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Food Crises and Asset Liquidation: Household-level Evidence from Tanzania

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Abstract

This paper studies the effects of food crises–large and sudden increases in food prices–on asset liquidation. Substantial research exists on household food insecurity as a result of a food crisis, but studies on households' coping strategies have so far been limited to natural shocks such as flood, drought, and financial crises. In this paper, I use an adapted version of the asset-based poverty trap model to explain households' use of asset liquidation as a coping strategy when faced with food crises. To test my theory, I employ a household-level panel data set from Tanzania that covers the years 2008, 2010, and 2012. I estimate fixed effects regressions of productive and unproductive asset levels on a measure of household-specific food prices. I find no statistically significant evidence in support of asset liquidation. My results suggest an asset smoothing behavior across all types of households.

Keywords: Asset Liquidation, Food Crises, Asset-based Poverty Trap

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1. INTRODUCTION

Between December 2007 and June 2008, a multitude of demand and supply factors caused international food prices to skyrocket, a shock commonly referred to as the 2007/08 global food crisis. In the span of six months, rice prices tripled and wheat prices doubled (Christiaensen, 2009). Tiwari and Zaman (2010) claim that 63 million individuals might have become malnourished in 2008 as a result of the price spikes. In general, the literature suggests a strong negative impact on most Sub-Saharan African countries. A study by Headey (2013) finds that the largest increase in self-assessed food insecurity in Sub-Saharan Africa occurred in Tanzania, where 23% of the population became more insecure as a result of the food price spike. While the impact of the crisis on food security has been widely studied, little attention has been paid to specific coping strategies households might use to counter the negative effects of the shock.

Some empirical studies suggest that, in some cases, households use informal loans from relatives and friends or sell their assets to cope with negative shocks that have an income effect (Arndt et al., 2008; D'Souza and Jolliffe, 2012; Lawson and Kasirye, 2013). Other papers explore households' decisions to smooth consumption or smooth assets under the framework of asset-based poverty trap and find evidence of a dynamic asset-level threshold at which households split into consumption smoothers and asset smoothers (Carter and Barrett, 2006; Hodinott, 2006; Carter and Lybbert, 2012). So far, all these studies have focused on financial crises and natural shocks such as droughts and floods, and theoretical models explaining coping strategies have only addressed rural households' behaviors.

This research is important because understanding how households choose to cope is key to designing safety nets that assist vulnerable populations at times of price shocks. I combine the asset-based poverty trap model with an agricultural household model in a framework that includes both rural and urban households and introduces food price spikes as a shock. My theory suggests that the extent to which households liquidate their assets to cope with the crises depends on their levels of assets and on the amount of food they produce.

I test my theoretical predications using detailed household data from the Living Standards Measurement Study (LSMS) on Tanzania. I construct household specific asset indices and price indices and estimate a regression equation of asset levels on the lagged values of food price indices and control variables. The general results suggest all types of households smooth assets when faced with adverse food price shocks. I find no statistically significance evidence in support of asset liquidation as a coping strategy.

The rest of the paper proceeds in five steps. Section 2 reviews the literature on the effects of food crisis and households' coping mechanisms. Section 3 proposes a household decision-making theory. Section 4 presents the data and the summary statistics of the main variables used in my regressions. Sections 5 and 6 present an empirical strategy and the results, respectively. Section 7 concludes the study, discusses some limitations, and offers directions for future research.

2. LITERATURE REVIEW

Household coping strategies have mostly been studied in the context of financial crises and natural shocks such as drought and flood and have found varying results.

Theoretical papers have studied households' coping strategies by looking at poverty dynamics. The frameworks used in these theoretical papers have come to be known as asset-based poverty trap theory. This theory is based on the idea of a dynamic asset-based poverty threshold at which households split into asset-smoothers and consumption smoothers in their wealth accumulation trajectories (Carter and Barrett, 2006). It assumes that households have limited access to financial markets from which to borrow and thus make a decision to either smooth consumption or smooth assets when faced with shocks. Carter and Lybbert (2012) reassess the intertemporal asset management problem with a poverty trap model in rural Burkina Faso and confirm the split of wealth accumulation trajectories; they find that any given sample of households may be comprised of two distinctive behavioral regimes, consumption smoothers and asset smoothers. They claim that the high marginal value of assets in the neighborhoods of critical wealth levels makes households in these neighborhoods reluctant to liquidate assets even in the face of economic shocks (Carter and Lybbert, 2012).

These two studies suggest models assessing households' decisions to smooth consumption or smooth assets when faced with shocks and test them using simulations. Zimmerman and Carter (2003) propose a stochastic dynamic programming model to explain savings and portfolio decisions in a resource-poor environment where agents face risk and subsistence constraints. Results from their simulations show that poorer agents acquire low-risk and low-return buffer assets such as stored grains and jewelery and pursue asset smoothing (maintain their assets) when faced with shocks rather than consumption smoothing. By adopting this defensive attitude, the poor are able to mitigate the risks associated with productive assets. Wealthier agents, on the other hand, invest in high-risk, high-return productive assets such as livestock and land and pursue conventional consumption smoothing, when confronted with shocks. Similarly, Hoddinott (2006) studies poverty dynamics and explore asset smoothing versus consumption smoothing at times of income shocks in rural Zimbabwe. He considers livestock as the principal asset held by these households, examining whether livestock liquidation was used to smooth consumption following the 1994-1995 drought. His findings suggest that droughts cause households with high initial levels of wealth to draw down assets. For instance, more than half the households owning more than two oxen sold at least one ox in the aftermath of the drought compared to 15 per cent of households owning only one or two oxen.

A few empirical papers test the predictions of the asset-based poverty trap theory. Giesbert and Schindler (2012) explore this theory in rural Mozambique and compare the effects of strategies drawing on assets (to smooth consumption) and strategies drawing on consumption (to smooth assets). Their results suggest that in the short run, food-insecure households that can afford to draw on unproductive assets are able to sustain their productive asset base.

Other empirical papers have explored the use of credit, asset liquidation, and consumption diversity to mitigate the negative impact of financial shocks and have find opposing results. D'Souza and Jolliffe's (2012) study of food-based coping strategies during the 2008 food crisis in Afghanistan suggests that households move toward staple food, and away from nutrient-abundant food, and thus trade off quality for quantity. Other studies have documented coping mechanisms at times of natural, economic, and health shocks. Rankin, Aytak, and Kavakli (2013) claim that 25% of households were forced to liquidate assets or take more debt, and 25% received financial support from their relatives in Turkey during the 2008 economic crisis. Lawson and Kasirye (2013) argue that households are more likely to reduce their food consumption when confronted with a drought and sell their assets when confronted with floods in Rwanda. Goh, Kang, and Sawada (2005) find that neither credit nor liquidation of assets served as coping devices in the initial phase of the 1997 financial crisis, possibly because of the credit crunch and asset price decline that resulted from the crisis. Yilma (2014) finds that economic and natural shocks were more likely to trigger dissaving and a reduction in food consumption than sale of assets and borrowing from informal sources in Ethiopia. Health shocks have the opposite effect (Yilma, 2014).

