case that both commodities are infra-marginal, G1, however, that I cannot reject the hypothesis, i.e. that there are not definitive impacts of the food transfers on dietary diversity relative to cash. While this does not confirm that the impact of food is identical to that of cash for infra-marginal recipients, it does provide support for the model, especially since the hypothesis is stronger rejected for other groups.

For the propensity score estimation, a rejection is contingent on the impact of food and/or both food commodities being different from cash if the propensity to be extra-marginal is zero, or:

$$H_0: \beta_1 = 0 \mid \Omega_1 = 0 \; [vs. H_A: \beta_1 \neq 0 \mid \widehat{\Omega}_1 = 0]$$
$$H_0: \beta_2 = 0 \mid \Omega_2 = 0 \; [vs. H_A: \beta_2 \neq 0 \mid \widehat{\Omega}_2 = 0]$$

In both periods, we see that including the propensity scores in the regression leads to an insignificant (not distinguishable from zero) impact of each transfer on dietary diversity (columns (2) and (4)), and in July this occurs for the transfer as a whole (column (1)). Here again I *fail to reject* the hypothesis in support of the alternative, finding some (if weak) support for the model's prediction.

d. Testing Hypothesis 4

The model predicts that, in addition to influencing consumption outcomes, the extra-marginality of both food transfer types could lead to greater expenditure on non-food items for cash than for food recipients. Overall I fail to reject this hypothesis, finding to the contrary that food recipients spend as much or more on non-food expenditures as cash recipients. There are minimal significant differences between cash and food recipients on non-food expenditures in July, and none at all in October. When divided between groups, the impacts of food transfers for some subsets are weakly positive (indicating greater purchases of non-food items by food recipients) in July and weakly negative (indicating greater purchases of non-food items by cash recipients) in October, which is consistent with the findings of Hoddinott et al. (2013) of greater expenditures by those respective groups in certain targeted areas. These effects are however small in magnitude.

Looking at the propensity score estimations shown in Table 12, while the food transfer impact is positive (column (1)), indicating greater purchases by food recipients, it is decreasing in the propensities to be extra-marginal, and on net negative for those who are extra-marginal in consumption of c_2. Likewise with the regressions divided by commodity, the degree to which cash recipients purchase more non-food goods is increasing in the degree of extra-marginality of c_2 (3.601-5.556=-1.955, column (2)). On the whole, however, I *fail to reject* Hypothesis 4 in favor of the alternative, that cash recipients would make more non-food purchases when commodities are extra-marginal.

This finding suggests that there are other uses of cash by cash recipients that are not addressed purely by the question of extra-marginality. A key candidate that emerges from the model in this paper is the use of cash for consumption-smoothing behavior, through payment of debts and/or gift-giving. This question is taken up in a companion paper in this dissertation, Upton et al. 2014.

e. Single-adult households

It is often supposed that policy outcomes inconsistent with our theories may be the result of intra-household bargaining dynamics, which can lead to inconsistencies and inefficiencies in behavior. I hence test this supposition by checking to see whether the model's predictions and results hold in the absence of intra-household bargaining, which we would presume to be the case in households with only one adult.

I define single-adult households as those of either gender for whom the spouse is deceased or otherwise absent during the transfer period. In July, this included just one male-headed household (whose wife was absent during that period), but in October it coincided precisely with female-headed households.[21]

The results for the key specifications on the food consumption score, first with food values alone (equations (18) and (19)) and then with the propensity scores (equations (22) and (23)), are shown in Table 13 for both periods. The food value has a positive impact on dietary diversity relative to cash, in slightly greater magnitude than for all households (columns (1) and

[21] The results for just female-headed households are virtually identical.

(5)). Hypothesis 1 and 2 are in turn rejected in October, as we see negative coefficients on T_1 and positive coefficients on T_2 (columns (6) and (8)). The propensity scores evidence is ambiguous, however, perhaps because the extra-marginality of foods does capture different information for single-adult (primarily female-headed) households. Finally, I can as for all households reject hypothesis 3 only in July, as the impacts of food and each food good are indistinguishable from zero when propensity scores are zero (columns (3) and (4)).

When we look at non-food expenditures (not shown), similarly also to the results for all households, food recipient single-adult households have slightly higher non-food expenditures in July, but there are no significant differences at all in October.

While there may be some evidence that there are differences in the nature of the extra-marginality of transfers for single-adult households, I would conclude on the whole that there is very little evidence that household-level bargaining dynamics affect the core predictions of the model.

VI. Summary and Conclusion

In this paper I take on a puzzle that has been with economists, and the community of scholars concerned with food security and food assistance policy, for years: the so-called "cash-out" puzzle, or degree to which in-kind transfers lead to different decisions and outcomes than cash transfers, even with the in-kind transfer is infra-marginal. In particular, I attempt to shed light on the mechanisms behind differential impacts of cash versus food transfers, and in this case the conditional superiority of food transfers, for dietary diversity objectives. While this question has been examined repeatedly and in many contexts, I take a novel approach that builds on development microeconomic theory, and evaluate it in the challenging and important context of rural Niger.

The model I construct in this paper includes a minor extension on a dynamic household decision model, in order to generate predictions on the impacts of cash versus food transfers for dietary diversity outcomes. The model predicts that, due to transaction costs involved in selling food, household will substitute toward consumption of extra-marginal transferred commodities. This substitution leads to negative impacts on dietary diversity relative to cash if the extra-marginal commodity is a cheap, staple grain, but positive impacts on dietary diversity relative to cash if the extra-marginal commodity is a higher quality food. The model yields additional predictions related to other uses of cash, in particular with respect to consumption-smoothing behavior, that are taken up in a companion paper (Upton et al. 2014).

The Niger context and particular sample of households in which I test this model's predictions is intriguing. I show that, for all households in the sample, both commodities provided in the transfer are largely extra-marginal. But the status of each good is dynamic, and the reasons for the extra-marginality are different between lean and harvest seasons. In the lean season, the grain transfer is largely infra-marginal in terms of grain consumption, but the specific commodities provided are still extra-marginal, and I find support for the model's prediction in a slightly negative impact of grain transfers relative to cash on the food consumption score. During the harvest, however, the commodities provided are still extra-marginal and the extra-marginality of grain over all increases due to local availability of millet. In turn, we see as the model predicts pronounced negative impacts on dietary diversity relative to cash. The other, higher quality good provided is a legume, which is extra-marginal for many households in both periods but primarily because households choose to substitute toward consumption of cheaper grains, especially during the harvest when home-produced grain is available. The model's predictions are supported here as well, with a pronounced positive impact of the legume good provided on dietary diversity relative to cash, particularly during the harvest.

