DIFFERENTIAL NUTRITIONAL RESPONSES ACROSS VARIOUS INCOME SOURCES AMONG EAST AFRICAN PASTORALISTS: INTRAHOUSEHOLD EFFECTS, MISSING MARKETS AND MENTAL ACCOUNTING

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Abstract

In this paper we explore the nutrition-income relationship for pastoralist households in East Africa. Previous estimates of income elasticities of nutritional demand have ranged from zero to close to unity. However, these estimates are always based on nutrition's relationship with total income. One possible reason for this wide range is that nutrition may respond differently to different sources of income if, for example, agents engage in "mental accounting", the practice of treating distinct income sources as not fully fungible. Estimating income-nutrition elasticities with total income may mask these differential responses and result in very different income elasticity estimates depending on which income source changes. Using dietary diversity as a measure of dietary quality, we find that differential dietary responses across income sources do exist among the pastoralist households studied. Possible explanations for this result are market failures for certain commodities, intrahousehold bargaining and mental accounting. Tests show that neither market failures nor intrahousehold bargaining fully account for the differential responses observed. Thus it appears that mental accounting indeed plays some part in explaining the nutritional patterns evident in this sample.

I. Introduction

The field of development economics is largely devoted to exploring ways of combating poverty, along with its many adverse effects. In countries at all levels of development, the food insecurity and low nutrient intake of the poor have occupied a central place in the study of poverty. Until recent decades, it was generally thought that the most effective way to combat hunger and malnutrition was through economic growth and, more specifically, raising the incomes of the poor. Conventional wisdom has held that while nutrient intake may not rise one for one with income, the income elasticity of nutrient demand is still substantially greater than zero.

In the last few decades however, some studies have challenged this idea arguing that increases in income will not produce substantial improvements in nutritional well-being (Behrman and Deolalikar 1990, Behrman and Deolalikar 1989, Behrman and Deolalikar 1987, Behrman et al. 1988, Bouis 1994, Bouis and Haddad 1992). If this claim holds true, then it has significant implications for how economists and policymakers think about the effects of economic growth and development on hunger, malnutrition and household food security.

Traditionally it has been thought that the low nutrient intake of the poor is largely due to low income. Substantial resources have therefore been devoted to income growth programs aimed at improving nutrition in poor communities. However, despite many studies on the subject, there is still little agreement over the extent to which the nutritional status of the poor responds to changes in their income. Studies examining this matter often look at the intake changes of specific nutrients, particularly calories, in relation to changes in some measure of income. The scope of the debate on this relationship ranges from studies arguing that the calorie-income curve is essentially flat (Behrman and Deolalikar 1990, Behrman and Deolalikar 1987, Bouis 1994, Bouis and Haddad 1992, Wolfe and Behrman 1983) to the other extreme

where studies have estimated income elasticities of caloric demand close to one (Pitt 1983, Strauss 1984). Other studies find a concave or elbow-shaped calorie-income curve (Ravallion 1990, Strauss and Thomas 1995, Strauss and Thomas 1990, Subramanian and Deaton 1996). These latter findings indicate that among the very poor, nutritional intakes would increase with income up to a certain level, after which the nutrient-income elasticity would decline, possibly to zero.

A number of reasons have been proposed for the wide range of estimates of the nutrient-income elasticity for poor households.[1] However, the vast majority of studies on this matter have not considered the possibility that nutrition may respond differently to different sources of income. To our knowledge, studies have thus far only explored the nutrition-income relationship using total income. Yet, there are reasons to believe that where income comes from may change how it is used in the household. These reasons include intrahousehold dynamics, market imperfections or missing markets for certain goods, and mental accounting. Thus nutritional status may have differential responses to changes in different income sources. Therefore the impact of income on nutrition might be more appropriately evaluated with income disaggregated into different sources.

The rest of this paper explores the possibility of differential nutritional responses to changes in various income sources. Section II briefly reviews evidence thus far for the existence of differential responses and reasons why they might occur, such as intrahousehold dynamics, market imperfections and mental accounting.

[1] Behrman and Deolalikar (1987) argue that an aggregation bias resulting from common methods of inferring nutrient intake cause and upward bias in nutrient-income elasticity estimates. Bouis and Haddad (1992) claim that estimates are often overestimated due to 'wastages and leakages' often unobserved by common data collection methods as well as because of correlated measurement errors between explanatory and dependent variables. A number of other studies also point to non-linearities in the relationship between nutrient intake and income that are often unaccounted for in functional forms modeling this relationship (Ravallion 1990, Strauss and Thomas 1995, Strauss and Thomas 1990, Subramanian and Deaton 1996).

Section III develops an empirical model of nutrition allowing for differential responses of nutrition across various income sources. Section IV describes the data set used for this paper and the setting from which it comes. Section V describes the econometric specifications used for estimation. Section VI discusses the estimation results and tests for differential responses of dietary diversity to different income sources. Possible explanations for differential responses are tested for in Section VII. Finally Section VIII concludes.

II. Differential Nutritional Responses across Income Sources

There is evidence that changes in certain sources of income may impact food intake differently than changes in other sources A number of studies have found intrahousehold dynamics of resource control and allocation cause different sources of income to impact expenditure patterns and activities differently (Breunig and Dasgupta 2005, Haddad et al. 1996). Other studies have found differential expenditure responses to changes in various income sources that were seemingly due to mental accounting (Duflo and Udry 2004, Hoffmann 2007, Kooreman 2000, O'Curry 1997).[2] Differential nutritional responses to income sources may also result due to the failure or absence of markets for certain home-produced goods (de Janvry et al. 1991).

Intrahousehold Distributional Effects

Intrahousehold dynamics might cause household consumption to respond differently to changes in different sources of income due to differences in preferences and resource control across various household members. Income sources typically controlled by household members more concerned with diet and nutrition may have a

[2] For a good discussion of mental accounting of some of the literature on it see Thaler (1999).

very different impact on household food intake than other income sources controlled by members less interested in nutrition. A number of studies have found that household resources and extra income controlled by women are typically more likely to be allocated towards the production of nutrition than those of men.[3]

Empirical studies have found that households in the United States exhibit a higher marginal propensity to consume food out of food stamps than out of cash income, even when households are unconstrained,[4] implying that food stamp income has a different impact on household consumption than cash income (Breunig and Dasgupta, 2005). Breunig and Dasgupta (2005) conjecture that this discrepancy is driven primarily by intrahousehold distribution effects. If so, then one would expect multiple-adult households to exhibit this behavior but not single-adult households. Studying households in San Diego, Breunig and Dasgupta (2005) find that single-adult households show no difference in their marginal propensity to consume food out food stamp or cash income, while multiple-adult households have an approximately six to eight times higher marginal propensity to consume food out of food stamp income than cash income. The authors interpret this economically and statistically significant difference as supporting their intrahousehold hypothesis.