In sum, studies have found evidence in support of asset liquidation in the literature. Studies that have assessed these coping strategies under the framework of asset-based poverty trap suggest that relatively asset-poor households whose asset levels near a certain threshold experience a high marginal utility of assets that incentivizes asset smoothing, while wealthier household smooth consumption. Empirical papers indicate that households' coping behaviors with regards to assets vary from shock to shock.

In this paper, I explore an income shock originating from food price spikes, taking into account potential positive benefits for food producers. I contribute to the literature by combining the agricultural household model and asset-based poverty trap theory in an analysis that includes both rural and urban households and introduces food price spikes as origin of the shock. Given urban households tend to possess relatively higher levels of unproductive assets, I test whether a critical threshold exists in terms of unproductive assets and where households split into consumption smoothers and asset smoothers. Furthermore, unlike droughts and floods, food price spikes can be advantageous to households that produce food. My paper thus addresses potential heterogeneity in coping behavior due to differentials in food production. In the next section, I propose a theory of asset-based coping behavior for different types of households.

3. THEORY

3.1. Intuition

I start by providing the intuition behind my model. Consider three arbitrary households that face credit constraints. All three households earn a fixed labor income and consume a set of commodities (maize, cassava, rice, wheat, sorghum) that they may or may not produce. The households trade in the commodities market as net-buyers or a net-sellers.

Household 1 lives in the Mbeya region, a maize growing area in rural Tanzania, and is a net-producer of maize. To produce maize, the household has access to a high and a low productivity technology. The low productivity technology consists of traditional farming equipment such as horses, ploughs, and harrows. The high productivity technology consists of equipment such as tractors, modern planters, and irrigation systems and is associated with higher returns to assets. Total output per acre is higher under the high technology. However, in order to adopt the high technology, the household must incur the fixed costs of gathering the necessary assets for the technology such that its total returns are greater under the low technology until a minimum level of capital is acquired. Around this minimum, the marginal value of productive assets becomes high due to the opportunity cost associated with the inability to use the high technology. Household 1, similar to other households, also needs to keep a socially acceptable minimum level of unproductive assets. These might consist of a set of cooking utensils, Beds or mattresses for sleeping, a television for entertainment, a couple of Chairs and a couple of Books (perhaps religious). Around this minimum, the marginal value of assets becomes high due to the social costs of falling short.

Household 2 lives in Dar Es Salaam, is a net-consumer of maize, and has low levels of productive assets but high levels of unproductive assets (substantially above the minimum social requirement). Household 3 lives in Dodoma, is a net-consumer of maize and has low levels of productive assets and low levels of unproductive assets (around the minimum social requirement).

What happens to these three households when maize prices suddenly skyrocket? How do they cope with the shock, given credit constraints? Because household 1 produces more maize than it consumes and trades the surplus for money, price increases will be advantageous. Household 1 is better off than before and thus needs no coping strategies against the shock. Household 2 and 3 are worse off because their purchasing power is diminished and their wage income is fixed. My theory predicts that household 2 copes by selling its extra unproductive assets to smooth consumption since the marginal value of these extra assets above the minimum social requirement is small. Household 3 reduces consumption to smooth assets since the marginal value of its assets is too high for the household to consider selling them off.

The next subsection formalizes these ideas.

3.2. Household Coping Model

Consider a farm or non-farm credit-constrained household that earns a fixed labor income, possesses assets, consumes a set of commodities that they may or may not produce, and trades in the commodities market. The model below shows the utility maximization problem the household faces and was adapted from and Carter and Lybbert (2012). Households maximize the present value of their utility over an infinite horizon by choosing how much to consume in the current period and how many assets to carry forward into the next period, given food prices, and subject to a number of constraints. The use of infinite horizon is common in the literature and is based on the assumption that parents are concerned about their children's welfare (Carter and Zimmerman, 2003).

$$\max_{c_0,T_1,M_1} E_0\left(\sum_{t=0}^{\infty}\delta^t u(c_t)|p\right)$$

subject to

$$\begin{aligned}
&p \times c_t \leq \pi_t - (T_{t+1-T_t}) - (M_{t+1-M_t})\\
&\pi(p) = F(T_t) \times p_t + F(M_t)\\
&F(T_t) = \max\left[F(T_t)^H, F(T_t)^L)\right]\\
&F(M_t) = \max\left[(r_t)^H, (r_t)^L)\right] \times M_t\\
&L_t \geq 0 \,\forall\; t,
\end{aligned} \tag{1}$$

where t denotes the time period, δ is the rate of time preference, M is the household's holding of unproductive assets, T is the household's holding of productive assets, π is the household's profits from farming, and r denotes fixed returns on assets. The last equation in the model implies that households are credit-constrained, as it reflects the inability to hold negative assets (loans).

The first equation after "subject to" is the budget constraint. It reflects income from production (π) and income from asset liquidation (given by the difference between assets in the current and future period). It implies that households that produce more than they consume will benefit from a price increase. Households that benefit from the shock need not make coping decisions. Those that are negatively impacted need to make a decision to liquidate assets to smooth consumption or to reduce consumption to smooth assets.

Asset-based poverty trap models suggest that there is a threshold level of productive assets around which agricultural households split into consumption smoothers and asset smoothers (Carter and Zimmerman, 2003). Following Carter and Lybbert (2012), let's assume this occurs as a result of households having access to a high and low productivity technology. Marginal returns to assets are always greater under the 'high' (H) than under the 'low' (L) technology:

$$F(T_t) = \max \left[F(T_t)^H, F(T_t)^L)\right] \tag{2}$$

$$\frac{\partial F(T)^H}{\partial T^H} \geq \frac{\partial F(T)^L}{\partial T^L}. \tag{3}$$

However, the high technology is associated with fixed costs such that total return is greater under the low technology until a minimum level of capital T^* is attained:

$$F(T)^H \leq F(T)^H \;\; \forall \;\; T \leq T^*. \tag{4}$$

This assumption implies a discontinuous jump in the marginal value of productive assets at point T^*.

In order to incorporate unproductive assets, I further assume that there is a minimum level of unproductive asset stock, M^* [1]. Below this level of assets, households earn a rate of return, r^L, and above it, they experience a rate of return r^H, where $r^H \geq r^L$. That is:

[1]This is an expansion of the models in the literature to include unproductive assets. Liquidating unproductive assets in favor of more productive assets might be a justifiable decision in the face of price spikes.

$$r^L < r^H \;\; \forall \;\; T \leq M^*. \tag{5}$$

In other words, households earn a relatively low rate of return until their assets reach a certain minimum, creating another discontinuous jump occurs in the marginal value of unproductive assets at point M^*.

This dynamic choice problem is not separable in time since future utility may depend on current consumption. The complexity of time-inseparable models grows exponentially with the number of periods since the optimization problem must be solved simultaneously (Carter and Zimmerman, 2003). It is standard in the literature to define a state variable L_t that captures past consumption. It is defined as 0 if the agent has had zero consumption and as 1, otherwise. The utility maximizing problem can be thought of as a choice of household consumption in the current period that maximizes the sum of the utility enjoyed from the consumption and the utility from their asset stocks to be carried forward to the next period, taking into account their level of impatience.