I then divide households into groups based on the extra-marginality of each commodity, and construct propensity scores, to confirm that these impacts vary within the population as a function of the extra-marginality of foods. While this task is challenging and somewhat imprecise, I find some additional support for the model through these methods, in particular that during the harvest period the negative (positive) impact of the grain (legume) transfer is (decreasing) increasing in the propensity for it to be extra-marginal. While the impact of food generally is still positive relative to cash for those for whom transfers are infra-marginal, the impacts of the separated commodities among these households is negligible.

I examine all results within the sub-sample of single-adult households to assess the influence of intra-household bargaining dynamics, and find that very similar results. This is to say that intra-household bargaining does not have an important effect on the degree to which the extra-marginality of transferred commodities influences their impacts.

These results, and the validation of this model, go a long way toward solving the puzzle of the conditional superiority of food transfers for dietary diversity outcomes in this context. There are some gaps in the results, however—such as in that the over-all food transfer has positive impacts in July, but this does not seem to be explained by the relative status of each commodity. In turn, the food transfer over-all still has positive impacts relative to cash for all households and all infra- or extra-marginality groupings. The model also predicts that cash recipients should purchase more non-food items than food recipients when food commodities are extra-marginal, but this prediction is not supported by the evidence. These gaps suggest that additional mechanisms remain to be explained by other dynamics, including the relative use of cash versus food for debts and gift-giving to smooth consumption over time.

While these specific results are unique to the context of Niger—characterized by extreme poverty and extraordinarily limited dietary diversity—the model, its principles, and predictions could be usefully applied elsewhere to examine the impacts of food versus cash transfers, and the importance of the content of the food basket, for differential impacts on consumption behavior.

The contribution of this paper is hence two-fold. First, it uses economic theory to build intuition on an important economic question. This is a theoretical contribution from the perspective of development microeconomics, and especially for the study of food security and food assistance. These results could also be used toward better design of food assistance programs. In particular, the results in Niger, while not applicable everywhere, can show us conditions under which food transfers—especially when providing a good of higher quality than poor recipients would otherwise consume—may have positive impacts on dietary diversity relative to cash. They also show the more generalizable result that providing a staple grain, especially one that is extra-marginal, will perform worse relative to cash toward dietary diversity outcomes.

The predictions of this model should be tested in other contexts, with different and various food commodities, in order to apply their intuition toward the decision to provide cash versus food and/or what foods to provide, particularly in light of dietary diversity objectives.

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Figure 1: The Southworth Theory on Food Versus In-Kind Transfers

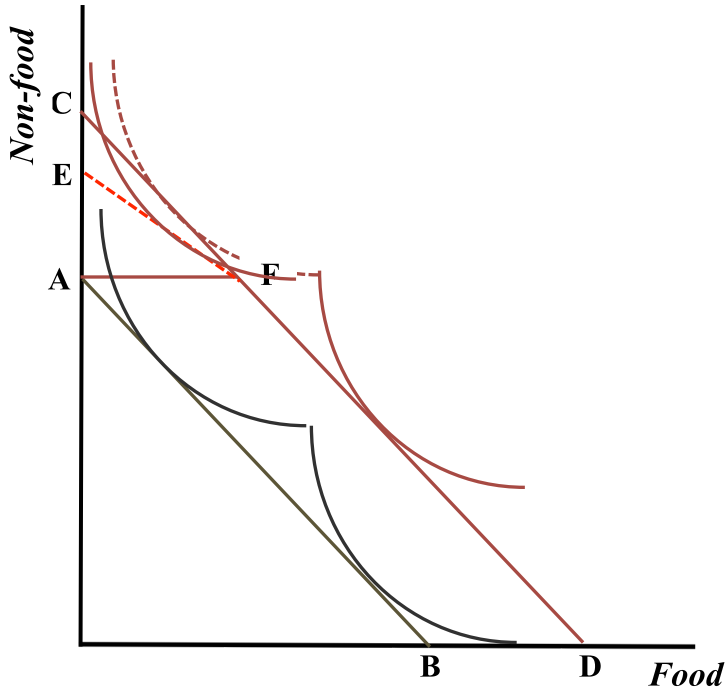
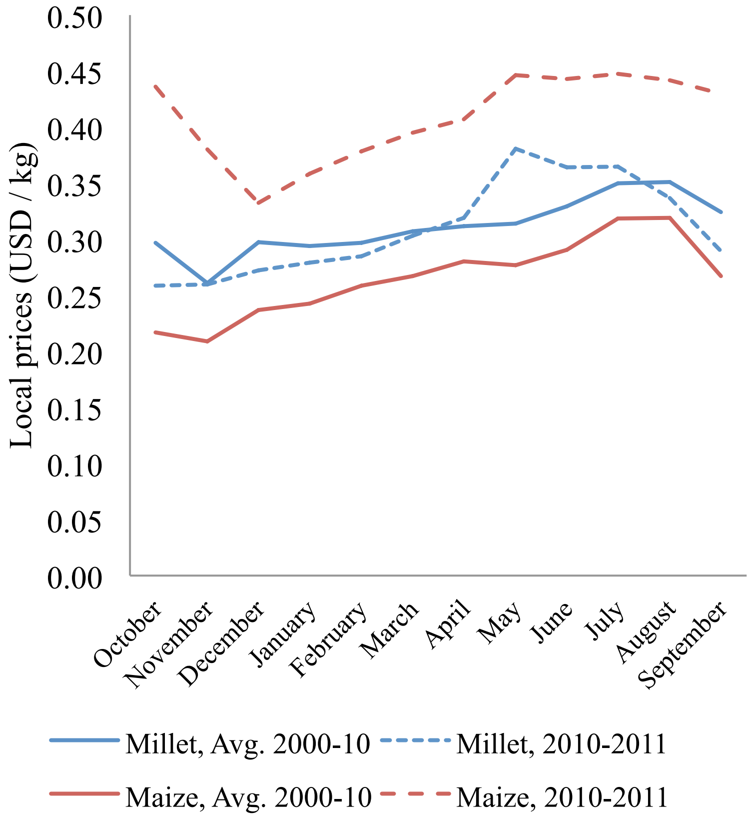