Market Failures and Missing Markets

Household specific market failures, or missing markets in an extreme case, for particular commodities may also cause varying expenditure responses to different income sources. Selective market failures for certain home-produced goods may result when household transaction costs associated with market participation for those goods increase to the point where those goods are rendered non-tradable for the

[3] For a review of this literature see Haddad et al. (1996).
[4] A household is unconstrained if it receives food stamps and but also spends a positive amount of cash income on food.

household in question. This then induces such households to be autarkic producers and consumers of those particular goods. Thus increases in household production of those goods would increase consumption of just those goods, but have little to no impact on other household consumption goods. For example, if market failures cause a household to be an autarkic producer and consumer of maize, then marginal increases in maize production would increase household maize consumption but have no substantial impact on household education expenditures. Thus, household-specific missing markets or market failures may cause expenditure activities to respond differently to changes in different sources of income (de Janvry et al. 1991).

Mental Accounting

Finally, households may spend various income sources differently due to what behavioral economists refer to as mental accounting. One component of mental accounting is that income is not fungible across different sources as standard economic theory assumes. Instead, people may assign certain expenditure activities, implicitly or explicitly, to specific 'mental' accounts funded by different sources of income. Thus changes in income and wealth in one mental account, such as a windfall, are not perfect substitutes for income changes in another account, such as wages for labor.

Instances of mental accounting are fairly well documented in consumer behavior in developed countries and in experimental economics.[5] However, studies explicitly testing for mental accounting in developing countries are scarce. In a study conducted in Uganda, Hoffmann (2007) found that households who received insecticide-treated mosquito nets were more likely to use them for household members most vulnerable to the effects of malaria. Alternatively, if households received cash to

[5] For a review of the literature on mental accounting see Thaler (1999).

purchase the nets on site, the nets were much more likely to be used by main income-earners in the household. Duflo and Udry (2004) found evidence of mental accounting in the expenditure patterns of households in Cote d'Ivoire. They found that yam cultivation, which is typically male-controlled, had a strong positive association with spending on household public goods and basic necessities, such as education, food staples, and overall food consumption. They also found that changes in income from male non-yam crops and female cultivated crops were strongly associated with the consumption of adult and prestige goods (tobacco, alcohol, jewelry, adult clothing and non-staple foods). Furthermore, increases in yam income were associated with decreases in spending on adult and prestige goods, whereas increases in income from male non-yam crops resulted in decreases in spending on food.

Factors associated with intrahousehold dynamics, missing markets and mental accounting could all cause differential nutritional responses across various income sources. With this in mind, it would be prudent to test the appropriateness of nutrition demand models using aggregated income as an explanatory variable rather than disaggregated income. Instead of looking at nutritional responses to changes in total income, it might by more appropriate to explore which income sources appear to be important to food expenditures and what are the nutritional responses to changes in different income components.

III. Model

The focus of this paper is to discover whether households exhibit differential nutritional responses to various sources of income. Previous studies in the development literature examining the nutrition-income relationship have assumed

equivalent income elasticities of nutrition across various income sources. A common functional form in this literature follows the log-linear equation:

$$(1) \qquad \ln N_{ivt} = \alpha + \beta \ln Y_{ivt} + \sum_{j=1}^{J} \delta^{j} \ln P_{vt}^{j} + \sum_{f=1}^{F} \gamma^{f} H_{ivt}^{f} + \sum_{c=1}^{C} \theta^{c} V_{vt}^{c} + \mu_{iv} + \varepsilon_{ivt}$$

where

i is an index for the individual,

v indexes the village or location,

t indexes the time period,

N is some measure of level of nutrition,

Y is income,

P is the price of food commodity *j*,

H is household specific characteristic *k*,

V is village or location specific characteristic *c*,

μ is unobserved individual specific effects and

ε is the disturbance term.

This model has been modified to allow for variations in nutrition-income elasticities across levels of income (Strauss and Thomas 1990, Subramanian and Deaton 1996). However studies modifying this model to allow for nutrition-income elasticities to vary across income sources are scarce.[6] If households do in fact have different nutrition elasticities with respect to different income sources, then estimated nutrition elasticities with respect to total income may be misleading.

[6] The only study we am aware of that allows nutritional responses to vary across income sources is Duflo and Udry (2004).

To illustrate, say a household earns income from two different sources, Y_1 and Y_2. Suppose the household uses income Y_2 primarily for food purchases and income Y_1 mostly for other expenditure activities and rarely for food expenditures. Suppose further that the nutrition elasticity with respect to Y_2 is positive while that with respect to Y_1 is zero. Say this household experiences a large increase in Y_1 and a very small increase in Y_2. Consequently the household experiences a large increase in total income but a very small increase in food expenditures, resulting in an estimated nutrition elasticity with respect to total income that is close to zero. This result masks the positive nutrition elasticity with respect to Y_2. On the other hand, if the large increase in total income was primarily due to an increase in Y_2, then a larger positive total income elasticity of nutrition would be estimated masking the zero nutrition elasticity with respect to Y_1. Either case could lead to mistargeted income growth programs concerned with nutrition.

The nutrition literature has estimated nutrition-income elasticities ranging from near zero (Behrman and Deolalikar 1990, Behrman and Deolalikar 1987, Bouis 1994, Bouis and Haddad 1992, Wolfe and Behrman 1983) to almost one (Pitt 1983, Strauss 1984). One possible explanation for this wide range of estimates is not accounting for the possibility of differential nutritional responses to changes in various income sources. The assumption that income elasticities of nutrition are equivalent across income sources has not been tested to date.

To explicitly test the assumption of equivalent nutrition elasticities we disaggregate income by source in (1) to get the following:

$$(2) \qquad \ln N_{ivt} = \alpha + \sum_{k=1}^{K} \beta^k \ln Y_{ivt}^k + \sum_{j=1}^{J} \delta^j \ln P_{vt}^j + \sum_{f=1}^{F} \gamma^f H_{ivt}^f + \sum_{c=1}^{C} \theta^c V_{vt}^c + \mu_{iv} + \varepsilon_{it}$$

where *k* indexes income sources and

(3) $Y_{ivt} = Y_{ivt}^1 + Y_{ivt}^2 + Y_{ivt}^3 + ... + Y_{ivt}^k$.

