Booms, Busts, and Household Enterprise: Evidence from Coffee Farmers in Tanzania[*]

Achyuta Adhvaryu[†]
Namrata Kala[‡]
Anant Nyshadham[§]

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Abstract

Smallholder agricultural commodity suppliers in developing countries are often vulnerable to global commodity price fluctuations. We study coping behavior by linking panel data on smallholder coffee farmers with a time series of global coffee prices. We document that global prices matter, through their effects on farmgate prices, coffee sales and revenues, and household expenditures. We show that during coffee price busts, enterprise ownership increases significantly, an effect that is driven by households without access to other means of coping. Enterprises used only for weathering shocks perform poorly, suggesting the need for more effective coping mechanisms for smallholder commodity farmers.

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[†]University of Michigan, e-mail: adhvaryu@umich.edu. web: www.achadhvaryu.com
[‡]Yale University, e-mail: namrata.kala@yale.edu. web: www.namratakala.com
[§]University of Southern California, e-mail: nyshadha@usc.edu. web: www.anantnyshadham.com

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1 Introduction

Commodity exports make up a large share of agricultural livelihoods in many low-income countries (Deaton 1999).[1] As price-takers in global commodity markets, smallholder farm households are often at the mercy of unpredictable events a world away. This is especially true in countries where government protections against price volatility are weak (van Hilten 2011). Household vulnerability is exacerbated by the fact that, though markets for savings, credit, and insurance exist in low-income agricultural contexts, they often function very poorly (Burgess and Pande 2005; Cole et al. 2013; Dupas and Robinson 2013; Karlan et al. 2013). Informal coping mechanisms, such as intra-village or intra-household transfers (Townsend 1994), labor-related migration (Bryan, Chowdhury, and Mobarak 2013; Dinkelman 2013; Morten 2013), and the like also exist, but are often imperfect. Furthermore, to the extent that households produce the same agricultural goods, commodity price shocks can create aggregate busts that are even more difficult to weather.

In this highly constrained environment, how do smallholder commodity producers cope with global price fluctuations that can generate dramatic shifts in farm profits as well as other shocks to income and productivity more generally? We study this question in the context of coffee farming households in Tanzania.[2] Linking detailed panel survey data on households to a time series of coffee prices, we find that global prices robustly predict farm gate prices, quantity sold and revenues from coffee, as well as household food and non-food expenditures. We show that to cope with price busts–and perhaps with any income/productivity shock more generally–, households resort to small-scale enterprise activity.[3] A one standard deviation drop in the global price increases the probability of enterprise ownership by about 5 percentage points, or 13 percent above mean ownership.[4] Most of this response takes the form of merchant business

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[1]For example, cocoa, Ghana's principal agricultural export, accounts for 22 percent of the country's farmland; there are more than 800,000 smallholder cocoa farmers in Ghana, and many more working at downstream stages of the supply chain (Ghana Ministry of Food and Agriculture 2011). Similarly, in Brazil, the world's largest coffee producer, 3.5 million individuals' livelihoods are supported primarily by coffee farming (Souza 2008).

[2]Coffee farming has some important features that help us generate unbiased estimates of the effects of agricultural profitability shocks. A main concern for identification is that households react to coffee prices by changing the intensity of coffee farming, or start or stop coffee farming altogether, based on the global price. Since coffee trees usually take more than three years to produce their first fruit, short-term entry and exit are not salient concerns for our study. We also verify in our data that global coffee price fluctuations did not change selection into the coffee grower sample or affect acreage under coffee.

[3]It is important to note that during these global coffee price busts, coffee-farming households still harvest the coffee but indeed sell the coffee immediately at the prevailing low price or store the coffee hoping to sell coffee in the future at a higher price, net of the depreciation due to rotting, etc. In either case, the net result is the same; that is, coffee-growing households suffer from lower farm incomes during low coffee price periods, sometimes disproportionately lower incomes due to increased storage of yields during low price periods.

[4]It is important to note that we believe the results of this study are not unique to agricultural household coping behaviors in response to global commodity price shocks, but are likely generalizable to other income and productivity shocks faced by these households. Indeed, Adhvaryu and Nyshadham (2013) document similar behaviors in response to temporary, acute health shocks to members of the household. In fact, in our current setting, one could

(e.g., roadside vendors selling farm goods) and is concentrated among households with less resources for coping, such as physical and financial assets. By and large, we find that other coping strategies–such as borrowing, outside wage employment, or changing the intensity of farming for other crops–are not salient in this context.