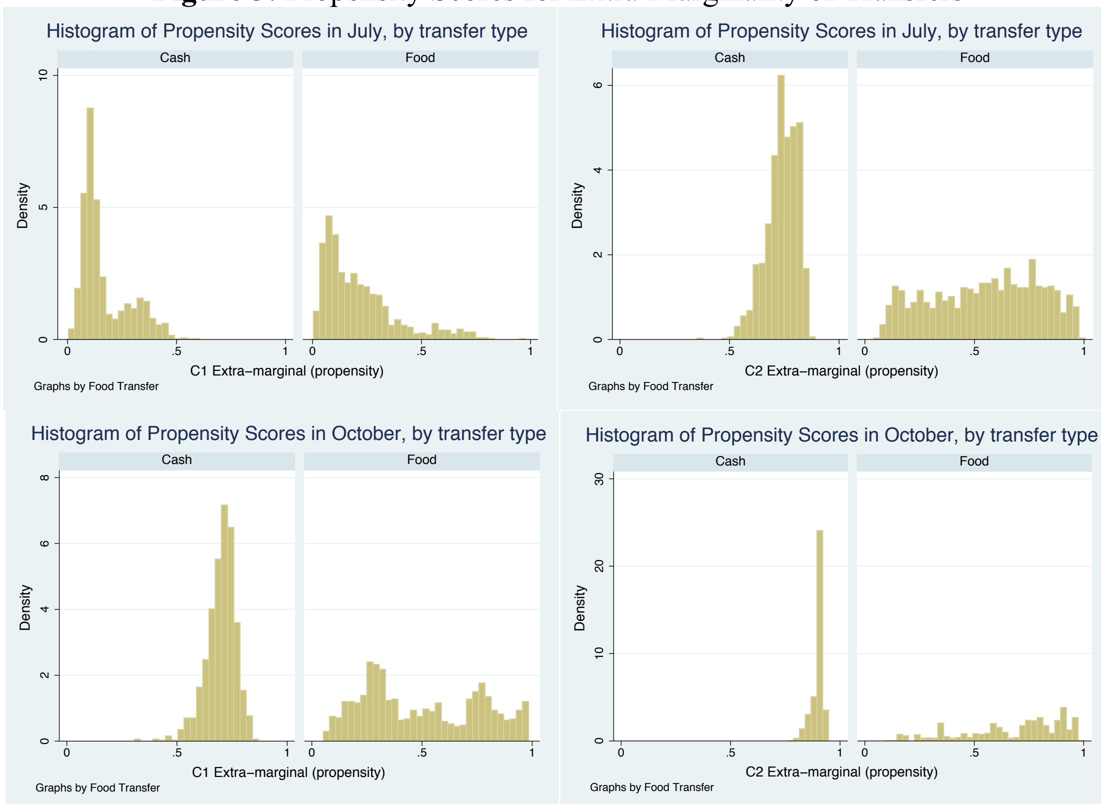
Figure 1: Analytics of cash versus food transfers. Line AB represents the household's initial budget line, with line CD representing the budget line when provided a cash transfer and line AFD representing the budget when provided with a food transfer (EFD in the case of food sales and transaction costs).

Figure 2: Harvest-to-harvest grain prices in Zinder (ten-year average & transfer year)



Data Source: National Statistics Office, Niger

Figure 3: Propensity Scores for Extra-Marginality of Transfers



Showing the predicted propensity to be extra-marginal in c1 (left), in July (top) and October (bottom), and separately the predicted propensity to be extra-marginal in c2 (right), in July (top) and October (bottom).

Propensity scores projected on entire sample, using Logit regressions on observed status for food recipients.

Table 1: T-tests on household and Village characteristics at baseline, by transfer type

	Household Level			Clustered at Worksite Level		
	CASH	FOOD	T-test p-value	CASH	FOOD	T-test p-value
Age of HH Head	48.37	48.47	0.878	47.61	47.87	0.856
Female HH Head	0.22	0.24	0.128	0.23	0.21	0.572
Heads with formal education	0.07	0.07	0.67	0.06	0.06	0.798
Household Size	7.47	7.23	0.081	7.41	7.17	0.447
Polygamous HH	0.15	0.17	0.116	0.15	0.17	0.276
Member of Ethnic Majority	0.91	0.89	0.06	0.91	0.87	0.386
Hausa	0.57	0.66	0	0.54	0.65	0.364
Asset Score (PCA), Baseline	-0.19	0.24	0	-0.15	0.22	0.123
Tropical Livestock Units, Baseline	0.83	1	0.078	1.07	1.17	0.781
Distance from village center (km)	0.45	0.32	0.001	0.37	0.37	0.987
Pastoral	0.42	0.38	0.047	0.44	0.44	0.975
Market in village	0.13	0.12	0.532	0.11	0.09	0.766
Time to reach market, if not in village (min)	56.88	65.42	0	56.16	68.84	0.351
Cereal bank in or near village	0.78	0.6	0	0.79	0.52	0.023
Distance to main road (km)	48	48	0.862	58	53	0.644
Zinder-Village Center distance (km)	58	52	0	58	53	0.395
Cell Phone Network in Village	0.95	0.93	0.082	0.87	0.96	0.24
Observations	1198	1070		27	25	