Using (2) we can test the null hypothesis

(4) H_0: $\beta^1 = \beta^2 = \beta^3 = ... = \beta^\kappa$

H_A: $\beta^m \neq \beta^n$ where $m \neq n$, $1 \leq m \leq k$ and $1 \leq n \leq k$

A rejection of the null hypothesis would indicate that there exist differential nutritional responses to different income sources and thus (1) is not an appropriate model for estimating nutrition elasticities with respect to income.

However this model is only adequate if the composition of income is similar among households at different levels of wealth. There is substantial evidence that nutrition income elasticities vary at different levels of wealth. Therefore if there are systematic differences in the income composition between poor and rich households, which are not controlled for explicitly, and these are related to patterns of income earning, then a rejection of the above null hypothesis may just be picking up differences in income-nutrition elasticities at various levels of wealth as opposed to differences due to income source. Therefore (2) must be further modified to allow for non-linearities in the relationship between the nutrition-income elasticity and income level.

To allow income elasticities to differ over different levels of income, dummy variables indicating the income quantile to which the household belongs are included in the model as both intercept shifters as well as interacted with income and price variables to allow for income and price elasticities to change with the level of income.[7] This gives us the following equation

[7] As another way of capturing these effects, Strauss and Thomas (1990) proposed a few functional forms of log-inverse log models that seemed to work well. However these models are problematic if

$$(5)\ \ln N_{ivt} = \sum_{l=1}^{L} Q_l[\alpha_l + \sum_{k=1}^{K} \beta_l^k \ln Y_{ivtl}^k + \sum_{j=1}^{J} \delta_l^j \ln P_{vtl}^j] + \sum_{f=1}^{F} \gamma^f H_{ivt}^f + \sum_{c=1}^{C} \theta^c V_{vt}^c + \mu_{iv} + \varepsilon_{it}$$

where Q is an indicator variable equal to one if the individual *i* belongs to income quantile *l* and *l = 1, 2, 3,…L*. This gives *L* testable hypothesis.

(6) $H_{10}: \beta^{11} = \beta^{12} = \beta^{13} = ... = \beta^{1k}$

$H_{1A}: \beta^{1m} \neq \beta^{1n}$ where $m \neq n$, $1 \leq m \leq k$ and $1 \leq n \leq k$

$H_{20}: \beta^{21} = \beta^{22} = \beta^{23} = ... = \beta^{2k}$

$H_{2A}: \beta^{2m} \neq \beta^{2n}$ where $m \neq n$, $1 \leq m \leq k$ and $1 \leq n \leq k$

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$H_{L0}: \beta^{L1} = \beta^{L2} = \beta^{L3} = ... = \beta^{Lk}$

$H_{LA}: \beta^{Lm} \neq \beta^{Ln}$ where $m \neq n$, $1 \leq m \leq k$ and $1 \leq n \leq k$

Equation (5) allows for different income and price elasticities of nutrition at different levels of income and also controls for the possibility for differential nutritional responses due to wealth differentials as opposed to income source differentials. A rejection of the null hypotheses in hypothesis (6) indicates that nutritional status does not respond equivalently to changes in different sources of income for individuals in that income quantile. This would indicate that a model using

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there are a number of observations where the log of income is between 0 and 1. Since in this paper, income is disaggregated there are many zero observations for each income source variable. This proved to be problematic when working with the log-inverse functional forms proposed by Strauss and Thomas (1990).

aggregated income as an explanatory variable is less appropriate than one in which income is disaggregated.

IV. Data and Setting

The data for this paper come from a comprehensive set of panel data collected by the USAID Global Livestock Collaborative Research Support Program (GL CRSP) project "Improving Pastoral Risk Management on East African Rangelands" (PARIMA). Households were surveyed in five locations in southern Ethiopia and six in northern Kenya[8], all in one livestock production and marketing region (Barrett et al. 2008). In total, 337 households are included in the data.[9] In each household the household head was surveyed along with up to two adult, non-head household members. Only household heads are included in this particular study. Surveys were conducted in March 2000 for baseline information and then quarterly from June 2000 to June 2002, resulting in 10 quarterly observations for each household.[10] Survey intervals were chosen to correspond to the bimodal rainfall patterns of the study region. Further details on these data are provided in Barrett *et al.* (2008).

The baseline survey gives information on individual and household characteristics such as household size, sex, age and education. The repeated surveys provide information on income earned from various sources such as trade, wages and salary, crop value, and remittances. They also report households' livestock holdings, trade, and production.

[8] The six study locations in Kenya were Dirib Gumbo, Kargi, Logologo, Ng'ambo, North Horr, and Sugata Marmar. In Ethiopia the study sites were Dida Hara, Dillo, Finchawa, Qorate, and Wachille.
[9] Due to some issues of attrition, interruption and missing observations of particular variables for certain individuals or communities the number of observations per survey period ranges from 186 to 303. Also, due to some known measurement error, the top and bottom 5% of observations over the observed income distribution were deleted from the study.
[10] The baseline survey in March 2000 did not provide dietary information or information on income over the quarter. Therefore this study included only 9 quarterly observations from June 2000 to June 2002 and information from the March 2000 survey was only used for baseline information on the household.

While a number of households are involved in activities such as trade, wage labor, or, to a very limited extend, crop cultivation, primary economic activities for most households in the area are centered on livestock. Pastoralism allows households to be opportunistic in the arid and semi-arid lands of the study region where uncertain rainfall makes primary production risky (Coppock, 1994). Only six households in the data do not own livestock over the study period. Mean annual rainfall in the study area is just around 400mm, making crop cultivation difficult. Therefore, pastoralist households rely chiefly on livestock for income. Average household herd size in the data is 12.10 tropical livestock units (TLU).[11] Production of livestock products makes up roughly 48% of all income earned in the study area over the survey period. Livestock trade is 17%, wages and salary is 11%, net remittances if 16%, non-farm non-livestock trade and business make up 5%, and crop value comprises only 2% of all income earned in the study area. Table 1 summarizes aggregated and disaggregated income in the study population.

In order to estimate equation (3) and control for the possibility of wealth differentials causing income elasticities to differ between income sources, the sample is broken up into three income terciles based on households' mean intertemporal income. Table 2 describes income and its composition for the lower, middle, and upper terciles. The percentage shares of total income for trade and business, livestock trade, and crop value do not change substantially across income terciles. The income share of wages and salary increase somewhat from 5% and 4% in the lower and middle terciles, respectively, to 11% in the upper tercile. The value of livestock products produced increases from 35% in the lower tercile to 49% in the middle and upper terciles. The most drastic difference across income terciles is the in the share of

[11] TLU is a standard measure for aggregating herd size across various species. 1 cattle = 1 TLU, 1 camel = 0.7 TLU, and 1 sheep or goat = 0.1 TLU.

remittances in total household income. Net remittances make up, on average, 41% of total household income in the lower tercile but only 26% and 17% in the middle and upper terciles, respectively. Table 3 provides summary statistics only for period-specific observations in which the household reported strictly positive income earnings for the particular income being described.