Following Lybbert and Carter (2012), let $J(L)$ be a function that represent the value function of accumulable asset stock (L). The optimization problem can be rewritten as:

$$\max_{c_0, T_1, M_1, L_1} E_0 \left((c_0) + \delta^t j * (T_1, M_1, L_1) \right) \tag{6}$$

This problem must be solved numerically since it doesn't have a closed form solution. Using numerical methods on samples of rural households, theoretical papers have found a threshold level of productive assets at which households split into consumption smoothers and asset smoothers due to sudden increases in the marginal value of assets around the threshold. This paper develops a number of hypothesizes. Higher food prices might render investment in productive assets more lucrative thereby incentivizing rich households to liquidate unproductive assets in favor of productive assets. Thus, an unproductive asset Micawber threshold might be plausible. Furthermore, it might be unnecessary for net-food producers to cope against adverse price shocks by liquidating assets, because they experience a net-positive change in income. In other words, the higher the stock of food production of the household, the less willing households must be to liquidate assets when averse food price shocks occur. To test these hypotheses, I introduce food price shocks and examine their effect on the level of both unproductive and productive assets for households with varying level of wealth, taking into account their productive capabilities.

The next section presents the data used to test my hypotheses and relevant summary statistics.

4. DATA AND SUMMARY STATISTICS

I use household data from the three rounds of the Tanzania National Panel Survey (TZNPS). These nationally representative surveys are a part of the Living Standards Measurement – Integrated Surveys (LSMS – IS) conducted by the World Bank. The fist round of the TZNPS was implemented between October 2008 and 2009 and covered 3,265 households and 16,707 individuals. The second round was implemented between October 2010 and September 2011 and covered new households in addition to all the households in the first round for a total of 3,924 households and 20,559 individuals. The third and most recent round was conducted between October 2012 and November 2013 and covered all the households in the previous two waves for a total of 5,010 households and 25,412 individuals.

4.1. The Asset Indices

Facing data constraints, researchers have used counts of assets as a measure of a households' asset ownership, assigning equal weights to all asset items (McKenzie, 2004). However, this method fails to take into account varying levels of returns associated with different asset items. Tractors for instance must be assigned a greater weighter than harrows. In this paper, I construct weighted productive and unproductive asset indices, where the weights are assigned using the first principal component from principal component analysis (PCP). This is a pragmatic approach to measuring inequalities in asset ownership given data constraints (McKenzie, 2004). The first principal component yields the weights for each household to provide maximum discrimination between households, with larger weights being given to assets that vary most across households. For instance, an asset owned by all the households will be given zero weight as it explains none of the variations across the households, whereas an asset owned by few households (such as tractors) will be given a larger weight. Given the lack of availability of price data, this method generates more sensible asset indices that assigning equal weight to all households items.

$$\lambda_{it} = \sum_{j=1}^{j} w_{ijt} A_{ijt}, \text{for household i at time t} \tag{7}$$

Using the unproductive asset indices, I classify the households as unproductive asset-rich if their levels of unproductive assets are greater than the median unproductive asset level. I define similar categories using the productive asset indices. Tables 1-2 show the mean counts of unproductive assets by household type (unproductive asset-rich and unproductive asset-poor). Tables 3 represents the mean counts of productive assets by household type (productive asset-rich and productive asset-poor). In the general, these two tables indicate that rich households have more assets that poor households. For instance, unproductive asset-rich households own an average of approximately 3 beds whereas unproductive-asset poor households own an average of approximately 2 beds. Productive asset-rich households have an average of approximately 7 educated members[2] whereas productive asset-poor households have an average of approximately 4 educated members.

4.2. Food Expenditure and Price Indices

The LSMS-IS data include both food consumption and food production modules. The "food consumption" module contains, for a list of food items, the quantity consumed, the quantity consumed from household production, the quantity consumed from purchases, and the total expenditure on the items during that week. Table 4 compares the mean expenditure (in Tanzanian Shillings) by item for households with low and high unproductive assets. Table 5 compares the mean expenditure by food item for households with low and high productive assets. It appears in both tables that maize and rice are the most consumed staples. As expected, consumption by asset-rich households is greater than consumption by asset-poor households for almost all the items. For instance,

[2]This is defined as the number of adult-age household members who have at least completed primary school.

unproductive asset-poor households consume husked rice worth 2545 TZS (roughly 1.14 dollars) whereas unproductive asset-rich households consume twice that amount.

Based on these food expenditure data, I construct household-specific weighted indices, where the weights represent the proportion of total food expenditure spent on each of the five main staple food items. The price indices were then calculated by computing the change in these prices with 2008 as base year. Since households consume staples in different proportions, a household-specific weighted index more reflects price shocks more accurately than a common price index. This approach could potentially induce bias, because the levels of assets of a household can affect the total amount of food expenditure and expenditure on specific food items. I address this issue in the robustness checks by constructing community-level weighted price indices.

In my regressions, I standardize the price indices around the mean for a more intuitive interpretation of the results. The value of each index thus represents the number of standard deviations of a household's asset (price) index above or below the mean asset (price) level for the sample.

4.3. Production Variables

The "agricultural production" module includes, for a list of production items, the amount produced, the amount sold, the value of the sales, the amount in storage, and the amount lost. Table 6 displays the value of food sales (in Tanzanian Shillings) by item for unproductive-asset rich and poor households, and 7 shows the value of food sales (in Tanzanian Shillings) by item for productive-asset rich and poor households. Maize is the most produced staple, followed by rice.

4.4. Overall summary statistics

Tables 8 and 9 compare summary statistics for asset variables and explanatory variables by household type. For both types of assets, asset levels are higher for the rich than for the poor, as expected. For instance, the mean unproductive asset level for rich households is two standard deviations above the sample mean unproductive assets levels. The mean unproductive asset level for rich households is one standard deviations below the sample mean unproductive assets levels (table 8). Price indices are higher for unproductive asset-poor households compared to unproductive asset-rich households, with the opposite being true for productive-asset poor and productive asset-rich households. As expected households that are rich in productive assets produce more than households that are poor in productive assets (table 9). All types of households tend to be led by men. Household size and gender of household head are similar across households.

4.5. Asset-smoothing versus consumption smoothing

Figure 1 shows the kernel density plot of unproductive asset levels by household type. As expected, the distribution of assets for asset-rich households is centered around a higher mean and is more spread out that the distribution of assets for asset-poor households. Similarly, Figure 2 shows the kernel density plot of productive asset levels by household type. The distribution of assets for asset-rich households is centered around a higher mean, but the spreads spreads are comparable. In the next section, I present an empirical strategy to capture the effects of adverse price shocks, when controlling for various covariates.