The idea that transient enterprise activity plays a primary role in coping with income shocks is not new to development economics.[5] Nor, perhaps, is this finding surprising, given that a majority of agricultural households in low-income countries own and operate informal, non-farm enterprises.[6] Most of these household enterprises are very small, usually consisting of a single business owner, sometimes with unpaid help from family members, and less frequently with hired workers (Kweka and Fox 2011). These businesses rarely formalize or transition into larger firms (Schoar 2009). Most households devote only a small fraction of their total labor to the enterprise sector, and frequently start and stop business operations, sometimes switching multiple times a year.[7] All these stylized facts are consistent with our result that enterprise is used as a coping mechanism for some households in agricultural contexts.

Yet, as only dabblers in business, it is not clear that agricultural households stand to reap large returns from intermittent enterprise activity. We document two facts in support of the hypothesis that enterprise is a second-best coping mechanism. First, households with greater physical and financial assets, which can be bartered for cash when farm profits are low, are significantly less likely to open a business during coffee price busts. The average effect is driven by households without access to these other (potentially more effective) mechanisms. Second, enterprises used only for weathering shocks (i.e., those businesses that are only open during coffee price busts) perform very poorly compared to enterprises that operate more consistently (i.e., throughout the time period of the panel). These intermittent business owners use less labor and working capital, and realize much lower profits.

Our study makes four contributions. First, we add to the literature on coping mechanisms in low-income contexts. Studies have demonstrated that households undertake a variety of measures to mitigate the deleterious effects of income shocks, including savings (Paxson 1992), wage labor (Kochar 1999), and temporary migration (Bryan et al. 2013; Dinkelman 2013; Morten 2013). We add household enterprise to this set of mechanisms. Ours is the first empirical test to our knowledge of the hypothesis that intermittent enterprises serve as a means of weathering

imagine using rainfall shocks or other such determinants of agricultural productivity as measures of income uncertainty; however, we contend that fluctuations in global commodity prices reflect more excludable instruments for agricultural profitability than do rainfall fluctuations, which have direct impacts on acute health, road infrastructure, etc.

[5]See Fields (1975) for the canonical model of transitional self-employment. More recent work by Schoar (2009) and de Mel, McKenzie, and Woodruff (2010) describes some evidence in support of this model.

[6]For example, household enterprises are important economic activities for 30 to 50 percent of agricultural households in Africa; that fraction is about 60 percent in south Asia (Ellis 1999). In our data from Tanzania, 56% of coffee-farming households own and operate a household enterprise at least once during the 3.5 year survey period.

[7]See, e.g., Adhvaryu and Nyshadham (2013) and Nyshadham (2013).

shocks to agricultural incomes. These results are particularly important where access to the aforementioned mitigation mechanisms is limited. For example, while the use of intermittent wage labor as a means of weathering farm income shocks has been shown in some regions of the world like India (Kochar 1999; Jayachandran 2006), the data from our sample of agricultural households in Kagera, Tanzania shows very little smoothing activity along this dimension.

Second, we add to the understanding of household enterprises in developing countries. In part due to their smallness and transience, and perhaps to what many perceive as a lack of potential for growth, little academic or policy attention has been paid to these enterprises, despite their high prevalence in low-income contexts. The wave of recent literature on barriers to micro-enterprise growth has mostly focused on the constraints and dynamics of small businesses owned by individuals for whom enterprise is their primary labor activity or source of income.[8] Household enterprises, particularly transient businesses in agricultural contexts, are thus often excluded from these studies by design. Despite the frequency with which agricultural households engage in non-farm enterprise activity, we know little about when and why these micro-businesses crop up, how successful they are, and whether they should be encouraged via policy intervention. Our results suggest that one role for these enterprises is as a salient, albeit flawed, method of coping during agricultural sector busts.

Third, our evidence complements the macro literature on non-agricultural self-employment. One key stylized fact in this literature is that self-employment and transitions from unemployment to self-employment are strongly countercyclical (Bosch and Maloney 2008; Fiess, Fugazza, and Maloney 2010; Loayza and Rigolini 2011; Koellinger and Thurik 2012; Finkelstein and Shapiro 2013). We show that this is true for self-employment in agricultural areas as well.

Fourth, we contribute policy insights regarding protecting against commodity price volatility. We demonstrate that negative global price shocks can be disastrous to low-income smallholder farmers. Insulating households from excessive volatility (via, e.g., cooperative-based savings schemes, price floors, and commodity storage facilities) should thus be a primary policy concern in producer countries. Moreover, since, as we show, the businesses used to weather shocks perform poorly, particularly during commodity price busts, policy should focus on improving markets in rural areas for potentially better means of coping, such as savings, credit, and insurance.

The remainder of the paper is organized as follows. Section 2 describes the world market for coffee and provides institutional details on coffee production in Tanzania. Section 3 describes our data set and construction of important variables. Section 4 presents our empirical strategy and discusses its validity. Section 5 presents results from the empirical tests of the main predictions of the model. Finally, section 6 concludes.

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[8]This literature is reviewed in McKenzie (2010) and McKenzie and Woodruff (2012).