The repeated surveys also ask individuals to recall their own food and beverage consumption over the past 24-hours. This information was used to calculated dietary diversity measures for each individual in each period. Dietary diversity is defined here as the number of unique food and drink items consumed over the recall period. For example, if an individual consumed three helpings of maize, one helping of beans, and two helpings of tea with milk, his dietary diversity count would be 4. Mean dietary diversity in the sample population is 3.14 and median dietary diversity is 3. Maize, tea and especially milk are by far the most consumed items in the study area.

V. Econometric Specification

In order to test for differential nutritional responses to changes in different income sources, equation (5) is estimated using dietary diversity as a measure of nutritional status. Studies on the income-nutrition relationship have often used nutrient intake or nutrient availability[12] as a measure of nutritional status. However both of these measures are subject to a number of quantitative and qualitative problems.[13] In reaction to these problems, dietary diversity has been proposed as a potential alternative indicator of dietary quality and food security (Arimond and Ruel

[12] Nutrient availability is measured using food expenditures, indicating the amount of nutrients available to be consumed based on food purchases.
[13] See Strauss and Thomas (1995) and Hoddinott and Yohannes (2002) for a discussion of these problems.

2004, Hatloy et al. 1998, Hoddinott and Yohannes 2002, Ogle et al. 2001, Onyango et al. 1998, Ruel 2002, Ruel 2003, Torheim et al. 2004). While the PARIMA data do not have good nutrient intake or availability information, they do have good data on dietary diversity.

Dietary diversity is here defined as the number of unique food and drink items consumed over a 24-hour recall period.[14] Lack of dietary diversity is especially problematic in poor communities in developing countries. Through improved micronutrient acquirement, a diverse diet has long been associated with enhanced nutritional status. Indeed, a number of studies have come out recently showing dietary diversity to be highly correlated with dietary quality and nutrient adequacy (Arimond and Ruel 2004, Hatloy et al. 1998, Hoddinott and Yohannes 2002, Ogle et al. 2001, Onyango et al. 1998, Torheim et al. 2004). Studies have also found a consistent and positive association between child growth and dietary diversity (Arimond and Ruel 2004, Onyango et al. 1998). Dietary diversity is unlikely to suffer from the same measurement errors and bias problems that have been problematic in many of the more conventional measures of nutritional status (Hoddinott and Yohannes 2002, Strauss and Thomas 1995). Consequently dietary diversity shows much promise as an indicator of dietary quality and is used here as the dependent variable in equation (5).

On the right-hand side of the equation (5), income is disaggregated into six different sources: income earned from non-farm and non-livestock trade and business such as from crafts, firewood and water; income earned from wages and salary; income earned from livestock trade; the value of livestock products produced; the value of crops harvested; and net remittances, which includes the value of cash and in-kind gifts as well as of food aid.[15] Village level food prices included in the model are

[14] Dietary diversity can also be defined as the number of unique food groups an individual consumes over the recall period. Recall periods can vary.
[15] For details on how each income source was constructed see Barrett *et al.* (2008)

those for maize and tea. Maize and tea are by far the most important food staples in the study region (other than milk which is mostly home produced since only a few households do not own livestock). Age, education, gender and household size are included as controls for individual- and household-level characteristics. To control for time-invariant village or location specific characteristics, regional dummy variables are included for 10 of the 11 locations.

VI. Estimation Results

In this section equation (5) is estimated using a random effects generalized least squares estimator. Since the discrete nature of dietary diversity would cause heteroskedasticity, White's correction for heteroskedasticity was used. Hypothesis (6) is then tested using a Wald test. A rejection of the null hypotheses in (6) indicates that different income sources have differential effects on individual nutritional status. Once differential effects are established, possible explanations for this result are then tested.

Full Sample Tests for Differential Effects

Full regression results are reported in the Appendix as A1 and A2. Table 4 reports the income and price elasticities estimated from equation (5) with income disaggregated. It also includes estimated elasticities from equation (1) with aggregated income as the explanatory variable. What is immediately striking is that the estimated income elasticities on both aggregated and disaggregated income are small relative to the estimated price elasticities. The estimated total income elasticities of dietary diversity is 0.072 for the lower tercile, 0.063 for the middle tercile and 0.035 for the upper tercile, each significant at the one percent, one percent and five percent levels, respectively. Price elasticities, on the other hand, are much higher in

magnitude. The relatively higher estimated price elasticities likely points to issues of market access. There is very little intertemporal variation in the prices measured. Most variation occurs cross-sectionally. It therefore appears that improving market access may have substantial nutritional benefits for individuals in the study locations.

Despite the small magnitude of estimated income elasticities, the estimated source-specific income elasticities appear, statistically, quite different from each other and from those estimated for total income. For the lower tercile, income elasticities for income from wages and salary and remittances are not statistically different from zero. Income elasticities for income from livestock trade and livestock products are both significant at the 10% level. The elasticity with respect to non-farm and non-livestock trade and business income is significant at the one percent level and that with respect to crop value is significant at the five percent level. The dietary diversity of individuals in the lower tercile appears to have the largest positive response to changes in income from trade and business and livestock trade with income elasticities of dietary diversity of 0.020 and 0.010, respectively. Lower tercile individuals' dietary diversity appears to have a negative response to changes in crop value with a statistically significant income elasticity of -0.025. As explained earlier, the arid and semi-arid lands of the study region are not well suited to crop production. It is likely that households in the lower tercile are cultivating crops out of necessity and desperation, hence the negative sign on this elasticity estimate. In the sample, crop value has a statistically significant negative correlation of –0.086 and –0.268 with trade and business income and remittances, respectively. Both of these income sources have higher estimated elasticities of dietary diversity than other sources of income. Although the estimated income elasticity for remittances in not significant at the 10% level, it is significant at the 15% level, albeit with a very low point estimate of 0.01. Therefore unless these households are cultivating a variety of crops it is

unlikely that increases in crop value will increase their dietary diversity. In fact of the 38 observations that reported positive crop values in the lower tercile, 22 of those observations had a dietary diversity of only one.[16]

Income sources that appear to be the most important to the dietary diversity of individuals in the middle tercile are crop value and remittances. The estimated elasticity with respect to crop value is 0.020 and is significant at the five percent level and that with respect to remittances is 0.025 and is significant at the one percent level. Elasticities estimated with respect to other income sources were not statistically different from zero for individuals in the middle tercile. For individuals in the upper tercile, statistically significant income elasticities were those with respect to non-farm, non-livestock trade and business, wages and salary, and remittances with trade and business and remittances having a relatively larger influence over dietary diversity.