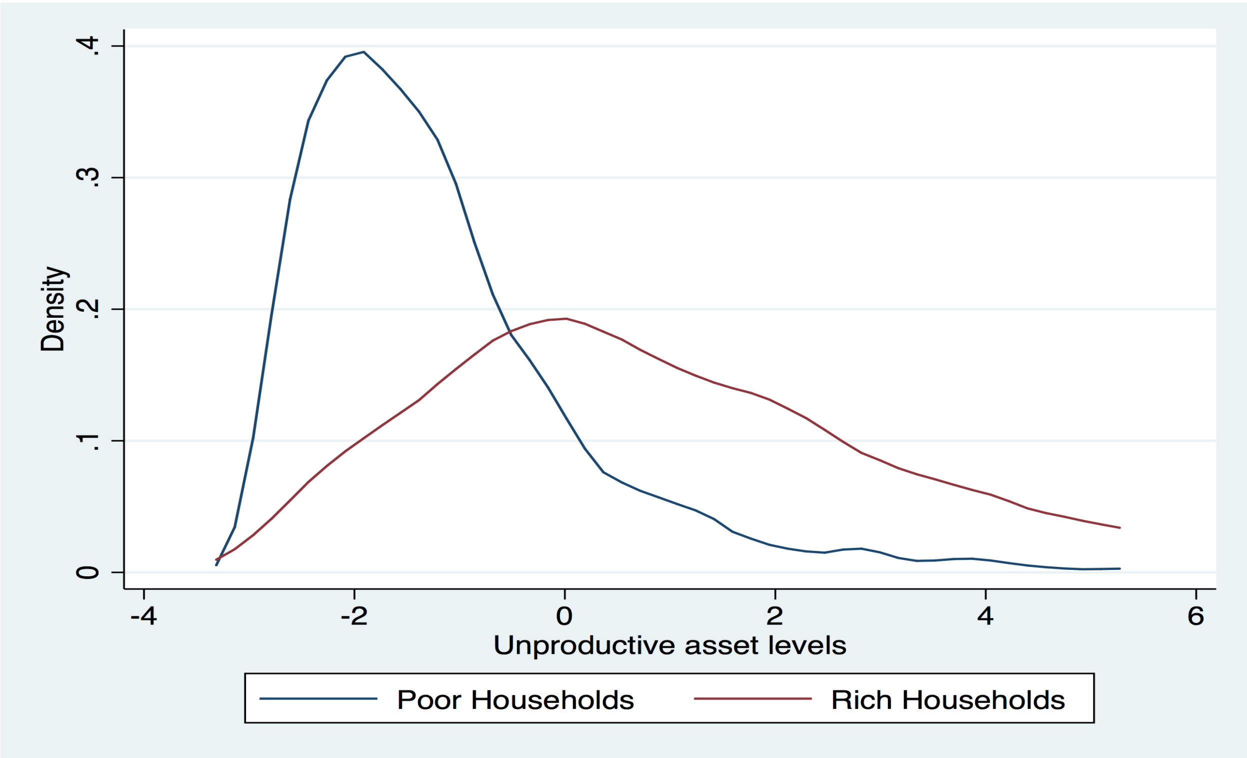

Figure 1: Unproductive asset levels by household type

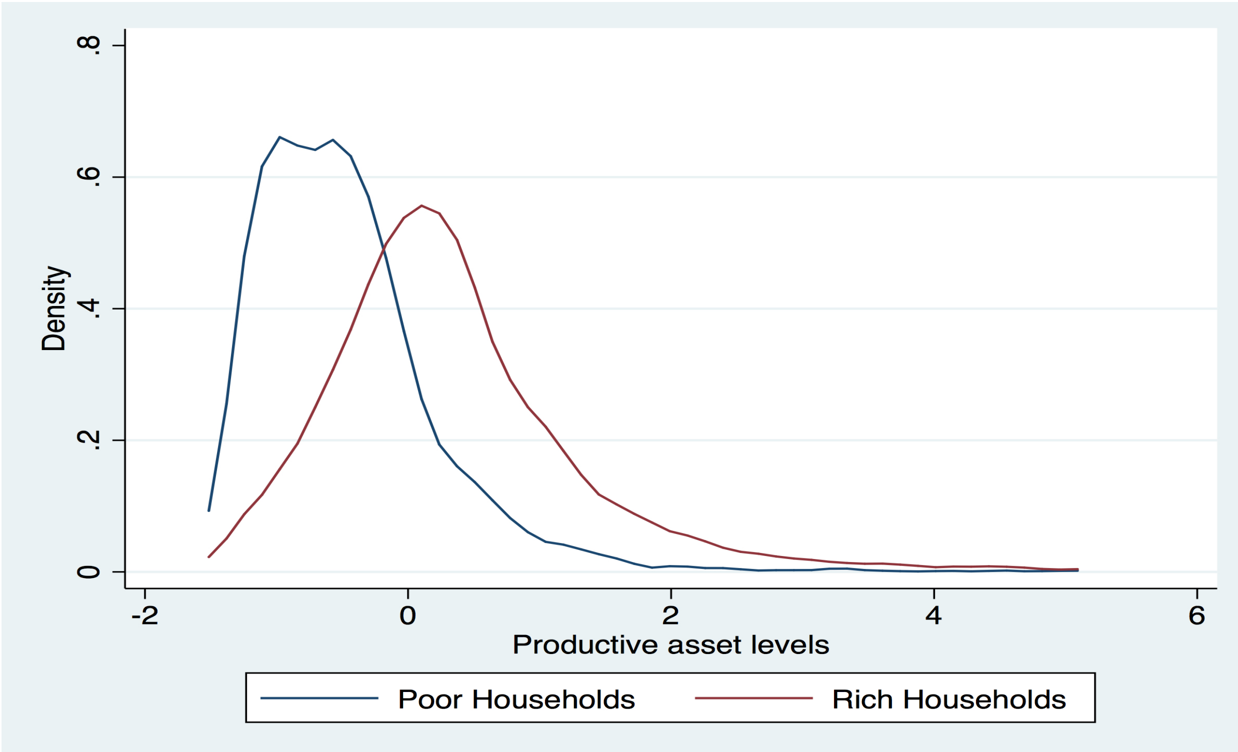

Figure 2: Productive asset levels by household type

5. EMPIRICAL STRATEGY

I estimate a household fixed effects regression of asset levels the lagged values of the the price indices and control variables, using the following specification.

$$\begin{aligned} A_{it} = \beta_0 + \beta_1 PriceIndex_{it-1} + \beta_2 ProductionValue_{it-1} + \beta_3 PriceIndex_{it-1} \\ \times ProductionValue_{it-1} + \beta_4 X_{it-1} + \beta_6 J_i + \beta_7 Y_t + \epsilon_{it-1}, \end{aligned} \quad (8)$$

where A_{it} is the household's asset level assets at time t. $PriceIndex_{it-1}$ is the household-specific price index in the previous period. For easiness of interpretation, asset indices and price indices are standardized around the population mean, so that each index measures the number of standard deviations the household is away from this population mean[3]. X_{it-1} is a vector of household characteristics–head gender and age, household size in the previous period. J_i are the household fixed effects and control for time-invariant effects specific to each household. Y_t are the

[3]The regressions with the non-standardized indices yield the same coefficient signs and significance.

year fixed-effects and control for location invariant effects that are common to all the households. ϵ_{it} is the classical error term.