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2 Context

In this section, we provide background information on coffee farming, the world coffee market and the specific institutional context explored in the empirical analysis below.

2.1 Coffee Farming

Coffee is a berry fruit that grows on short trees or shrubs. All coffee species are indigenous to Africa and some Indian Ocean islands such as Madagascar. Though there are at least 25 major species of coffee, the two most economically important species are arabica and robusta. Coffee trees take up to 2-3 years to first produce fruit, and can live up to 100 years, though their productive life is only 50 years. Arabica is, in general, considered the higher quality species, commanding a higher price in trade but more susceptible to quality differentiation. Though robusta trees take longer to produce fruit, flower irregularly, and have a higher caffeine content, their berries command a lower price due to a higher yield and a lower sensitivity to growing conditions (can grow in higher temperatures, lower altitudes, and moderately wet to extremely wet climates and is less susceptible to pests). Arabica is grown predominantly throughout Latin America, in Central and East Africa, and India. Robusta is grown in West and Central Africa, throughout Southeast Asia, and in Brazil. (www.ico.org). About 90% of coffee is produced in developing countries (Ponte 2002), the majority of it by smallholder farmers (Oxfam 2001).

2.2 World Coffee Market

Coffee is a major commodity traded in the global market, with 97 million bags of 60 kg being shipped and trading worth US $16.5 billion occurring in 2010. Major producing countries comprise Brazil, Vietnam, and Colombia, and major consuming countries include the United States, Japan, and Germany (Coffee Exporter's Guide 2012). International coffee prices can be of four types - physicals, indicator prices, futures, and differentials. Physical prices are those that are determined differentially for coffees of different quality on a day-to-day basis determined by supply and demand. The ICO also determines and publishes indicator prices, which are spot prices for four broad types of coffee: Colombian mild arabicas, Other mild arabicas, Brazilian and other natural arabicas, and robustas. Unlike physical prices, these do not differentiate by quality within a category, and are determined by the average supply and demand of specific growths of coffee within a category.[9] In addition, the ICO publishes a combined version of these four prices, which is the international spot price of coffee. Thirdly, futures prices are projections of prices for certain future time periods for arabica and robusta. Finally, differentials represent

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[9] For more detail regarding the specific growths that are part of each of the four indicator price calculations and other methodological details, refer to Procedures for the Collection, Transmission, Calculation And Publication of Group And Composite Prices Effective from 1 October 2001.

the price differences between futures prices and the individual prices. Since price differentials are complicated by the varying availability of and demand for different kinds of coffee, they can be very volatile on a daily basis.

2.3   Small-Holder Coffee Farmers in Tanzania

Coffee is one of Tanzania's largest exports. Tanzania produces between 30 and 40 thousand metric tonnes of coffee each year, almost entirely for export. It produces about 0.8% of world output (Tanzania Coffee Board Report 2010), with both arabica and robusta species being grown in different regions of the country. Roughly 70% of its exports are arabica and the other 30% is robusta. However, though Tanzanian coffee production centers around arabica, the data we use in our empirical analysis comes from a panel survey of households in the Kagera region of Tanzania near Lake Victoria, which is the predominant area of robusta cultivation in Tanzania. Accordingly, we focus our study on fluctuations in the export price of robusta coffee, rather than arabica, and use robusta indicator prices in our analysis. Given the largely distinct growing regions of the world, optimal growing conditions, and pest susceptibility, the international prices of arabica and robusta exhibit a great deal of independent variation. Figure 1 presents a graph of robusta indicator prices during our survey period.

Co-operative unions and primary societies at the village level have traditionally been the main institutions undertaking procurement of coffee from farmers (Baffes 2005). The Tanzania Coffee Marketing Board is the primary government body in charge of regulation of the coffee industry. Farmers deliver coffee to the primary societies, which transports it to union-owned processing facilities. Post-processing and grading, the coffee was delivered to the Marketing Board, and transported to regional auctions from where it is purchased by private buyers and subsequently exported.

There have been some institutional changes beginning in 1990 to minimize losses of co-operative unions and private societies. For instance, prior to 1992, farmers would receive an initial payment on delivery that was based on a pre-announced price by the Coffee Board. After sales at the auction, the Board would deduct fees and transfer the remaining revenues to the co-operative unions, who then deducted their input credits if any and their processing costs before transferring the remainder to primary societies. The primary societies deducted their own costs and if there was money left over, this was given to the farmers. In 1990, the Board delegated some payment authority to the co-operative unions and made attempts to make payments more timely (Baffes 2005). In 1992, the authority to decide the advance payments as well as the total payments were delegated to the unions, and the Board stopped pre-announcements of the initial payments.

More far-reaching reforms that allowed private traders to purchase directly from farmers occurred in 1994, designed to incentivize farmers to improve quality by ensuring they get a

higher proportion of export prices. Since our survey data ends in 1993, we do not have these larger policy changes affecting our data.[10] Econometrically, we ensure that our estimates are not affected by any policy changes before 1994 by using year and month fixed effects. Our empirical strategy section discusses our estimation process in detail.