Estimated tea price elasticities were –0.209 in the lower tercile and –0.337 in the middle tercile, each significant at the one percent level. The estimated tea price elasticity for the upper tercile was -0.092, however it was not statistically significantly different from zero. As would be expected, the upper tercile is less price elastic than the other terciles. The middle tercile, however, is more price elastic than the lower.

Unlike the tea price elasticities, which had the expected negative sign, the estimated maize price elasticities were positive, although they were not significantly different from zero for the lower and middle terciles. Given the prominence of maize as a dietary staple in all of the study locations, the positive estimated elasticities are likely due to a substitution effect. Rising maize prices will cause individuals to decrease their consumption of the staple good, maize, and to substitute it with other

[16] A dietary diversity of one means that the individual only consumed one type of food or drink item over the 24-hour recall period. However, they could have consumed that food or drink item multiple times during that period.

foods. Unless individuals completely eliminate maize from their diet then this substitution effect would cause dietary diversity to increase.

There do seem to be differences in the relative magnitudes and significance of the estimated income elasticities for the various income sources. In addition, the impacts of individual income sources on dietary diversity appear different from the impact of aggregated income. However, we must test statistically for differences in dietary diversity responses to changes in various sources of income, particularly since the estimated income elasticities are very low.

A Wald test of hypothesis (6) rejects the equality of income source elasticities for each income tercile. Equivalent income source elasticities is rejected at the at the 5% level for the lower tercile and the 10% level for the middle and upper terciles with test statistics of $\chi^2(5) = 11.77$, 10.46, and 10.01, respectively. Differential responses of dietary diversity towards different income sources are thus confirmed statistically. The next step then is to explore possible explanations for this result.

VII. Possible Explanations for Differential Responses

As discussed earlier, three possible explanations for this result exist in the literature: missing markets for certain home produced commodities, intrahousehold dynamics of resource control and allocation, and mental accounting. There is no way to explicitly test for mental accounting as the cause of the differential responses. However, missing markets and intrahousehold effects can be tested directly as explanations. If both fail to account to account for the differential responses of dietary diversity to various income sources, then mental accounting is left as the residual explanation.

Missing Markets and Non-Tradable Goods

Almost all households in the study area own livestock and thus produce milk. However, income earned from livestock products, which include milk production, appears to be less important to dietary diversity than other income sources. The estimated elasticity with respect to livestock production income is not statistically different from zero for the middle and upper terciles and is only 0.008 for the lower tercile. Given the prominence of livestock products as an income source in this population (livestock products make up 34%, 48% and 49% of income in the lower, middle and upper terciles, respectively) one would expect it to play a larger role in the provision of basic necessities such as food, outside of milk.

A possible reason behind this result is that many pastoralist households might not participate in markets for livestock products, rendering those goods non-tradable. If the transaction costs associated with market-based exchange induce the household to be an autarkic milk producer and consumer, any increased income from production of that non-tradable good necessarily expands only the quantity of milk that household consumes, not the variety of foods it consumes. Therefore production of milk and other livestock products may do little to enhance dietary diversity.

In order to test the possibility that household-specific non-tradable home-produced goods causes the deferential dietary diversity responses observed in the full sample, equation (5) was re-estimated using just the sub-sample of observations where households recorded positive milk sales, as opposed to just positive milk production. Those who sell milk necessarily treat milk as tradable. By focusing only on these observations, we excluded any household-period observations for which milk might have been non-tradable. In addition, positive milk sales indicate that households participated in a more formal market setting in settlements where they were not only

able to participate in the market for milk but also would have the opportunity to participate in markets for other goods as well.

Restricting the sample resulted in a much smaller data subset. The milk market sub-sample has only 327 of the full sample's 2,089 observations covering only 127 households as opposed to 318 households in the full sample. The small sample size was too restrictive to estimate equation (5) controlling for the different income quantiles. Therefore, in order to conserve degrees of freedom, equations (1) and (2) were estimated, with dummy variables for the middle and upper tercile left in as intercept shifters only. There are no systematic differences in the income composition between the three income terciles in this sub-sample.

Descriptive statistics on the milk market sample can be found in Tables (5) and (6), where Table (6) provides descriptive statistics only on households in the sample that earned positive amounts of the particular source of income being described. In addition to pooling the income terciles, the seasonal dummy variables were dropped to conserve degrees of freedom. The seasonal variables were not statistically significant and are adequately represented by the average rainfall variable. Dropping the seasonal dummy variables did not substantially change the estimated parameters but it did increase the precision of the estimates.

Table (7) reports parameter estimates for the milk market sub-sample. In the aggregated income model, equation (1), the total income elasticity of dietary diversity is 0.042 and is not statistically significant at standard levels ($p = 0.110$). When income is disaggregated and equation (2) is estimated with the milk market sub-sample, the estimated income elasticities again differ by source as well as from the total income elasticity. Income from remittances and livestock trade appear to be most important to dietary diversity in this sample. The dietary diversity elasticity with respect to remittances is statistically significant at the five percent level with a value of

0.021. The elasticity with respect to livestock trade is only just significant at the 10% level with a magnitude of 0.009. Other income source elasticities are not statistically significantly different from zero. However, this might be due to the small sub-sample size. As can be seen in Table (6), of the 311 observations in this sub-sample only livestock products and remittances have more than 200 observations of positive reported earnings. Only 154 observations reported positive earnings in trade and business and 126 in livestock trade. There were very few income earners in wages and salary and crops with only 22 and 21 observations reporting positive earnings in those income sources, respectively.

Although livestock products make up a large portion of the income earned in the sub-sample, its estimated elasticity is not only not statistically significant, it is also negative. Livestock product income is negatively correlated with remittances in this sample. Thus even though the sample has been restricted such that milk is necessarily treated as tradable, livestock product income still has little, and possibly negative, effect on dietary diversity. The large standard errors of some of the elasticity estimates are likely due to the small size of the milk market sub-sample.