Table 2: Food consumption (and sources), with Cash / Food ttests, by round

	JULY				OCTOBER			
	All HHs	CASH	FOOD	P-value	All HHs	CASH	FOOD	P-value
Millet (any)	95%	96%	94%	0.018	98%	100%	95%	0
No. of Days Consumed	5.6	5.8	5.3	0	5.9	6.2	5.6	0
Purchased	74%	84%	62%	0	16%	23%	9%	0
Home-produced	19%	10%	28%	0	80%	76%	84%	0
Transfer	2%	1%	3%	0.001	0%	0%	1%	0.006
Sorghum (any)	51%	60%	41%	0	60%	36%	88%	0
No. of Days Consumed	2.1	2.5	1.6	0	2.7	1.3	4.2	0
Purchased	39%	53%	23%	0	13%	21%	4%	0
Home-produced	9%	6%	12%	0	10%	14%	6%	0
Transfer	2%	0%	5%	0	36%	0%	77%	0
Maize (any)	51%	18%	88%	0	11%	6%	17%	0
No. of Days Consumed	2.6	0.5	4.9	0	0.3	0.1	0.4	0
Purchased	10%	15%	6%	0	5%	5%	6%	0.913
Home-produced	0%	0%	0%	0.936	0%	0%	0%	0.255
Transfer	39%	2%	81%	0	5%	0%	11%	0
All Grain (any)	100%	100%	100%	0.345	100%	100%	100%	.
No. of Days Consumed	6.9	6.8	6.9	0	6.9	6.9	6.9	0
Purchased	88%	97%	78%	0	60%	70%	50%	0
Home-produced	22%	14%	31%	0	81%	77%	85%	0
Transfer	40%	3%	82%	0	38%	0%	81%	0
T1 Extra-Marginal		N/A	22%			N/A	50%	
Cowpeas (any)	68%	60%	76%	0	35%	6%	68%	0
No. of Days Consumed	1.9	1.5	2.3	0	0.9	0.2	1.8	0
Purchased	35%	52%	16%	0	1%	2%	1%	0.025
Home-produced	6%	6%	5%	0.267	3%	3%	3%	0.627
Transfer	26%	1%	54%	0	30%	1%	63%	0
Other Beans (any)	5%	2%	8%	0	7%	5%	10%	0
No. of Days Consumed	0.2	0.1	0.3	0	0.2	0.1	0.4	0
Purchased	1%	1%	1%	0.799	1%	2%	1%	0.005
Home-produced	0%	0%	0%	0.91	2%	3%	0%	0
Transfer	3%	1%	6%	0	4%	0%	9%	0
Tubers (any)	26%	31%	21%	0	31%	33%	28%	0.026
No. of Days Consumed	0.6	0.7	0.5	0	0.6	0.7	0.5	0.003
Purchased	25%	30%	20%	0	30%	31%	27%	0.049
Home-produced	0%	0%	0%	0.819	1%	1%	0%	0.082
All non-grain staples (any)	76%	71%	83%	0	59%	40%	81%	0
No. of Days Consumed	2.6	2.2	3.0	0	1.7	0.9	2.6	0
Purchased	62%	77%	45%	0	36%	40%	31%	0
Home-produced	6%	7%	6%	0.165	6%	7%	4%	0
Transfer	28%	1%	59%	0	34%	1%	72%	0
T2 Extra-Marginal		N/A	55%			N/A	69%	
Observations	2268	1198	1070		2209	1179	1030	

Table 3: Foods Received (percent), by Transfer Period

	July	October
Legume Received:		
Cowpeas	31.31	28.45
Lentils	13.93	23.4
Beans	54.77	48.16
Grain Received:		
Sorghum	56.26	94.17
Maize	43.74	5.83
Number of HHs	1070	1030

Table 4: OLS results on the Food Consumption Score, for ALL HOUSEHOLDS in JULY

	Food Dummy				Food Value, Total				Food Value, Separated			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Food Transfer	6.318**	4.921**	4.815**	3.427**								
	(2.558)	(2.165)	(2.013)	(1.428)								
Food X TransCost	0.952	1.215	1.278	0.872								
	(1.502)	(1.165)	(1.174)	(1.036)								
Food Transfer Value (ITT, Proj4)					0.185**	0.146**	0.147**	0.107**				
					(0.084)	(0.068)	(0.063)	(0.045)				
Food Value X TransCost					0.024	0.033	0.035	0.024				
					(0.048)	(0.036)	(0.036)	(0.031)				
Transfer Value, Grain (ITT)									-1.283**	-1.006	-0.661	-0.003
									(0.610)	(0.608)	(0.690)	(0.350)
c1 value X TransCost									-1.084**	-0.643	-0.821*	-0.508***
									(0.457)	(0.435)	(0.426)	(0.187)
Transfer Value, Other Foods (ITT, Proj4)									1.933**	1.518*	1.12	0.235
									(0.752)	(0.756)	(0.846)	(0.454)
c2 value X TransCost									1.412**	0.881	1.089**	0.682***
									(0.566)	(0.551)	(0.528)	(0.235)
Distance from village center (km)	-0.595	-0.293	-0.265	0.347	-0.593	-0.28	-0.233	0.368	-0.578	-0.289	-0.207	0.334
	(0.824)	(0.861)	(0.935)	(0.906)	(0.822)	(0.861)	(0.949)	(0.910)	(0.824)	(0.860)	(0.916)	(0.901)
Pastoral		3.796**	4.041**	1.097		3.955**	4.123**	1.122		2.514	3.265	0.794
		(1.808)	(1.815)	(2.398)		(1.805)	(1.857)	(2.409)		(2.284)	(2.015)	(2.318)
Household-level assets and controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Village-level prices and transaction costs	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Commune FEs	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes
No. of Households	2245	2242	2231	2231	2245	2242	2231	2231	2245	2242	2231	2231
R-Squared	0.047	0.18	0.201	0.313	0.039	0.176	0.199	0.312	0.076	0.195	0.206	0.313

*, **, and *** represent significance at the 10%, 5%, and 1% level, respectively

Household-level assets and controls (not shown) include: age of household head (years), female household head (dummy), head with formal education (dummy), household size, polygamous household, household is member of ethnica majority (dummy), Hausa (dummy), Asset score (PCA), TLU

Village-level prices (in CFA) and transaction costs include: Millet price, Change in millet price (over period), Cowpea price, Change in cowpea price (over period), Price of a cow, Change in price of cow (inter-seasonal), Price of goat, Change in price of goat (inter-seasonal), Market in village (dummy), Time to reach market if not in village (minutes), Cereal bank in or near village (dummy), Distance to main road (km), Cell phone network in village

Table 5: OLS results on the Food Consumption Score, for ALL HOUSEHOLDS in OCTOBER