3   Data

This study uses survey data from the Kagera region of Tanzania, an area west of Lake Victoria, and bordering Rwanda, Burundi and Uganda. Kagera is mostly rural and primarily engaged in producing bananas and coffee in the north, and rain-fed annual crops (maize, sorghum, and cotton) in the south. The Kagera Health and Development Survey (KHDS) was conducted by the World Bank and Muhimbili University College of Health Sciences. The sample consists of 816 households from 51 clusters (or communities) located in 49 villages covering all five districts of Kagera, interviewed up to four times, from Fall 1991 to January 1994, at 6 to 7 month intervals. The randomized sampling frame was based on the 1988 Tanzanian Census.

A two-stage, randomized stratified sampling procedure was employed. In the first stage, Census clusters (or communities) were stratified based on agro-climactic zone and mortality rates and then were randomly sampled. In the second stage, households within the clusters were stratified into "high-risk" and "low-risk" groups based on illness and death of household members in the 12 months before enumeration, and then were randomly sampled. There was moderate attrition from the longitudinal sample - 9.6% of households sampled in wave 1 were lost by wave 4. However, to preserve balancing across health profiles in the sample, lost households were replaced with randomly selected households from a sample of predetermined replacement households stratified by sickness. KHDS is a socio-economic survey following the model of previous World Bank Living Standards Measurement Surveys.

The survey covers individual-, household-, and cluster-level data related to the economic livelihoods and health of individuals, and the characteristics of households and communities. Our sample is confined to households who reported harvesting coffee at least once in the survey period (1991-1994), which includes over 80% of the households in the entire sample. We combine the Kagera household survey with data on monthly international coffee prices available with the International Coffee Association.

The monthly prices are robusta coffee prices, which is primarily the variety of coffee grown in the Kagera region. Figure 1 shows the graph of monthly prices from the survey period (1991-1994). During this period, prices were relatively low compared to the historical average.

In the following paragraphs, we outline the variables we use in our analyses. A more detailed description of the definition of each of the variables used in the analysis can be found in

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[10]For a comprehensive study of Tanzania's coffee sector and reforms, refer to Baffes (2005).

the data appendix. Tables 1 and 2 present summary statistics for international coffee prices as well as the household-level variables used in the analysis.

3.1   Price Lag Variable

The first wave of the survey asked households about their economic and labor activities in the 12 months preceding the survey. The second, third, and four waves of the survey however, asked households about their economic and labor activities in the last 6 months. This is because the time lag between waves was about 6-7 months, and the questions were changed to avoid questions about overlapping time periods. In order to estimate the impact of international coffee price fluctuations on the household, we match the outcome variables to the appropriate international price faced by the household at the time when it made decisions regarding labor allocations and microenterprise ownership.

Since we have information on the month and year in which households were surveyed, we matched the average international price for the time period about which the survey asked. In the first wave, this was the average price for the last 12 months preceding the survey month of the households, and for the subsequent waves, it was the average price for the last 6 months. Thus, if a household was interviewed in wave 1 in September 1991, the price faced by the household is the average international robusta coffee price from September 1990- August 1991. If it was interviewed in any wave other than the first, the price faced by the household is the average international robusta coffee price for the preceding 6 months - for instance, if a household was interviewed in September 1993, prices from March 1993-August 1993 would be considered.

The average price computed in this manner is about 46 cents/lb, with a standard deviation of about 3.9 cents/lb. Our independent variable of interest is the lagged robusta price divided by its standard deviation over the survey period. The coefficient on this variable is the marginal effect of a one standard deviation in the price.[11]

3.2   Household-Level Variables

At the household-level, we examine the impact of coffee prices on revenues from coffee, consumption expenditure and microenterprise ownership. Since surveys were carried out after about 6 months following the first survey, the period to which the survey questions pertain is the last 12 months for the first wave, and for the last 6 months for the three subsequent waves. Area harvested for coffee is on average only about 10% of area harvested by households, but

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[11]Note we have chosen to use spot prices in the analysis as opposed to futures prices or other price series. This was done for two reasons: 1) historic futures prices for robusta covering the study period are hard to come by from reliable sources, and 2) the correlation between spot prices and futures prices when contemporaneously available is very near to 1.

annual revenues from coffee sales comprise about 43% of agricultural revenues for the sample, which increase to 67% if only households reporting non-zero coffee revenues are included. Thus, it is a significant component of household income.