A Wald Test testing the equivalence of income source elasticities only weakly fails to reject the null hypothesis in hypothesis (1) with a test statistic of $\chi^2(5) = 8.99$ and a p-value of 0.1097. Based on the value of their estimated elasticities, income sources that appear important to dietary diversity in the full sample, namely remittances and trade and business, also appear to be important in the milk market sub-sample. Additionally, the relative differences between the estimated elasticities in the milk market sub-sample are as large as those in the full sample. However the standard errors are also relatively larger in the milk market sample than in the full sample. This combined with the loss of degrees of freedom may contribute to the Wald Test's failure to reject the null hypothesis of equality of income source

elasticities. Therefore, although the Wald Test fails to reject the null hypothesis of equivalent income elasticities across income sources, it does so very weakly and there still seems to be evidence that dietary diversity does respond differently to changes in different income sources. However, missing markets may at least partly explain the differential dietary diversity responses observed in the full sample.

Intrahousehold Bargaining and Resource Allocation

Many pastoralist households in the study region practice polygamy. In addition, households also often include extended family members such as parents, siblings of the household head or his spouse(s), and adult children. Therefore intrahousehold processes of bargaining and resource allocation could provide a reasonable explanation for the differential responses of dietary diversity to different income sources. In such households, preferences surely vary among members. So if different income sources are associated with different household members, it would result in the differential dietary responses across income sources that we find.

In order to test for intrahousehold effects as the cause for differential responses, a method similar to that performed by Breunig and Dasgupta (2005) was adopted. Breunig and Dasgupta (2005) restricted their analysis to single-adult households in order to test whether intrahousehold effects cause cash income to impact household consumption differently than food stamp income. We likewise restrict the data to households where the household head was unmarried. Since many households also house extended family members the sample was further restricted to households in which the household head was single and the oldest non-head household member was no older than 10 years less than the age of the head. By restricting the sub-sample to only households with one adult, this necessarily excludes any

households that are affected by processes of intrahousehold bargaining, since only one member in the household has any significant bargaining power.[17]

Due to the culture of the area the vast majority of the households in the single-adult sub-sample are female-headed households. In fact, there are just 13 observations on only two male-headed households included in the single adult sub-sample. The female household heads in the sub-sample are often widowed or divorced and almost half of the observations in this sub-sample are in the lower income tercile.

Summary statistics on this sub-sample are provided in Tables 8 and 9. Table 9 provides descriptive statistics on households in this sub-sample that reported positive earnings of the particular income described. As with the milk market sub-sample, limiting the data to only single adult households resulted in a much smaller sub-sample and was too restrictive on degrees of freedom to control for income terciles. The single adult sub-sample has only 508 of the 2089 observations in the full sample and only 75 of the 318 households in the full sample. Therefore, again to preserve degrees of freedom, equations (2) and (1) were estimated in which the income terciles are pooled.

Table 10 reports parameter estimates for equations (2) and (1) using the single adult sub-sample. In the aggregated income model, the total income elasticity of dietary diversity is 0.054 and is statistically significant at the one percent level. But as with the milk market sub-sample and full sample, certain income sources appear to be more important to dietary diversity than others when income is disaggregated and equation (2) is estimated with the single adult sub-sample. The most influential income sources on dietary diversity are trade and business and wages and salary, with statistically significant estimated elasticities of 0.014 and 0.017, respectively. Other

[17] This of course assumes that children have no substantial or systematic bargaining power over resource allocation within the household. While we cannot test this assumption, we feel safe in making it.

income source elasticities are not statistically different from zero. A Wald Test again rejects the null hypothesis of equal income elasticities of dietary diversity across income sources at the 10% level with a test statistic of $\chi^2(5)=9.68$ ($p = 0.0847$). Thus, even after controlling for intrahousehold effects, there still exist differential responses of dietary diversity to changes in various sources of income.

VIII. Conclusion

We find evidence of differential dietary diversity responses to changes in various income sources. The differential impacts of various income sources on dietary diversity persist after controlling for intrahousehold effects as a possible explanation. Thus intrahousehold processes of resource control and allocation fail to fully account for this result. Statistical tests failed to fully reject household-specific missing markets as an explanation for the differential effects. However, the failure to reject was weak and there still appears to be evidence of differential effects after controlling for missing markets. Thus both intrahousehold effects and market failures appear unable to fully account for the differential responses of dietary diversity across income sources. This leaves mental accounting as the residual explanation.

For the most part, research on the nutrition-income relationship in developing countries has investigated the nutritional impacts of changes in total household income. However, where income comes from may change how it is used in the household. Therefore, it may be more accurate to examine the impact of different sources of income on nutritional status rather than merely aggregate income. If income source matters to how households respond nutritionally to changes in income, then this has important implications for how the relationship between income and nutrition is assessed. Income generating programs concerned with the food intake of poor households may be ineffective, or even counter productive, if they are not

targeting appropriate income sources. Recognizing and better understanding the consumption behavior of poor households as it relates to various sources of income could substantially improve policy targeting and development efforts on the whole. Treating all income equally may lead to inadequate assessments of income-consumption relationships.

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Table 1: Full Sample Summary Statistics

N=2089

Groups=318

	Proportion of Total Income	*Mean*	*Standard Deviation*	*Min*	*Max*
Total Income	1.00	7417.92	7433.77	380	34233.79
Trade and Business	0.06	409.94	1470.14	0	27000
Wages and Salary	0.06	826.19	3608.95	0	30000
Livestock Trade	0.13	1250.43	2745.27	0	30000
Livestock Products	0.44	3556.13	5237.63	0	32850
Crop Value	0.02	160.52	1194.36	0	25080
Remittances	0.29	1214.70	1779.28	0	28463.9
Herd Size (TLU)		12.16	18.01	0	269.93
Dietary Diversity		3.17	1.50	1	8

Table 2: Full Sample Summary Statistics by Income Tercile

	N	*% of Household Income*	*Mean*	*Standard Deviation*	*Min*	*Max*
Lower Tercile	698					
Total Income		1.00	3160.63	2637.04	400	19601.38
Trade and Business		0.06 (0.17)	189.45	635.82	0	5700
Wages and Salary		0.05 (0.16)	143.95	740.26	0	15000
Livestock Trade		0.11 (0.25)	572.34	1489.84	0	10407.52
Livestock Products		0.34 (0.38)	1105.66	1758.93	0	19601.38
Crop Value		0.02 (0.13)	86.43	454.04	0	6004
Remittances		0.41 (0.38)	1062.81	1364.58	0	13182.44
Middle Tercile	700					
Total Income		1.00	6195.45	5680.39	380	33705.5
Trade and Business		0.05 (0.14)	260.02	970.71	0	12690
Wages and Salary		0.03 (0.13)	215.31	1134.87	0	18000
Livestock Trade		0.15 (0.27)	1437.09	3140.20	0	30000
Livestock Products		0.48 (0.37)	3056.51	3961.43	0	25374.25
Crop Value		0.02 (0.11)	156.71	1045.73	0	18120
Remittances		0.27 (0.32)	1069.80	1853.37	0	28463.9
Upper Tercile	691					
Total Income		1.00	12956.72	8771.47	515	34233.79
Trade and Business		0.07 (0.17)	784.55	2228.20	0	27000
Wages and Salary		0.11 (0.25)	2134.16	5915.43	0	30000
Livestock Trade		0.14 (0.23)	1746.29	3134.93	0	17135.27
Livestock Products		0.49 (0.34)	6537.57	6982.94	0	32850
Crop Value		0.02 (0.09)	239.22	1728.83	0	25080
Remittances		0.17 (0.23)	1514.93	2021.01	0	15976.88