The household fixed effects control for time-invariant factors within a household that are not already controlled for by the demographics variables by the household characteristics variables. Year fixed effects control for time changing factors that are common to all households. Lagged values are used because households make dynamic decisions about their future assets and consumption based on the present period. Therefore, changes in consumption smoothing and asset smoothing behavior in one period reflect changes in conditions and the incidence of shocks in the previous period.

I estimate equation 8 for the two types of asset indices and the two types of households for each asset index. All the continuous variables are transformed into logs to correct for heteroskedasticity. My theory suggests that the coefficient on the price index should be positive or zero for households that have low levels of assets and negative for households that have high levels of assets. My theory also implies that the greater the amount of food rich households produce, the more positive the benefits of the price increase would be and thus the less they would be willing to liquidate assets.

6. RESULTS

6.1. Main Results: using median to define the asset status groups

I estimate equation 8 twice for each type of asset, once for each household category. A household is defined as rich in each case if it possesses asset levels above the median asset level. Using median values to categorize the households produces a natural split of the sample into two equal categories to make comparison easier. I change the definition of the categories as a robustness check in the next subsection. Table 10 uses a comprehensive productive and unproductive asset indices. These indices incorporate all the assets listed in the summary statistics. Models 1 and 3 show the results for unproductive asset-poor and productive asset-poor households, respectively. The coefficients on the price index variable suggest, for poor households, a one standard deviation increase in prices results in a 0.012 standard deviation decrease in unproductive assets and a 0.001 standard deviation increase in productive assets, both insignificant. Models 2 and 4 show the results for unproductive asset-rich and productive asset-rich households, respectively. The coefficients on the price index variable suggest, for rich households, a one standard deviation increase in prices result in a 0.014 standard deviation increase in unproductive assets and a 0.025 standard deviation increase in productive assets, both insignificant.

The coefficient on the price index variable on models 1-4 imply that both unproductive asset-rich and poor households maintain their unproductive assets, and both productive asset-rich and poor maintain their productive assets, when faced with price shocks. This provides evidence in support asset smoothing across all types of assets and all types of households.

It is also useful to interpret the coefficient on production and the interaction of production and price. In models 1 and, the coefficient estimates on production variables indicate that the higher poor households produce, the higher their productive levels and the lower their unproductive assets levels. Similar results are observed for rich households. However, none of these production effects are significant.

In the next subsection, I perform robustness checks by altering my definition of poor and rich, changing the composition of asset indices, and using a smaller set of staples.

6.2. Robustness check 1: using community-level weighted price indices

As explained earlier, the use of household-specific weighted price indices could induce bias in my result, as asset levels likely have an influence on total food expenditure and expenditure on specific food items. To address this issue, I construct community-level weighted price indices, where the weights are the proportions of total food expenditure allocated to each food item. The results are displayed on table 2. The coefficients are similar in magnitude and significance to the coefficients in table 11, which alleviates my concerns on the use of household-specific price indices.

6.3. Robustness check 2: using liquidatable assets

Comprehensive asset indices include items that might not be liquidatable. To test the robustness of the estimates, I estimate the regressions using liquidatable asset indices [4] only (Table 12). These assets are marked with an asterisk on tables 1-3. The productive index includes reapers, tractors, poultry, and livestock (excludes labor). The unproductive index includes items such as bicycles, phones, radio, tables etc. The results are practically the same as the previous results.

6.4. Robustness check 3: using cattle as assets

Household assets might be difficult to market at times of income shocks where the supply of assets might cause asset prices to drop (Rankin et al., 2013). However, cattle might be easier to market, as it is a common store of wealth among poor households. I estimate my regression model using only cattle assets, which include poultry, livestock, and donkeys. The results are shown on table 13. Model 13 represents the results for households with low cattle ownership (below median ownership) and model 14 shows the results for households with high cattle ownership (above median). Again, I find no evidence of asset liquidation among rich or poor households, as the coefficients are not statistically different from 0.

6.5. Robustness check 4: using the 75th percentile to define the asset groups

Next, I define a household as rich in one type of asset if their asset level is greater than or equal to the 75th percentile for the specific type of asset, and as poor otherwise. The results (Table 14) are the same, which suggests a lack of variability in asset levels.

6.6. Robustness check 5: using maize, rice, and cassava in price indices

I perform a final robustness check by changing the staples included in the computation of price index weights and production value. Instead of including the five most consumed commodities, I now only include the top three commodities: maize, rice, and cassava. The main results (Table 15) remain.

[4] In terms of unproductive indices, I assume that houses and landline phones are not liquidatable. In terms of productive indices, I assume that lands/fields and labour are not liquidatable.

7. CONCLUSION AND DISCUSSION

This paper investigates the effect of large and sudden increases in food prices such as those that occurred worldwide between 2007 and 2009 on asset liquidation. I employ a detailed household-level panel data set from Tanzania that covers the years 2008, 2010, and 2012 and compute household-specific weighted price indices. Further, I construct a productive and an unproductive asset index using principal component analysis and divide the sample into asset rich and asset poor subgroups. My fixed effect regressions suggest households with low levels of assets smooth assets by reducing consumption. According to my theory, these outcomes occur because, for households with low levels of assets, the marginal value of assets is so high that they would rather smooth assets by decreasing consumption. I found no evidence in support of asset liquidation behavior from rich households, as theory would suggest.

The first and foremost weakness of these results might be endogeneity caused by omitted variables such as covariant shocks such as floods, droughts, diseases etc. that I was not able to control for. I cannot establish causality from my results. The change in asset levels might be due to external shocks that vary by region and thus affect households differently.

A second limitation of my paper is the method used to construct the asset indices. I used principal component analysis to assign a weight on each asset based on the variability in ownership. This approach yields weights that provide maximum discrimination based on variance in ownership. While this method yields a more plausible outcome than a method that assigns equal weight to all types of assets, my results would have been more accurate with asset prices reflecting the values of specific household asset items.

A third limitation is a lack of data. Given my panel data only includes three years, the variability is assets is not significant, especially with the lag structure specified in my empirical model. A panel with more data could resolve this issue and perhaps lead to results that are more consistent with theory.

Overall, my results are far from conclusive, but suggest a preference for asset smoothing over consumption smoothing among (poor) households facing price shocks. Future research should address the key limitations outlined above. Stronger evidence in support of asset smoothing would help policymakers and governments identify those with low levels of assets that are most vulnerable to changes in prices and provide them safety nets in times of food insecurity.