Regarding micro-enterprise ownership, almost 40% of the households reported owning an enterprise over the four waves. As Table 2 indicates, about 44% of households reported never owning an enterprise, and about 12% owned an enterprise in all four waves. Over half the enterprises owned are merchant businesses, which are enterprises that undertook trading or other informal non-farm self-employment. Non-merchant businesses are those that require skilled or semi-skilled labor, and include enterprises such as stall keeping and restaurant ownership to professions such as blacksmith, plumber, or carpenter. For a full description of the included categories, please refer to the data appendix. The main distinction between these two types of enterprise is that merchant businesses require relatively little or no investment in fixed or human capital.

To analyze intensive-margin household enterprise decisions, we examine several intensive margin variables for four categories of households. The first category is households who own at least one enterprise for all four waves. We label these households "stayer" households. About 12% of the households in the sample are these stayer households. Other households who own an enterprise at least once but are not stayers are labeled "switcher" households, since they switch enterprise status during the course of the panel. Switcher households comprise about 50% of the households in our sample. The switchers are further divided into two categories. The first is households that only own an enterprise when the coffee price is low, as defined by when the price is below its 25% percentile value for the survey period. They are labeled "coper" households, since we posit that these households use enterprise as a means of weathering income shocks. As indicated in Table 2, about 6% of households are copers. The second category is all other switcher households, who comprise about 44% of the sample households.[12] We examine the intensive margin outcomes for these categories of households to test whether these households make different enterprise decisions and have differently performing enterprises, as well as to study the relative success of using enterprise as a coping mechanism. Table 1 presents summary statistics for ownership, intensive margin outcomes, and household and financial characteristics of the whole sample as well as all the four categories of the households. As discussed in the following paragraphs, the largest contrast amongst intensive margin variables are between the stayers and the copers, with most of the intensive margin variables for the other switcher households lying in between. Note that since these variables are considered conditional on owning an enterprise, these values are not driven mechanically by the fact that

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[12]Note that, while coper households are not particularly numerous in the data, they make up roughly 12.5% of the sample of switcher households more generally and roughly 10% of the households who ever operate an enterprise in the sample. This comparison of the coper households with stayers and other switchers will form the basis of the performance results discussed below.

stayer households own a business for longer periods.

The intensive margin variables studied comprise three categories of enterprise operations - capital assets, labor and performance. The first category is composed of three variables - a binary variable for whether the enterprise owns a capital asset, a binary variable for whether the enterprise bought or sold a capital asset, and the total input expenditure in the survey period.

The majority of enterprises - about 77%- own a capital asset, although the number is relatively larger for the stayers, about 87%, and relatively low for the copers, about 43%. The difference amongst the four categories is lower for binary variable for whether the enterprise bought or sold a capital asset during the survey period. Average input expenditures are about 2,961.23 Tanzanian shillings (TZS) for the whole sample. The expenditures for copers are 585.50 TZS, and nearly 10 times larger , about 5,071.23 TZS for the stayer households. Input expenditures for the other coper households are 1,881 TZS, midway between the stayers and copers.

The labor category comprises three variables - the first is the number of weeks spent in self-employment during the survey period for all household members who reported working in self-employment in the last 7 days, aggregated up to the household-level. On average, households spend about nearly 15 weeks in self-employment, though stayer households spend about 21 weeks, coper households spent only about 5 weeks, and other switcher households spend about 11 weeks. The second labor category variable is a binary variable for whether a household member helped in the enterprise, which on average was true for about 34% of the entire sample, and ranged from 27% for the copers and nearly 40% for the stayers. The third variable is a binary variable for whether a hired worker was employed in the enterprise. Only about 17% of enterprise- owning households hire a worker. Stayers households are the most likely to hire workers at about 26%, though the copers and other switcher households have similar likelihoods, 12% and 14% respectively.

The performance category consists of two variables - the number of months the enterprise has been operating, and a binary variable for whether the business had positive profits in the reference period. The literature on entrepreneurship has highlighted the issues with accurate measurement of financial flows for micro-enterprises in developing countries (de Mel, McKenzie, and Woodruff 2009). For this reason, we consider the binary profitability measure to have lower measurement error than a continuous measure of profit. For the first outcome, in case the the household owned multiple enterprises, we consider the enterprise that has been operating the longest. Coper households operate their business only for 2.8 months of the last 6-12 months[13] on average, while stayer enterprises are much more active, operating for 5.5 months. Enterprises owned by the switcher households operated for about 4 months on average. On average about 54% of enterprise-owning households reported positive profits for at least one

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[13]As noted previously, the survey period is the last 12 months for the first wave, and the last 6 months for the second, third, and fourth wave.

of their enterprises. This figure was lower for copers, about 27%, and higher for stayers, while nearly 66% of stayer households reported positive profits. As with most other intensive margin variables, the outcome for other switcher households was in between - about 49% of these households had profitable enterprises.