Table 3: Full Sample Summary Statistics on Positive Income Earners

	N	*% of Household Income*	*Mean*	*Standard Deviation*	*Min*	*Max*
Lower Tercile						
Total Income	698	1.00	3160.63	2637.04	400	19601.38
Trade and Business	137	0.29 (0.27)	965.24	1147.85	18.20	5700
Wages and Salary	91	0.37 (0.27)	1104.15	1780.98	30	15000
Livestock Trade	152	0.53 (0.28)	2628.23	2192.35	247	10407.52
Livestock Products	387	0.62 (0.29)	1994.18	1951.94	136.88	19601.38
Crop Value	37	0.47 (0.33)	1630.43	1184.93	29.42	6004
Remittances	550	0.52 (0.35)	1348.80	1406.28	10	13182.44
Middle Tercile						
Total Income	700	1.00	6195.45	5680.39	380	33705.5
Trade and Business	167	0.19 (0.23)	1089.89	1748.68	10	12690
Wages and Salary	88	0.27 (0.25)	1712.71	2784.56	50	18000
Livestock Trade	214	0.49 (0.26)	4700.76	4116.62	300	30000
Livestock Products	539	0.62 (0.30)	3969.49	4093.7	127.75	25374.25
Crop Value	47	0.35 (0.28)	2334.02	3380.07	29.42	18120
Remittances	499	0.38 (0.32)	1500.72	2042.88	1.49	28463.9
Upper Tercile						
Total Income	691	1.00	12956.72	8771.47	515	34233.79
Trade and Business	284	0.17 (0.23)	1908.88	3154.57	20	27000
Wages and Salary	156	0.48 (0.48)	9453.25	9280.99	36	30000
Livestock Trade	291	0.33 (0.33)	4146.68	3659.96	300	17135.27
Livestock Products	586	0.58 (0.58)	7708.98	6961.88	12.78	32850
Crop Value	36	0.31 (0.31)	4591.76	6194.06	160	25080
Remittances	554	0.22 (0.22)	1889.56	2094.56	11.86	15976.88

Table 4: Full Sample Elasticity Estimates

N=2089

Groups=318

	Lower		*Middle*		*Upper*	
	Elasticity	*Standard Error*	*Elasticity*	*Standard Error*	*Elasticity*	*Standard Error*
Disaggregated Income Model						
Trade & Business	0.020***	0.006	0.004	0.006	0.011***	0.004
Wages & Salary	0.007	0.007	0.010	0.006	0.007**	0.003
Livestock Trade	0.010*	0.005	0.005	0.004	-0.003	0.003
Livestock Products	0.008*	0.005	0.007	0.005	0.003	0.004
Crop Value	-0.025**	0.013	0.020**	0.009	0.007	0.011
Remittances	0.011	0.007	0.025***	0.007	0.013**	0.006
Tea Price	-0.209***	0.067	-0.337***	0.085	-0.092	0.079
Maize Price	0.060	0.058	0.029	0.043	0.091*	0.047
Aggregated Income Model						
Aggregated Income	0.072***	0.021	0.063***	0.016	0.035**	0.017
Tea Price	-0.238***	0.062	-0.270***	0.084	-0.076	0.080
Maize Price	0.105**	0.054	0.076**	0.037	0.122**	0.043

***, ** and * significant at the one, five and ten percent level, respectively

Table 5: Milk Market Sub-Sample Summary Statistics

	N	*% of Household Income*	*Mean*	*Standard Deviation*	*Min*	*Max*
Lower Tercile	74					
Total Income		1.00	3839.32	2376.25	475.45	12141.47
Trade and Business		0.02 (0.08)	90.55	323.50	0	1799
Wages and Salary		0.00 (0.01)	6.76	46.14	0	380
Livestock Trade		0.10 (0.20)	515.35	1111.26	0	4500
Livestock Products		0.64 (0.30)	2416.99	1754.88	0	7278.93
Crop Value		0.01 (0.03)	22.68	137.64	0	918.33
Remittances		0.24 (0.25)	786.99	870.53	0	3596.24
Middle Tercile	82					
Total Income		1.00	8208.03	5930.26	805.94	33705.5
Trade and Business		0.05 (0.10)	408.69	767.77	0	3599
Wages and Salary		0.01 (0.06)	168.93	792.42	0	5661.9
Livestock Trade		0.16 (0.25)	1821.00	3341.54	0	16100
Livestock Products		0.57 (0.29)	4541.06	3724.89	0	18250
Crop Value		0.03 (0.14)	178.35	799.54	0	4845
Remittances		0.17 (0.21)	1090.00	1535.22	0	8348.16
Upper Tercile	155					
Total Income		1.00	14592.85	7957.63	1115.82	34224
Trade and Business		0.09 (0.15)	1168.16	2073.92	0	13398.3
Wages and Salary		0.03 (0.12)	552.36	2780.00	0	24000
Livestock Trade		0.11 (0.18)	1565.38	2608.95	0	12500
Livestock Products		0.63 (0.29)	9676.16	7408.42	0	32850
Crop Value		0.02 (0.09)	333.80	1746.81	0	17864.4
Remittances		0.12 (0.16)	1296.99	1623.12	0	9487.73