8. APPENDIX

Table 1: **Unproductive asset statistics by unproductive asset status, measured in counts (Part 1)**

Statistics	Beds*	Chairs*	Houses	Kitchen utensils*	Mosquito nets*	Tables*	Books*	Computers*	Stoves*	Fridges*	Iron*	Landline phones
Rich Households												
mean	3.021	3.922	1.027	61.715	2.873	1.652	4.574	0.125	1.311	0.339	0.714	0.043
sd	1.659	3.551	0.995	62.621	1.843	1.234	15.147	1.514	0.999	0.566	0.633	0.245
N	2998	2998	2998	2998	2998	2998	2998	2998	2998	2998	2998	2998
Poor Households												
mean	1.826	1.473	1.032	25.464	1.728	0.454	0.653	0.015	0.301	0.003	0.049	0.002
sd	1.258	1.822	0.803	15.739	1.396	0.618	1.899	0.450	0.575	0.056	0.217	0.052
N	2205	2205	2205	2205	2205	2205	2205	2205	2205	2205	2205	2205

Note: All the variables are in counts. For instance, rich households own an average of 3 beds, whereas poor households own an average of 1.8 beds.

Table 2: **Unproductive asset statistics by unproductive asset status, measured in counts (Part 2)**

Statistics	Lanterns*	Motorcycles*	Music systems*	Phones*	Radio and cassettes*	Record sets*	Room furniture*	Sofas*	Tables*	Television*	Watches*
Rich Households											
mean	1.087	0.036	0.071	1.951	1.015	0.043	1.236	2.301	1.652	0.574	0.641
sd	1.086	0.197	0.381	1.498	0.754	0.508	1.389	2.361	1.234	0.708	0.846
N	2998	2998	2998	2998	2998	2998	2998	2998	2998	2998	2998
Poor Households											
mean	0.342	0.005	0.005	0.487	0.527	0.001	0.178	0.121	0.454	0.013	0.097
sd	0.620	0.070	0.095	0.674	0.589	0.030	0.515	0.533	0.618	0.114	0.328
N	2205	2205	2205	2205	2205	2205	2205	2205	2205	2205	2205

Note: All the variables are in counts. This table is a continuation of the previous table.

Table 3: **Productive asset statistics by productive asset status, measured in counts**

Statistics	Educated labor	Uneducated labor	Hoes*	lands/Fields	Boats/canoes*	Donkeys*	Harrow*	Livestock*	Poultry*	Tractors*	Water pumps*	Carts*	Reapers*
Rich Households													
mean	6.587	0.527	3.266	2.241	0.021	0.108	0.005	6.976	10.014	0.005	0.049	0.063	0.005
sd	2.970	0.780	2.148	2.059	0.202	0.658	0.082	28.816	30.645	0.095	0.244	0.308	0.085
N	2207	2207	2207	2207	2207	2207	2207	2207	2207	2207	2207	2207	2207
Poor Households													
mean	3.824	0.268	0.793	0.565	0.000	0.002	0.000	0.359	1.395	0.000	0.000	0.003	0.000
sd	2.097	0.528	0.980	0.811	0.000	0.045	0.000	1.689	4.063	0.000	0.000	0.058	0.000
N	2996	2996	2996	2996	2996	2996	2996	2996	2996	2996	2996	2996	2996

Note: All the variables are in counts. The two categories are: productive asset-rich and productive asset-poor.

Table 4: **Food expenditure statistics (by item) by unproductive-asset status, measured in Tanzanian shillings per week**

Statistics	Dry cassava	Fried cassava	Husked rice	Cob maize	Maize flour	Maize grain	Paddy rice	Sorghum flower	Sorghum grain	Wheat	Total
Rich Households											
mean	103.428	345.881	5778.989	56.738	3221.917	222.790	20.280	187.076	31.112	282.780	10250.992
sd	731.767	1098.244	5999.936	487.706	4537.883	1109.469	401.543	702.771	269.477	1235.227	8776.907
N	2998	2998	2998	2998	2998	2998	2998	2998	2998	29980	2998
Poor Households											
mean	141.689	142.834	2545.862	21.474	2200.666	203.293	5.261	68.190	25.100	64.785	5419.155
sd	795.911	564.146	4105.039	193.034	3827.036	1036.770	120.568	615.091	309.334	504.219	5868.005
N	2205	2205	2205	2205	2205	2205	2205	2205	2205	2205	2205

Note: All the consumption variables are on a weekly basis and measured in Tanzanian shillings (TZS).

Table 5: **Food expenditure statistics (by item) by productive-asset status, measured in Tanzanian shillings per week**

Statistics	Dry cassava	Fried cassava	Husked rice	Cob maize	Maize flour	Maize grain	Paddy rice	Sorghum flower	Sorghum grain	Wheat	Total
Rich Households											
mean	163.788	235.206	4426.652	51.699	2958.036	308.542	18.940	142.449	33.099	229.112	8567.522
sd	957.115	918.916	6117.185	507.965	4866.641	1402.960	366.743	766.049	321.470	1242.752	9211.900
N	2207	2207	2207	2207	2207	2207	2207	2207	2207	2207	2207
Poor Households											
mean	87.124	277.971	4395.666	34.496	2664.683	145.272	10.214	132.453	25.224	161.874	7934.976
sd	570.435	914.280	5029.511	275.292	3787.512	749.553	270.255	588.514	258.752	771.082	7046.652
N	2996	2996	2996	2996	2996	2996	2996	2996	2996	2996	2996

Note: All the consumption variables are on a weekly basis, measured in TZS.

Table 6: **Statistics for food production (by item) by unproductive-asset status, measured in Tanzanian shillings per year**

Statistics	Maize	Paddy	Sorghum	Wheat	Cassava	Total
Rich Households						
mean	18561.408	13743.496	408.439	90.060	262.842	33066.244
sd	1.98e+05	1.69e+05	8454.378	3507.734	8464.865	2.64e+05
N	2998	2998	2998	2998	2998	2998
Poor Households						
mean	11719.592	8485.941	968.821	151.927	568.934	21895.215
sd	76082.354	85185.768	11315.366	5246.817	11370.583	1.16e+05
N	2205	2205	2205	2205	2205	2205

Note: All the production variables are on an annual basis and measure the value of marketed food production in TZS.

Table 7: **Statistics for food production (by item) by productive asset status, measured in Tanzanian shillings per year**

Statistics	Maize	Paddy	Sorghum	Wheat	Cassava	Total
Rich Households						
mean	28310.897	23410.059	1175.011	224.286	543.271	53663.525
sd	1.80e+05	2.10e+05	13284.549	6294.883	12764.688	2.81e+05
N	2207	2207	2207	2207	2207	2207
Poor Households						
mean	6344.009	2753.171	256.175	36.716	281.542	9671.612
sd	1.39e+05	34877.770	5960.993	1836.012	6844.194	1.44e+05
N	2996	2996	2996	2996	2996	2996

Note: All the production variables are on an annual basis and measure the value of marketed food production in TZS.