Table 1 also includes summary statistics for the characteristics of the household head and measures of financial resources of the household. These characteristics are taken from the first wave that each household appears and treated as fixed for the purposes of exploring heterogeneous enterprise activity responses to coffee price fluctuations in Table 5 below. Household head characteristics comprise gender, literacy and numeracy skills, and a binary variable that is 1 if the household head underwent some primary schooling and 0 otherwise. Financial resource measures comprise six measures, that indicate whether a household sent and received remittances, whether the household had positive savings, whether it had positive debt, and two indicator variables for whether the household's financial and physical stock were above the sample median values of financial and physical stock respectively. As Table 2 indicates, stayer households are more likely to have a male household head who is literate and numerate relative to the whole sample, especially the coper households. Their measures of financial resources are also higher relative to the sample - for instance, they are about 18 percentage points more likely to have financial stocks that are greater than the median value in the sample. The gap is larger relative to the coper households - stayer households are 24 percentage points more likely to have financial stocks that are greater than the median value relative to the coper households.

Households are relatively similar along certain dimensions such as gender of the household head, though stayers are more likely about 6% more likely to have a male head of the household. Thus, on average, the stayers operate their enterprises on a more regular basis, work for longer in their enterprises, are more likely to own an asset and hire workers, as well as more likely to be profitable compared to either of the switcher households categories. These outcomes are reversed for the coper households, and the other switcher households usually have outcomes that are in between these two categories.

Table 2 presents the ownership histories wave by wave, in conjunction with coffee prices.

4   Empirical Strategy

The empirical analysis proceeds in four stages.

First, we seek to determine the extent to which global coffee prices matter for our sample of coffee farmers. We do this by testing whether global prices are correlated with the farmgate coffee prices that farmers face, and whether the global price affects quantities of coffee harvested, coffee revenues, and household expenditures on food and non-food items.[14]   The following

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[14]Since the farm-gate price that households face is likely endogenously determined (for example, bargaining

model is estimated at the household x wave level, for outcome O, price p, and month (θ_m), year (δ_y), and household (μ_h) fixed effects:

$$O_{hmy} = \alpha + \beta p_{my} + \mu_h + \delta_y + \theta_m + \epsilon_{hmy}. \tag{1}$$

As described in the previous section, price p varies at the month x year level. Households surveyed in the same month of a particular wave will thus face the same (retrospective) coffee price; households that happen to have been surveyed in different months of the same wave will face differing prices.

Second, we estimate how fluctuations in the coffee price affect business ownership. In the coffee grower household sample, we regress an ownership dummy on the coffee price, as well as month, year, and household fixed effects using model specified in equation 1. We also make a distinction between merchant and non-merchant businesses, as defined in the previous section. We regress these two ownership variables in separate specifications to study whether sensitivity of business ownership to coffee price fluctuations is different across business types.

Third, we examine differences in business performance (inputs, duration of operation, and profits) across switchers ($S = 1$) and stayers ($S = 0$). For business performance outcome B, we estimate the following random effects (denoted ρ_h) specification:

$$B_{hmy} = \alpha + \beta S_h + \rho_h + \delta_y + \theta_m + \epsilon_{hmy}. \tag{2}$$

In addition, we estimate how "coper" households compare with other switcher households relative by via the following specification:

$$B_{hmy} = \alpha + \beta_1 R_h + \beta_2 Q_h + \rho_h + \delta_y + \theta_m + \epsilon_{hmy}. \tag{3}$$

where R_h is a dummy variable that equals 1 if the household is a coper household and Q_h is a dummy variable that equals 1 if the household is a different kind of switcher household. Wald tests of whether β_1 is different from β_2 for the different intensive margin variables test for whether coper households' enterprises are run and perform differently from other switcher households.

Finally in this section of the empirical strategy, since coper households are more likely to own an enterprise during low price periods by contruction, we restrict the above comparison to low price periods. Thus, we run the previous random effects specification restriced to low price periods (periods when the robusta price is below the 25th percentile of its values during

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power of the household or the farming cooperative to which the household belongs could influence farm-gate price), we focus instead on the international price of coffee. Absent stringent price control policies (which were not relevant for our time period in Tanzania), fluctuations over time in the international coffee price should generate exogenous changes in farm-gate prices, and should thus impact agricultural profitability for coffee-growing households.

the survey period).

Fourth, we estimate equation 1 for other possible means of weathering shocks, such as savings, debt/loans, and remittances.

Standard errors in all regressions are clustered to allow arbitrary correlation in the error term at the level of the enumeration cluster.

5   Results

In this section, we present the results of the empirical analysis proposed above. The aim of this section is to understand household responses in enterprise activity to fluctuations in agricultural profitability deriving from the global price of coffee.

5.1   Preliminary Graphical Analysis

Before discussing the results from the empirical analysis presented in section 4, we begin with a descriptive graphical analysis of the data. We hypothesize that some coffee-growing households will be more likely to start up enterprises when the global coffee price drops and more likely to shut down these enterprises when the price rises. Figure 2 depicts the percentage of households in each month of the survey that report owning an enterprise against the 6 month lagged mean of the international price of robusta coffee. It provides descriptive evidence of countercyclical enterprise ownership as well as some evidence of a steady rise in entrepreneurship among coffee-growing households.