Table 6: Milk Market Sub-Sample Summary Statistics on Positive Income Earners

	N	*% of Household Income*	*Mean*	*Standard Deviation*	*Min*	*Max*
Lower Tercile						
Total Income	74	1.00	3839.32	2376.25	475.45	12141.47
Trade and Business	10	0.15 (0.18)	670.03	646.09	35.80	1799
Wages and Salary	2	0.07 (0.05)	250	183.85	120	380
Livestock Trade	19	0.38 (0.23)	2007.17	1359.25	358.02	4500
Livestock Products	67	0.70 (0.23)	2669.51	1649.83	475.45	7278.93
Crop Value	2	0.23 (0.02)	839.17	111.96	760.00	918.33
Remittances	59	0.30 (0.25)	987.07	867.71	44.66	3596.24
Middle Tercile						
Total Income	82	1.00	8208.03	5930.26	805.94	33705.5
Trade and Business	37	0.11 (0.13)	905.75	929.30	39	3599
Wages and Salary	5	0.23 (0.14)	2770.38	1925.27	260	5661.9
Livestock Trade	32	0.42 (0.24)	4666.32	3933.18	400	16100
Livestock Products	80	0.59 (0.28)	4654.58	3700.13	380	18250
Crop Value	7	0.33 (0.39)	2089.24	1993.07	75	4845
Remittances	66	0.21 (0.21)	1354.25	1604.28	1.49	8348.16
Upper Tercile						
Total Income	155	1.00	14592.85	7957.63	1115.82	34224
Trade and Business	107	0.13 (0.16)	1692.19	2313.80	39	13398.3
Wages and Salary	15	0.28 (0.27)	5707.69	7313.39	100	24000
Livestock Trade	75	0.23 (0.20)	3235.11	2947.95	350	12500
Livestock Products	147	0.67 (0.26)	10202.76	7244.48	302.94	32850
Crop Value	12	0.24 (0.21)	4311.58	4899.91	459.17	17864.4
Remittances	122	0.15 (0.16)	1647.82	1664.38	18.87	9487.73

Table 7: Milk Market Sub-Sample Elasticity Estimates

N=311

Groups=127

	Elasticity	*Standard Error*	*P-value*
Disaggregated Income Model			
Trade & Business	0.011	0.019	0.545
Wages & Salary	-0.010	0.009	0.255
Livestock Trade	0.009*	0.005	0.100
Livestock Products	-0.006	0.007	0.371
Crop Value	0.006	0.018	0.765
Remittances	0.021**	0.010	0.040
Tea Price	-0.077	0.098	0.431
Maize Price	-0.094	0.100	0.344
Aggregated Income Model			
Aggregated Income	0.042	0.027	0.110
Tea Price	0.018	0.027	0.848
Maize Price	-0.084	0.093	0.411

** and * significant at the five and ten percent level, respectively

Table 8: Single Adult Sub-Sample Summary Statistics

	N	*% of Household Income*	*Mean*	*Standard Deviation*	*Min*	*Max*
Lower Tercile	245					
Total Income		1.00	3167.48	2982.16	450	17721.67
Trade and Business		0.06 (0.17)	213.06	702.31	0	5700
Wages and Salary		0.06 (0.18)	196.68	1058.26	0	15000
Livestock Trade		0.11 (0.26)	593.14	1648.16	0	10010.66
Livestock Products		0.31 (0.38)	976.57	1651.05	0	10149.7
Crop Value		0.03 (0.14)	112.54	571.46	0	6004
Remittances		0.44 (0.39)	1075.48	1533.44	0	13182.44
Middle Tercile	189					
Total Income		1.00	5902.04	6313.76	425	33705.5
Trade and Business		0.06 (0.15)	196.24	494.50	0	4500
Wages and Salary		0.03 (0.13)	240.88	1429.58	0	18000
Livestock Trade		0.14 (0.26)	1501.77	3749.33	0	30000
Livestock Products		0.46 (0.37)	2902.36	4217.33	0	24405.83
Crop Value		0.02 (0.12)	182.20	1443.41	0	18120
Remittances		0.29 (0.34)	878.59	943.82	0	6095.55
Upper Tercile	74					
Total Income		1.00	15309.77	9510.25	1486	34224
Trade and Business		0.14 (0.28)	1766.96	4691.95	0	27000
Wages and Salary		0.28 (0.34)	5670.15	8158.42	0	25500
Livestock Trade		0.06 (0.11)	784.05	1541.92	0	8800
Livestock Products		0.32 (0.31)	4388.59	6288.19	0	32850
Crop Value		0.02 (0.13)	445	3021.87	0	25080
Remittances		0.19 (0.20)	2255.01	2857.64	0	15976.88

Table 9: Single Adult Sub-Sample Summary Statistics on Positive Income Earners

	N	*% of Household Income*	*Mean*	*Standard Deviation*	*Min*	*Max*
Lower Tercile						
Total Income	245	1.00	3167.48	2982.16	450	17721.67
Trade and Business	44	0.31 (0.28)	1186.37	1271.72	46.92	5700
Wages and Salary	33	0.43 (0.27)	1460.22	2576.16	100	15000
Livestock Trade	45	0.59 (0.30)	3229.33	2521.36	400	10010.66
Livestock Products	127	0.60 (0.32)	1883.93	1885.71	182.5	10149.7
Crop Value	17	0.39 (0.36)	1621.92	1542.42	29.42	6004
Remittances	196	0.55 (0.36)	1344.35	1605.93	36	13182.44
Middle Tercile						
Total Income	189	1.00	5902.04	6313.76	425	33705.5
Trade and Business	56	0.19 (0.22)	662.30	722.19	30	4500
Wages and Salary	31	0.21 (0.25)	1468.61	3308.16	50	18000
Livestock Trade	54	0.48 (0.26)	5256.20	5455.08	300	30000
Livestock Products	139	0.62 (0.30)	3946.37	4481.08	334.52	24405.83
Crop Value	8	0.48 (0.34)	4304.54	5972.88	125	18120
Remittances	147	0.38 (0.34)	1129.61	928.19	48	6095.55
Upper Tercile						
Total Income	74	1.00	15309.77	9510.25	1486	34224
Trade and Business	46	0.22 (0.33)	2842.5	5708.51	30	27000
Wages and Salary	34	0.60 (0.25)	12340.91	7900.66	1000	25500
Livestock Trade	24	0.18 (0.12)	2417.5	1850.79	700	8800
Livestock Products	62	0.38 (0.30)	5238.00	6542.00	255.5	32850
Crop Value	3	0.53 (0.44)	10976.67	12645.3	650	25080
Remittances	72	0.20 (0.20)	2317.65	2872.09	175	15976.88

Table 10: Single Adult Sub-Sample Elasticity Estimates

N=508

Groups=75

	Elasticity	*Standard Error*	*P-value*
Disaggregated Income Model			
Trade & Business	0.014**	0.006	0.019
Wages & Salary	0.017***	0.005	0.001
Livestock Trade	-0.005	0.006	0.388
Livestock Products	0.006	0.006	0.273
Crop Value	-0.005	0.013	0.670
Remittances	0.005	0.008	0.524
Tea Price	-0.247**	0.122	0.042
Maize Price	0.081	0.068	0.234
Aggregated Income Model			
Aggregated Income	0.054***	0.021	0.009
Tea Price	-0.254**	0.121	0.035
Maize Price	0.083	0.064	0.198

*** and ** significant at the one and five percent level, respectively