Table 8: **Summary of unproductive asset levels and explanatory variables by unproductive asset status**

Statistics	**Unproductive asset Index**	**Price index**	**Production value**	**Household size**	**Gender of HH head**	**Age of HH head**
Rich Households						
mean	2.012	8046.579	33066.244	5.737	0.792	46.485
sd	2.409	46786.547	2.64e+05	3.074	0.406	14.184
N	2998	2623	2998	2998	2998	2998
Poor Households						
mean	-1.675	14112.732	21895.215	4.880	0.688	47.817
sd	0.633	1.11e+05	1.16e+05	2.646	0.463	16.219
N	2205	1556	2205	2205	2205	2205

Note: Price indices and asset indices are not standardized. Household size is in counts, production value in TZS.

Table 9: **Summary of productive asset levels and explanatory variables by productive asset status**

Statistics	**Productive asset Index**	**Price index**	**Production value**	**Household size**	**Gender of HH head**	**Age of HH head**
Rich Households						
mean	0.751	10689.972	53663.525	7.114	0.821	50.761
sd	1.871	87339.990	2.81e+05	3.007	0.384	13.851
N	2207	1621	2207	2207	2207	2207
Poor Households						
mean	-0.785	10061.432	9671.612	4.092	0.694	44.315
sd	0.338	70181.543	1.44e+05	2.095	0.461	15.386
N	2996	2558	2996	2996	2996	2996

Note: Price indices and asset indices are not standardized. Production value is in TZS. The gender of HH head measures the proportion of households that are led by men.

Table 10: **Main regression results**

VARIABLES	model 1 Unproductive asset level (Poor)	model 2 Unproductive asset level (Rich)	model 3 Productive asset level (Poor)	model 4 Productive asset level (Rich)
Lag (price index)	-0.012	0.014	0.001	0.025
	(0.012)	(0.029)	(0.027)	(0.042)
Lag (production value)	-0.081	-0.245	0.071	0.240
	(0.120)	(1.156)	(0.723)	(0.488)
Lag (production × price index)	0.091	0.263	-0.076	-0.207
	(0.117)	(1.138)	(0.713)	(0.465)
Lag (household size)	0.007	-0.016	-0.063*	0.231
	(0.038)	(0.045)	(0.037)	(0.180)
Lag (head gender)	0.041	0.038	-0.002	-0.035
	(0.050)	(0.056)	(0.048)	(0.184)
Lag (head age)	0.092	0.065	0.019	0.057
	(0.071)	(0.090)	(0.073)	(0.283)
Year = 2010	0.173***	0.074**	-0.025	-0.025
	(0.035)	(0.037)	(0.035)	(0.108)
Year = 2012	0.208***	-0.117***	-0.034	-0.344***
	(0.037)	(0.038)	(0.035)	(0.118)
Constant	-0.954***	0.380	-0.312	-0.266
	(0.281)	(0.325)	(0.273)	(1.163)
Observations	2,187	3,016	3,043	2,160
R-squared	0.055	0.025	0.003	0.025
Number of panel_id	1,506	1,623	1,694	1,521

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note:Price indices and asset indices are standardized.

Table 11: **Results when using community level weighted indices**

VARIABLES	model 5 Unproductive asset level (Poor)	model 6 Unproductive asset level (Rich)	model 7 Productive asset level (Poor)	model 8 Productive asset level (Rich)
Lag (price index)	-0.0281	-0.0740	0.00645	-0.0663
	(0.0527)	(0.0472)	(0.0540)	(0.101)
Lag (production value)	-0.000609	-0.00336	-0.00216	-0.00450
	(0.00175)	(0.00394)	(0.00557)	(0.00387)
Lag (production × price index)	-0.00174	0.00472	-8.38e-05	-0.00345
	(0.00148)	(0.00294)	(0.00334)	(0.00374)
Lag (household size)	0.0241	-0.00977	-0.0630*	0.0458
	(0.0152)	(0.0326)	(0.0335)	(0.0567)
Lag (head gender)	-0.00898	0.0518	0.0490	0.0373
	(0.0209)	(0.0436)	(0.0458)	(0.0615)
Lag (head age)	-0.0143	-0.0441	-0.0948	-0.0400
	(0.0269)	(0.0638)	(0.0635)	(0.0845)
Year = 2010	0.177***	0.0892***	-0.00509	0.0284
	(0.0150)	(0.0291)	(0.0339)	(0.0383)
Year = 2012	0.106	-0.192*	-0.00101	-0.294
	(0.109)	(0.101)	(0.116)	(0.209)
Constant	-0.540***	0.653***	0.115	0.433
	(0.115)	(0.240)	(0.245)	(0.359)
Observations	4,328	4,288	4,281	4,335
R-squared	0.075	0.020	0.004	0.016
Number of panel_id	2,158	2,147	2,218	2,210

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note:Price indices and asset indices are standardized.

Table 12: **Results using only liquidatable assets**

	model 9	model 10	model 11	model 12
VARIABLES	Unproductive asset level (Poor)	Unproductive asset level (Rich)	Productive asset level (Poor)	Productive asset level (Rich)
Lag (price index)	-0.011	0.013	-0.001	0.009
	(0.012)	(0.029)	(0.036)	(0.055)
Lag (production value)	-0.053	-0.181	0.023	0.121
	(0.117)	(1.150)	(0.990)	(0.645)
Lag (production × price index)	0.064	0.196	-0.027	-0.100
	(0.114)	(1.132)	(0.976)	(0.615)
Lag (household size)	0.011	-0.025	-0.089*	0.409*
	(0.038)	(0.045)	(0.051)	(0.238)
Lag (head gender)	0.033	0.034	-0.082	-0.173
	(0.049)	(0.055)	(0.066)	(0.244)
Lag (head age)	0.101	0.089	0.049	0.180
	(0.069)	(0.089)	(0.100)	(0.374)
Year = 2010	0.178***	0.089**	-0.064	0.009
	(0.035)	(0.037)	(0.048)	(0.143)
Year = 2012	0.222***	-0.086**	-0.094*	-0.231
	(0.037)	(0.038)	(0.048)	(0.157)
Constant	-0.984***	0.317	-0.004	-1.200
	(0.274)	(0.324)	(0.374)	(1.539)
Observations	2,187	3,016	3,043	2,160
R-squared	0.062	0.021	0.007	0.012
Number of panel_id	1,506	1,623	1,694	1,521

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 13: **Results when using only cattle (donkeys, livestock, poultry)**

	(1)	(2)
	model 13	model 14
VARIABLES	Cattle index (Poor households)	Cattle index (Rich households)
Lag (price index)	-0.0195	0.0113
	(0.0668)	(0.0211)
Lag (production value)	-	0.149
		(0.167)
Lag (production × price index	-0.00364	-0.143
	(0.0676)	(0.161)
Lag (household size)	-0.0235	-0.0138
	(0.0671)	(0.0325)
Lag (head gender)	-0.00331	0.0338
	(0.0867)	(0.0433)
Lag (head age)	-0.0979	-0.0917
	(0.126)	(0.0638)
Year = 2010	-0.0414	-0.0448
	(0.0509)	(0.0317)
Year = 2012	-	-0.0300
		(0.0289)
Constant	0.408	0.319
	(0.484)	(0.242)
Observations	1,812	3,391
R-squared	0.005	0.005
Number of panel_id	1,514	2,113