	Food Dummy				Food Value, Total				Food Value, Separated			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Food Transfer	6.398***	5.752***	6.308***	4.856***								
	(2.006)	(1.635)	(1.407)	(1.025)								
Food X TransCost	-0.201	-0.318	-0.38	-0.25								
	(1.261)	(0.909)	(0.744)	(0.723)								
Food Transfer Value (ITT, Proj4)					0.181***	0.160***	0.187***	0.138***				
					(0.062)	(0.050)	(0.046)	(0.032)				
Food Value X TransCost					0	-0.004	-0.007	-0.001				
					(0.041)	(0.028)	(0.023)	(0.022)				
Transfer Value, Grain (ITT)									-1.242***	-1.246***	-1.663***	-1.300***
									(0.463)	(0.316)	(0.482)	(0.405)
c1 value X TransCost									0.447	0.495	0.511	0.742**
									(0.497)	(0.360)	(0.321)	(0.293)
Transfer Value, Other Foods (ITT, Proj4)									1.867***	1.829***	2.297***	1.823***
									(0.533)	(0.377)	(0.552)	(0.479)
c2 value X TransCost									-0.523	-0.584	-0.595	-0.854**
									(0.527)	(0.402)	(0.361)	(0.344)
Distance from village center (km)	1.151	1.565**	2.115***	2.474***	1.072	1.493**	2.041***	2.387***	1.155	1.565**	2.090***	2.506***
	(0.744)	(0.616)	(0.534)	(0.518)	(0.750)	(0.618)	(0.546)	(0.509)	(0.744)	(0.619)	(0.473)	(0.480)
Pastoral		5.314***	4.938**	12.616***		5.187***	4.766**	12.542***		5.537***	5.184***	10.764***
		(1.595)	(1.905)	(2.960)		(1.651)	(1.958)	(2.940)		(1.537)	(1.916)	(3.129)
Household-level assets and controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Village-level prices and transaction costs	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Commune FEs	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes
No. of Households	2076	2076	2055	2055	2076	2076	2055	2055	2076	2076	2055	2055
R-Squared	0.05	0.126	0.165	0.242	0.043	0.12	0.161	0.241	0.066	0.14	0.178	0.249

*, **, and *** represent significance at the 10%, 5%, and 1% level, respectively

See list of included controls in notes of Table 4.

Table 6: OLS Regression on FCS for ALL households with separated food values

	July				October			
	No Transaction Cost		Transaction Cost		No Transaction Cost		Transaction Cost	
Transfer Value, Sorghum (ITT)	-2.208***	-0.235	-1.969***	-0.113	-1.928*	-3.118***	-1.547	-3.011***
	(0.646)	(0.429)	(0.697)	(0.414)	(0.962)	(0.525)	(0.978)	(0.463)
Sorghum Value X TransCost			-0.919	-0.724*			0.581*	1.195***
			(0.636)	(0.428)			(0.345)	(0.270)
Transfer Value, Maize (ITT)	-1.931***	-0.277	-1.746***	-0.179	-1.937**	-2.758***	-1.741**	-2.723***
	(0.589)	(0.388)	(0.632)	(0.380)	(0.770)	(0.428)	(0.788)	(0.380)
Maize Value X TransCost			-0.792	-0.613			0.832**	1.231***
			(0.682)	(0.468)			(0.394)	(0.293)
Transfer Value, Cowpeas (ITT)	6.161***	5.462**	6.479***	5.072**	6.438	12.720***	4.83	11.615***
	(2.150)	(2.248)	(2.421)	(2.307)	(4.586)	(2.977)	(4.720)	(2.742)
Cowpea Value X TransCost			0.811	2.114			-3.489	-3.854***
			(2.210)	(1.866)			(2.186)	(1.222)
Transfer Value, Other Beans (ITT)	4.925**	2.511	5.071**	1.908	6.227	11.388***	4.887	10.168***
	(2.032)	(1.804)	(2.320)	(1.892)	(4.288)	(2.604)	(4.412)	(2.390)
Other Legume Value X TransCost			1.31	2.744			-3.075	-3.214***
			(2.427)	(1.874)			(2.051)	(1.101)
foodval_oil	5.514	-1.992	4.092	-1.883	2.549	0.024	2.857	1.459
	(3.973)	(2.226)	(4.587)	(2.296)	(2.903)	(2.434)	(3.119)	(2.193)
Oil Value X TransCost			3.154	0.235			1.001	-1.344
			(3.069)	(1.717)			(1.758)	(1.162)
Distance from village center (km)			-0.595	0.547			1.151	2.504***
			(0.825)	(0.937)			(0.745)	(0.497)
Pastoral		-5.168***		-2.114		9.435***		11.439***
		(1.892)		(3.982)		(2.526)		(3.289)
HH Controls & Assets	No	Yes	No	Yes	No	Yes	No	Yes
Village Prices & Transaction Costs	No	Yes	No	Yes	No	Yes	No	Yes
Commune FEs	No	Yes	No	Yes	No	Yes	No	Yes
No. of Households	2263	2257	2245	2242	2209	2206	2076	2076
R-Squared	0.065	0.322	0.071	0.323	0.067	0.232	0.074	0.252

*, **, and *** represent significance at the 10%, 5%, and 1% level, respectively
See list of included controls in notes of Table 4.

Table 7: OLS results on the Food Consumption Score, by sub-groups, in JULY												
	Group 2-1: Grain extra-marginal		Group 2-2: Legume extra-marginal		Group 4-1: Both goods infra-marginal		Group 4-2: Both goods extra-marginal		Group 4-3: Only grain extra-marginal		Group 4-4: Only legume extra-marginal	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Food Transfer Value (ITT, Proj4)	0.108		0.087*		0.159***		0.09		0.158		0.083	
	(0.066)		(0.048)		(0.057)		(0.075)		(0.101)		(0.050)	
Food Value X TransCost	-0.02		-0.02		0.058		-0.067		0.153		-0.025	
	(0.061)		(0.035)		(0.037)		(0.050)		(0.100)		(0.034)	
Transfer Value, Grain (ITT)		-0.794		-0.831*		0.961*		-0.767		-1.358**		-0.989*
		(0.571)		(0.473)		(0.563)		(0.727)		(0.618)		(0.514)
c1 value X TransCost		-0.888		-1.395***		0.058		-1.55		3.236*		-1.447***
		(1.010)		(0.389)		(0.366)		(1.793)		(1.800)		(0.404)
Transfer Value, Other Foods (ITT, Proj4)		1.13		1.152*		-0.8		1.037		1.873**		1.339**
		(0.741)		(0.578)		(0.677)		(0.908)		(0.846)		(0.625)
c2 value X TransCost		1.124		1.698***		0.055		1.919		-3.375		1.742***
		(1.340)		(0.498)		(0.453)		(2.390)		(2.208)		(0.514)
Distance from village center (km)	0.143	0.132	0.351	0.298	0.15	0.125	0.143	0.121	0.097	0.115	0.365	0.32
	(0.838)	(0.823)	(0.893)	(0.862)	(0.849)	(0.855)	(0.834)	(0.819)	(0.794)	(0.796)	(0.886)	(0.856)
Pastoral	2.07	1.287	-5.613**	-6.263***	20.869***	21.401***	-0.151	-0.166	-5.969	-6.536	-7.059***	-7.712***
	(2.876)	(2.675)	(2.387)	(2.011)	(3.238)	(3.330)	(3.111)	(3.121)	(5.208)	(5.355)	(2.517)	(2.151)
HH Controls & Assets	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Village Controls & Transaction Costs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Commune FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Households	1396	1396	1756	1756	1575	1575	1331	1331	1230	1230	1590	1590
R-Squared	0.261	0.263	0.308	0.314	0.284	0.286	0.246	0.249	0.254	0.255	0.307	0.314

*, **, and *** represent significance at the 10%, 5%, and 1% level, respectively

See list of included controls in notes of Table 4.