Figure 3 plots separately the percentage of households in each month of the survey that report owning merchant and non-merchant enterprises along with the coffee price over time. The patterns suggest that the countercyclical enterprise response to coffee prices seems to be primarily in merchant enterprises, while non-merchant enterprises contribute the steady acyclical rise in entrepreneurship in the coffee-growing sample. Next, we employ panel regression analysis, as outlined in section 4 to more rigorously investigate the relationships between enterprise activity and coffee price fluctuations among coffee-growing households.

5.2   Effects of Global Prices on Farming Decisions and Expenditures

To begin the regression analysis, we first verify that global coffee prices actually matter for the coffee farmers in our sample. The general idea is to regress measures of coffee farmgate pricing and production, as well as household expenditures, on the global coffee price. Results are reported in Table 3.

We first investigate the relationship between the global price and the farmgate price, imputed from our transactions data. The results, reported in column 1 of Table 3, demonstrate that

the farmgate price is very sensitive to movements in the global price: a one standard deviation (SD) increase in the global price increases the farmgate price by more than a tenth of its standard deviation .[15]

Next, we examine effects of coffee price fluctuations on whether a household sold a positive quantity of coffee and whether it received positive coffee revenues. These results, reported in columns 2 and 3, show that a one SD change in the global price of coffee increases the probability that a household sold some coffee and received some amount of coffee revenues by roughly 9 and 5.5 percentage points, respectively. The estimates are significant at the 1 and 5 percent level, respectively; and the results are consistent with an upward-sloping supply of coffee.

Lastly, we explore the extent to which households are able to smooth consumption in the face of coffee price fluctuations. We regress total household expenditures on the global coffee price and find strong evidence against perfect smoothing. Total expenditures increase by more than 45,000 TSh (from a mean of roughly 220,000) amongst coffee-farming households for a one SD rise in the coffee price (column 4). We then split expenditures into food and non-food categories, and find substantial changes in expenditures in both corresponding to movements in the coffee price. Both food expenditures (column 5, approximately 9,000 from a mean of nearly 40,000) and non-food expenditures (column 6, approximately 12,000 from a mean of more than 75,000) reflect large variations in response to shocks to the global coffee price.

Despite these large, unmitigated impacts of coffee price shocks on household revenues and expenditure, price variations do not significantly predict movements along either the extensive (column 7) or intensive (column 8) margins of coffee growing. That is, column 7 reports that a one SD increase in the price of coffee insignificantly reduces the probability of a household harvesting some amount of coffee by .7 percentage points; while column 8 reports that the same price increase drives households to harvest only .02 acres more of coffee (albeit insignificantly).

We interpret both results as evidence of no short-run relationship between coffee price and coffee-growing. A lack of response in coffee-growing on the part of households is mostly due to the long time to yield for coffee. This stability in the sample of coffee-growing households allows us to focus on responses along other margins such as participation in the enterprise sector and labor and capital allocations across sectors.

5.3 Household Enterprise Activity and Coffee Price Fluctuations

Having verified the impacts of coffee price shocks on household revenues and expenditures and shown that coffee price does not affect the sample of coffee-growing households, we examine whether global coffee price changes affect the probability of non-agricultural business owner-ship among coffee-growing households. Results of this analysis are reported in Table 4. Column

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[15]It bears mentioning that we can only impute the farmgate price for households who had non-zero coffee revenues in the 6-month window prior to survey.

1 shows results of a regression of an enterprise ownership dummy on the coffee price. We find that a one SD rise in the global price *decreases* the probability of enterprise ownership by about 5 percentage points, about 13 percent of mean ownership. We interpret this finding as strong evidence of countercyclical household entrepreneurship in our sample. On average, households are much more likely to engage in enterprise activity during coffee price busts, and shut their businesses during coffee price booms.

In columns 2 and 3, we examine ownership of merchant and non-merchant businesses. The results show quite strongly that households are much more likely to cope with income variations due to coffee price shocks using merchant businesses. A one SD rise in the coffee price leads to a 4.28 percentage point drop in the probability of a household owning a merchant enterprise. Ownership of non-merchant businesses, on the other hand, does not vary significantly with the coffee price, and the coefficient is a quarter of the size of the impact of coffee price on merchant-type business ownership. These regression results verify the patterns depicted in Figures 2 and 3.