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 14: **Results using 75th percentiles to define the asset groups**

VARIABLES	model 17 Unproductive asset level (Poor)	model 18 Unproductive asset level (Rich)	model 19 Productive asset level (Poor)	model 20 Productive asset level (Rich)
Lag (price index)	-0.012	0.014	0.001	0.025
	(0.012)	(0.029)	(0.027)	(0.042)
Lag (production value)	-0.081	-0.245	0.071	0.240
	(0.120)	(1.156)	(0.723)	(0.488)
Lag (production × price index)	0.091	0.263	-0.076	-0.207
	(0.117)	(1.138)	(0.713)	(0.465)
Lag (household size)	0.007	-0.016	-0.063*	0.231
	(0.038)	(0.045)	(0.037)	(0.180)
Lag (head gender)	0.041	0.038	-0.002	-0.035
	(0.050)	(0.056)	(0.048)	(0.184)
Lag (head age)	0.092	0.065	0.019	0.057
	(0.071)	(0.090)	(0.073)	(0.283)
Year = 2010	0.173***	0.074**	-0.025	-0.025
	(0.035)	(0.037)	(0.035)	(0.108)
Year = 2012	0.208***	-0.117***	-0.034	-0.344***
	(0.037)	(0.038)	(0.035)	(0.118)
Constant	-0.954***	0.380	-0.312	-0.266
	(0.281)	(0.325)	(0.273)	(1.163)
Observations	2,187	3,016	3,043	2,160
R-squared	0.055	0.025	0.003	0.025
Number of panel_id	1,506	1,623	1,694	1,521

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 15: **Results when using only maize, rice, and cassava for price indices and production**

VARIABLES	model 21 Unproductive asset level (Poor)	model 22 Unproductive asset level (Rich)	model 23 Productive asset level (Poor)	model 24 Productive asset level (Rich)
Lag (price index)	-0.013	0.014	-0.003	0.016
	(0.013)	(0.031)	(0.029)	(0.036)
Lag (production value)	0.020	-0.068	0.380	0.119
	(0.233)	(1.127)	(0.612)	(0.566)
Lag (production × price index)	-0.003	0.071	-0.397	-0.092
	(0.225)	(1.124)	(0.611)	(0.516)
Lag (household size)	0.003	-0.019	-0.061	0.273
	(0.039)	(0.045)	(0.038)	(0.179)
Lag (head gender)	0.033	0.042	0.000	-0.035
	(0.052)	(0.056)	(0.049)	(0.186)
Lag (head age)	0.088	0.068	0.013	0.134
	(0.072)	(0.090)	(0.073)	(0.284)
Year = 2010	0.180***	0.074**	-0.026	0.005
	(0.036)	(0.037)	(0.035)	(0.108)
Year = 2012	0.219***	-0.115***	-0.035	-0.319***
	(0.038)	(0.038)	(0.035)	(0.119)
Constant	-0.935***	0.372	-0.292	-0.666
	(0.285)	(0.325)	(0.274)	(1.170)
Observations	2,190	3,022	3,039	2,173
R-squared	0.058	0.024	0.003	0.025
Number of panel_id	1,524	1,627	1,697	1,533

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

9. REFERENCES

Arndt, C, R. Benfica, N. Maximiano, A. Nucifora, and J. Thurlow. (2008). “Higher Fuel and Food Prices: Economic Impacts and Responses for Mozambique.” *International Food Policy Research Institute.*

Carter, M. R., & Barrett, C. B. (2006). “The Economics of Poverty Traps and Persistent Poverty: An Asset-based approach.” *Journal of Development Studies*, 42(2), 178-199.

Carter, M. R., & Lybbert, T. J. (2012). “Consumption versus Asset Smoothing: Testing the Implications of Poverty Trap Theory in Burkina Faso.” *Journal of Development Economics*, 99(2), 255-264.

Christiaensen, L. (2009). “Revisiting the Global Food Architecture: Lessons from the 2008 Food Crisis.” *Review of Business and Economics.*

Coulombe, H., and Q. Wodon. (2008). “Geographic Impacts of the Food Price Crisis in Sub-Saharan Africa.” *World Bank Economic Review.*

Cudjoe, G., Breisinger, C., & Diao, X. (2010). “Local Impacts of a Global Crisis: Food price Transmission, Consumer Welfare and Poverty in Ghana.” *Food Policy*, 35(4), 294-302.

Deaton, A. 1989. “Rice Prices and Income Distribution in Thailand: A Non-Parametric Analysis.” *The Economic Journal* 99 (395).

D’Souza, A., Jolliffe, D. (2012). “Rising Food Prices and Coping Strategies: Household-level Evidence from Afghanistan.” *The Journal of Development Studies.*

Giesbert, L., & Schindler, K. (2012). “Assets, Shocks, and Poverty Traps in Rural Mozambique.” *World Development*, 40(8), 1594-1609.

Goh, C., Kang, S. J., & Sawada, Y. (2005). “How did Korean Households Cope with Negative Shocks from the Financial Crisis?” *Journal of Asian Economics.*

Headey, D. D. (2013). “The Impact of the Global Food Crisis on Self-assessed Food Security.” *World Bank Economic Review.*

Hoddinott, J. (2006). “Shocks and their Consequences across and within Households in Rural Zimbabwe.” *Journal of Development Studies*, 42(2), 301-321.

Lawson, D., & Kasirye, I. (2013). “How the Extreme Poor Cope with Crises: Understanding the Role of Assets and Consumption.” *Journal of International Development.*

McKenzie, D. J. (2005). “Measuring Inequality with Asset Indicators.” *Journal of Population Economics*, 18(2), 229-260.

Mitchell, D. (2008). “A Note on Rising Food Prices.” *The World Bank, Policy Research Working Paper Series.*

Rankin, B. H., Aytac, I. A., & Kavakli Birdal, N. B. (2013). “2008 ekonomik krizinin olasi etkileri ve turkiye’de kentlerde evli ciftlerin yasadigi hanelerde kullaninlan basetme yontemleri. (the 2008 economic crisis and household coping strategies among married urban families in turkey. with english summary.).” *Middle East Technical University Studies in Development.*

Tiwari, S., & Zaman, H. (2010). “The Impact of Economic Shocks on Global Undernourishment.” *The World Bank, Policy Research Working Paper Series.*

Verpoorten, M., Arora, A., Stoop, N., & Swinnen, J. (2013). “Self-reported Food Insecurity in Africa during the Food Price crisis.” *Food Policy*, 39, 51-63.

Wodon, Q., & Zaman, H. (2010). “Higher Food Prices in Sub-Saharan Africa: Poverty Impact and Policy Responses.” *World Bank Research Observer.*

Yilma, Z. (2014). “Coping with Shocks in Rural Ethiopia.” *Journal of Development Studies*, 50(7), 1009-1024.

Zimmerman, F. J., & Carter, M. R. (2003). “Asset Smoothing, Consumption Smoothing and the Reproduction of Inequality under Risk and Subsistence Constraints.” *Journal of Development Economics*, 71(2), 233-260.