Table 8: OLS results on the Food Consumption Score, by sub-groups, in OCTOBER

	Group 2-1: Grain extra-marginal		Group 2-2: Legume extra-marginal		Group 4-1: Both goods infra-marginal		Group 4-2: Both goods extra-marginal		Group 4-3: Only grain extra-marginal		Group 4-4: Only legume extra-marginal	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Food Transfer Value (ITT, Proj4)	0.055		0.099***		0.248***		0.058		0.098		0.117**	
	(0.035)		(0.033)		(0.057)		(0.038)		(0.080)		(0.053)	
Food Value X TransCost	-0.033		-0.005		0.022		-0.022		-0.15		0.001	
	(0.024)		(0.023)		(0.025)		(0.024)		(0.095)		(0.023)	
Transfer Value, Grain (ITT)		-1.342***		-1.599***		-0.501		-1.487***		-1.572*		-1.956***
		(0.412)		(0.417)		(0.629)		(0.450)		(0.891)		(0.570)
c1 value X TransCost		0.670**		0.811***		0.051		0.431*		2.185**		1.216*
		(0.291)		(0.232)		(0.516)		(0.238)		(0.956)		(0.672)
Transfer Value, Other Foods (ITT, Proj4)		1.696***		2.100***		1.125		1.888***		2.022*		2.542***
		(0.496)		(0.502)		(0.696)		(0.535)		(1.011)		(0.674)
c2 value X TransCost		-0.807**		-0.944***		-0.019		-0.528**		-2.698**		-1.418*
		(0.339)		(0.264)		(0.591)		(0.245)		(1.090)		(0.790)
Distance from village center (km)	2.245***	2.335***	2.340***	2.458***	2.208***	2.222***	2.232***	2.323***	2.055***	2.087***	2.282***	2.341***
	(0.434)	(0.415)	(0.487)	(0.459)	(0.495)	(0.479)	(0.427)	(0.405)	(0.419)	(0.406)	(0.514)	(0.485)
Pastoral	12.816***	12.205***	14.566***	12.749***	10.801***	12.028***	14.005***	14.767***	1.01	0.028	10.338**	5.565
	(2.966)	(3.060)	(3.185)	(2.860)	(3.908)	(3.887)	(3.779)	(3.316)	(3.086)	(3.172)	(4.186)	(5.822)
HH Controls & Assets	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Village Controls & Transaction Costs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Commune FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Households	1562	1562	1743	1743	1290	1290	1471	1471	1160	1160	1341	1341
R-Squared	0.19	0.197	0.236	0.246	0.271	0.272	0.206	0.213	0.2	0.204	0.245	0.257

*, **, and *** represent significance at the 10%, 5%, and 1% level, respectively

See list of included controls in notes of Table 4.

Table 9: OLS Regression on FCS for ALL households with extra-marginality propensity scores

	JULY		OCTOBER	
	(1)	(2)	(3)	(4)
Food Transfer Value (ITT, Proj4)	-0.178		-0.778*	
	(0.243)		(0.423)	
Food Value X c1-Extra (pscore)	0.642**		0.193	
	(0.283)		(0.328)	
Food Value X c2-Extra (pscore)	0.223		0.805	
	(0.344)		(0.593)	
Food Value X c1-Extra (pscore) X TransCost	0.455*		-0.199**	
	(0.235)		(0.091)	
Food Value X c2-Extra (pscore) X TransCost	-0.126		0.132**	
	(0.079)		(0.060)	
Transfer Value, Grain (ITT)		0.612		-0.297
		(1.012)		(1.009)
c1 Value X c1-Extra (pscore)		0.763		-6.191***
		(2.470)		(1.783)
c1 Value X c2-Extra (pscore)		-1.69		2.771
		(1.657)		(1.662)
c1 value X TransCost		0.636		-0.186
		(0.839)		(0.910)
c1 Value X c1-Extra (pscore) X TransCost		5.971*		6.257**
		(3.329)		(2.828)
c1 Value X c2-Extra (pscore) X TransCost		-3.086*		-3.555
		(1.841)		(2.504)
Transfer Value, Other Foods (ITT, Proj4)		-1.226		-0.905
		(1.158)		(2.627)
c2 Value X c1-Extra (pscore)		0.392		8.032***
		(2.781)		(2.065)
c2 Value X c2-Extra (pscore)		2.666		-2.228
		(1.809)		(2.768)
c2 value X TransCost		-0.398		0.211
		(0.947)		(1.037)
c2 Value X c1-Extra (pscore) X TransCost		-6.114		-7.598**
		(3.940)		(3.283)
c2 Value X c2-Extra (pscore) X TransCost		3.064		4.314
		(2.212)		(2.916)
C1 Extra-marginal (propensity)	-7.694	-7.26	-13.614	-17.340*
	(7.414)	(7.416)	(9.209)	(8.680)
C2 Extra-marginal (propensity)	-4.798	-5.887	-26.649	-17.289
	(9.520)	(10.294)	(18.512)	(32.235)
Distance from village center (km)	0.405	0.11	2.196***	2.428***
	(0.864)	(0.828)	(0.384)	(0.391)
Pastoral	-6.169*	-5.316*	8.148**	9.560**
	(3.624)	(3.133)	(3.920)	(3.691)
HH Controls & Assets	Yes	Yes	Yes	Yes
Village Controls & Transaction Costs	Yes	Yes	Yes	Yes
Commune FEs	Yes	Yes	Yes	Yes
No. of Households	2081	2081	1891	1891
R-Squared	0.326	0.331	0.251	0.264

Table 10: OLS Regression on Total Non-Food Expenditure for ALL households with extra-marginality propensity scores

	JULY		OCTOBER	
	(1)	(2)	(3)	(4)
Food Transfer Value (ITT, Proj4)	0.522**		0.295	
	(0.198)		(0.426)	
Food Value X c1-Extra (pscore)	-0.343		-0.035	
	(0.301)		(0.378)	
Food Value X c2-Extra (pscore)	-0.641**		-0.361	
	(0.295)		(0.399)	
Food Value X c1-Extra (pscore) X TransCost	-0.151		0.162	
	(0.115)		(0.099)	
Food Value X c2-Extra (pscore) X TransCost	0.084**		-0.086	
	(0.033)		(0.081)	
Transfer Value, Grain (ITT)		-1.953*		-0.886
		(1.152)		(1.267)
c1 Value X c1-Extra (pscore)		-2.722		-1.786
		(1.842)		(1.886)
c1 Value X c2-Extra (pscore)		3.358		0.867
		(2.035)		(2.212)
c1 value X TransCost		0.31		-1.15
		(0.825)		(1.285)
c1 Value X c1-Extra (pscore) X TransCost		3.158		-7.335
		(2.767)		(5.855)
c1 Value X c2-Extra (pscore) X TransCost		-1.658		7.817*
		(1.514)		(4.632)
Transfer Value, Other Foods (ITT, Proj4)		3.601***		3.977
		(1.291)		(2.937)
c2 Value X c1-Extra (pscore)		2.533		2.187
		(2.499)		(2.254)
c2 Value X c2-Extra (pscore)		-5.566**		-4.483
		(2.468)		(3.639)
c2 value X TransCost		-0.426		1.059
		(0.982)		(1.282)
c2 Value X c1-Extra (pscore) X TransCost		-4.133		8.453
		(3.377)		(6.841)
c2 Value X c2-Extra (pscore) X TransCost		2.272		-8.642
		(1.883)		(5.367)
C1 Extra-marginal (propensity)	19.383***	17.974**	1.201	2.26
	(6.468)	(7.077)	(16.131)	(16.646)
C2 Extra-marginal (propensity)	10.093	16.211**	9.525	46.550**
	(7.935)	(7.310)	(14.579)	(22.125)
Distance from village center (km)	-0.845**	-0.731**	0.076	0.341
	(0.356)	(0.355)	(0.350)	(0.291)
Pastoral	-2.998	-2.877	2.544	5.326
	(2.026)	(2.080)	(3.150)	(3.603)
HH Controls & Assets	Yes	Yes	Yes	Yes
Village Controls & Transaction Costs	Yes	Yes	Yes	Yes
Commune FEs	Yes	Yes	Yes	Yes
No. of Households	2085	2085	1891	1891
R-Squared	0.206	0.212	0.295	0.3

Table 11: OLS Regression on FCS, for single-adult households

	July				October			
	Food Values		Propensity Scores		Food Values		Propensity Scores	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Food Transfer Value (ITT, Proj4)	0.142*		0.354		0.181***		-1.167*	
	(0.071)		(0.574)		(0.053)		(0.585)	
Food Value X TransCost	-0.036				0.021			
	(0.071)				(0.033)			
Food Value X c1-Extra (pscore)			0.966**				0.175	
			(0.451)				(0.516)	
Food Value X c2-Extra (pscore)			-0.592				1.25	
			(0.769)				(0.763)	
Food Value X c1-Extra (pscore) X TransCost			0.475				-0.166	
			(0.455)				(0.139)	
Food Value X c2-Extra (pscore) X TransCost			-0.151				0.144*	
			(0.165)				(0.084)	
Transfer Value, Grain (ITT)		-0.865		-2.969		-1.740***		-5.830***
		(0.726)		(2.228)		(0.381)		(1.981)
c1 value X TransCost		0.959*		-7.835		1.581*		14.963*
		(0.543)		(5.632)		(0.824)		(7.703)
c1 Value X c1-Extra (pscore)				12.418**				-5.54
				(5.403)				(3.860)
c1 Value X c2-Extra (pscore)				-0.454				9.662***
				(3.813)				(3.444)
c1 Value X c1-Extra (pscore) X TransCost				20.174***				11.834
				(6.760)				(11.863)
c1 Value X c2-Extra (pscore) X TransCost				0.804				-26.658*
				(6.392)				(14.928)
Transfer Value, Other Foods (ITT, Proj4)		1.345		4.028		2.439***		8.712**
		(0.863)		(2.528)		(0.431)		(3.918)
c2 value X TransCost		-1.287*		9.59		-1.762*		-16.586**
		(0.704)		(7.168)		(0.948)		(7.158)
c2 Value X c1-Extra (pscore)				-11.604*				6.604
				(6.023)				(4.959)
c2 Value X c2-Extra (pscore)				-0.619				-13.336***
				(4.403)				(4.805)
c2 Value X c1-Extra (pscore) X TransCost				-24.158***				-12.745
				(8.142)				(11.939)
c2 Value X c2-Extra (pscore) X TransCost				-1.202				29.440**
				(8.105)				(13.501)
C1 Extra-marginal (propensity)			-4.325	0.359			-17.876	-16.036
			(11.415)	(10.738)			(16.326)	(20.109)
C2 Extra-marginal (propensity)			18.688	16.436			-47.152*	28.171
			(21.395)	(21.715)			(23.491)	(35.516)
Distance from village center (km)	1.436	1.319	0.684	0.899	1.617**	1.826**	0.991	1.424*
	(2.024)	(1.975)	(1.988)	(2.075)	(0.756)	(0.816)	(0.939)	(0.845)
Pastoral	4.129	0.753	-13.003	-17.938**	15.311***	8.566	4.576	10.087
	(4.670)	(5.272)	(8.904)	(7.477)	(4.241)	(7.152)	(6.495)	(8.079)
HH Controls & Assets	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Village Controls & Transaction Costs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Commune FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Households	473	473	394	394	434	434	343	343
R-Squared	0.334	0.34	0.355	0.378	0.287	0.305	0.324	0.355

*, **, and *** represent significance at the 10%, 5%, and 1% level, respectively

Single-adult households are defined as female-headed households with no other adult women (co-spouses) present, and households with the head absent during the transfer period.

See list of included controls in notes of Table 4.

Table 12: OLS Regression on Total Non-Food Expenditure for ALL households with extra-marginality propensity scores				
	JULY		OCTOBER	
	(1)	(2)	(3)	(4)
Food Transfer Value (ITT, Proj4)	0.522**		0.295	
	(0.198)		(0.426)	
Food Value X c1-Extra (pscore)	-0.343		-0.035	
	(0.301)		(0.378)	
Food Value X c2-Extra (pscore)	-0.641**		-0.361	
	(0.295)		(0.399)	
Food Value X c1-Extra (pscore) X TransCost	-0.151		0.162	
	(0.115)		(0.099)	
Food Value X c2-Extra (pscore) X TransCost	0.084**		-0.086	
	(0.033)		(0.081)	
Transfer Value, Grain (ITT)		-1.953*		-0.886
		(1.152)		(1.267)
c1 Value X c1-Extra (pscore)		-2.722		-1.786
		(1.842)		(1.886)
c1 Value X c2-Extra (pscore)		3.358		0.867
		(2.035)		(2.212)
c1 value X TransCost		0.31		-1.15
		(0.825)		(1.285)
c1 Value X c1-Extra (pscore) X TransCost		3.158		-7.335
		(2.767)		(5.855)
c1 Value X c2-Extra (pscore) X TransCost		-1.658		7.817*
		(1.514)		(4.632)
Transfer Value, Other Foods (ITT, Proj4)		3.601***		3.977
		(1.291)		(2.937)
c2 Value X c1-Extra (pscore)		2.533		2.187
		(2.499)		(2.254)
c2 Value X c2-Extra (pscore)		-5.566**		-4.483
		(2.468)		(3.639)
c2 value X TransCost		-0.426		1.059
		(0.982)		(1.282)
c2 Value X c1-Extra (pscore) X TransCost		-4.133		8.453
		(3.377)		(6.841)
c2 Value X c2-Extra (pscore) X TransCost		2.272		-8.642
		(1.883)		(5.367)
C1 Extra-marginal (propensity)	19.383***	17.974**	1.201	2.26
	(6.468)	(7.077)	(16.131)	(16.646)
C2 Extra-marginal (propensity)	10.093	16.211**	9.525	46.550**
	(7.935)	(7.310)	(14.579)	(22.125)
Distance from village center (km)	-0.845**	-0.731**	0.076	0.341
	(0.356)	(0.355)	(0.350)	(0.291)
Pastoral	-2.998	-2.877	2.544	5.326
	(2.026)	(2.080)	(3.150)	(3.603)
HH Controls & Assets	Yes	Yes	Yes	Yes
Village Controls & Transaction Costs	Yes	Yes	Yes	Yes
Commune FEs	Yes	Yes	Yes	Yes
No. of Households	2085	2085	1891	1891
R-Squared	0.206	0.212	0.295	0.3

*, **, and *** represent significance at the 10%, 5%, and 1% level, respectively
See list of included controls in notes of Table 6.

Table 13: OLS Regression on FCS, for single-adult households

	July				October			
	Food Values		Propensity Scores		Food Values		Propensity Scores	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Food Transfer Value (ITT, Proj4)	0.142*		0.354		0.181***		-1.167*	
	(0.071)		(0.574)		(0.053)		(0.585)	
Food Value X TransCost	-0.036				0.021			
	(0.071)				(0.033)			
Food Value X c1-Extra (pscore)			0.966**				0.175	
			(0.451)				(0.516)	
Food Value X c2-Extra (pscore)			-0.592				1.25	
			(0.769)				(0.763)	
Food Value X c1-Extra (pscore) X TransCost			0.475				-0.166	
			(0.455)				(0.139)	
Food Value X c2-Extra (pscore) X TransCost			-0.151				0.144*	
			(0.165)				(0.084)	
Transfer Value, Grain (ITT)		-0.865		-2.969		-1.740***		-5.830***
		(0.726)		(2.228)		(0.381)		(1.981)
c1 value X TransCost		0.959*		-7.835		1.581*		14.963*
		(0.543)		(5.632)		(0.824)		(7.703)
c1 Value X c1-Extra (pscore)				12.418**				-5.54
				(5.403)				(3.860)
c1 Value X c2-Extra (pscore)				-0.454				9.662***
				(3.813)				(3.444)
c1 Value X c1-Extra (pscore) X TransCost				20.174***				11.834
				(6.760)				(11.863)
c1 Value X c2-Extra (pscore) X TransCost				0.804				-26.658*
				(6.392)				(14.928)
Transfer Value, Other Foods (ITT, Proj4)		1.345		4.028		2.439***		8.712**
		(0.863)		(2.528)		(0.431)		(3.918)
c2 value X TransCost		-1.287*		9.59		-1.762*		-16.586**
		(0.704)		(7.168)		(0.948)		(7.158)
c2 Value X c1-Extra (pscore)				-11.604*				6.604
				(6.023)				(4.959)
c2 Value X c2-Extra (pscore)				-0.619				-13.336***
				(4.403)				(4.805)
c2 Value X c1-Extra (pscore) X TransCost				-24.158***				-12.745
				(8.142)				(11.939)
c2 Value X c2-Extra (pscore) X TransCost				-1.202				29.440**
				(8.105)				(13.501)
C1 Extra-marginal (propensity)			-4.325	0.359			-17.876	-16.036
			(11.415)	(10.738)			(16.326)	(20.109)
C2 Extra-marginal (propensity)			18.688	16.436			-47.152*	28.171
			(21.395)	(21.715)			(23.491)	(35.516)
Distance from village center (km)	1.436	1.319	0.684	0.899	1.617**	1.826**	0.991	1.424*
	(2.024)	(1.975)	(1.988)	(2.075)	(0.756)	(0.816)	(0.939)	(0.845)
Pastoral	4.129	0.753	-13.003	-17.938**	15.311***	8.566	4.576	10.087
	(4.670)	(5.272)	(8.904)	(7.477)	(4.241)	(7.152)	(6.495)	(8.079)
HH Controls & Assets	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Village Controls & Transaction Costs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Commune FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Households	473	473	394	394	434	434	343	343
R-Squared	0.334	0.34	0.355	0.378	0.287	0.305	0.324	0.355

*, **, and *** represent significance at the 10%, 5%, and 1% level, respectively

Single-adult households are defined as female-headed households with no other adult women (co-spouses) present, and households with the head absent during the transfer period.

See list of included controls in notes of Table 6.