Next, we explore the degree to which this enterprise activity response to coffee price fluctuations among coffee-growing households varies by the household's financial resources. That is, to the degree that intermittent enterprise activity appears to be an income shock mitigation mechanism for some households in the sample, we might suspect that this response would be most pronounced amongst households constrained in other obvious dimensions of mitigation (e.g. buffer financial stock, divestible physical capital, access to debt). Accordingly, in Table 5 we report heterogeneous effects of coffee price fluctuations on enterprise activity by various dimensions of financial resources. We interact coffee price with physical asset stock, financial savings, loans issued, debt received, and total asset stock. Total asset stock is equal to the sum of physical asset stock, savings, and loans issued minus debt received. In each specification reported in Table 5, we include the main effects of the financial variables and the coffee price in addition to the their interaction.

We find that the enterprise response to coffee price fluctuations indeed varies by financial resources of the household. Households with greater resources (higher physical and financial asset stock, less debt) are less likely to increase their enterprise activity in response to coffee booms. This heterogeneity in the effects of coffee price on enterprise is significant across all five measures of household resources. Perhaps of interest, the estimates of the main effects of these resource measures indicate that households with greater resources are less likely on average to own enterprises; however, it is unclear which way the causation runs. That is, do households with greater assets choose not to start enterprises, or are households with enterprises likely to draw down their assets or less likely to accumulate assets in the first place. Accordingly, we do not interpret the main effects of resources here, but rather only their interaction with the exogenous coffee price fluctuation.

5.4 Enterprise Inputs and Performance of Switchers, Copers, and Stayers

We have shown that when coffee prices drop, some households (particularly those with limited means and access to financial resources) start non-agricultural enterprises (mostly merchant businesses) as a means of mitigating these shocks. Conversely, these households shut down these enterprises when coffee prices rebound. However, as shown in the summary statistics tables discussed above, some households engage in enterprise activity irrespective of the global price of coffee. We next explore how the businesses of households that stay in enterprise compare in terms of inputs and performance to the businesses of households that switch in and out of enterprises and those that use enterprise only as a means of weathering income shocks.

As mentioned in the data section, we define "stayer" households as those that own an enterprise in all 4 waves of the panel. On the other hand, we define "switcher" households as those that own an enterprise in at least one of the 4 waves in the panel, but not in all 4 waves. Finally, we separate switcher households into "copers" (those that only own enterprises in periods in which the coffee price is in the first quartile of the observed distribution) and "other switchers" (those switcher households that do not qualify as copers by the above definition).

We regress measures of capital and labor inputs as well as business performance on the dummy for "switcher" and report the results in Table 6. Results from regressions of these measures on dummies for "coper" and "other switcher" are reported in Table 6. Columns 1 through 3 of Table 6 show that the enterprises of switcher households are less likely to own assets, less likely to participate in asset transactions, and expend less on average on inputs than those of stayer households.

Similarly, columns 4 and 6 of Table 6 show that switcher households spend less time working in their enterprises and are less likely to hire paid workers for their enterprises. However, column 5 shows no evidence that switcher and stayer households differ in the probability of having household members help with their businesses. Finally, columns 7 and 8 show that switcher enterprises operate for more than a month less in the six months prior to survey and are less likely to turn a positive profit. Overall, the results in Table 6 suggest that switcher enterprises input less into their businesses and do not perform as well as stayer enterprises.

Table 7 shows that the differences in enterprise inputs and performance observed in Table 6 between switcher enterprises and stayer enterprises are even starker between coper enterprises and stayers. The differences between stayers' enterprises and copers' enterprises are roughly twice as large as those between stayers' and other switcher households' in terms of asset ownership, asset transactions, months operating, and profitability. The differences between these differences are statistically significant, as are the differences in weeks spent working for the enterprise and total input expenditure. Overall, the copers appear the least input-intensive and successful of the enterprise households in the sample, followed by other switcher households.

The stayer enterprises are of course the most input-intensive and successful in the sample.

Next, we repeat this exercise for only low price periods; that is, we compare switchers and stayers (and then copers, other switchers, and stayers) keeping only observations in which households are operating enterprises in the presence of first quartile coffee prices. This exercise helps to reveal whether the differences in input intensity and performance among household enterprises, depicted in Tables 6 and 7 above, are due solely to the unique environments in which copers and switchers tend to operate enterprises (i.e. during coffee busts) rather than due, at least in part, to inherent differences in scale or ability of different types of entrepreneurial households.

Specifically, while comparing inputs and performance in all periods for copers and stayers might simply reflect the tendency of the former to operate enterprises only in bad economic environments as compared to the consistent enterprise operation of the latter, restricting this comparison solely to low price periods will help to isolate the contributions of household or enterprise-specific characteristics to input intensity and performance. The results reported in Tables 8 and 9 are from specifications exactly analogous to those in Tables 6 and 7 respectively, except for the restriction of global coffee price to the first quartile of its observed distribution during the study period.

Table 8 shows that switchers are indeed still less likely to own or transact in assets and have lower input expenditure in low price periods than stayer household enterprises. Similarly, weeks of self-employment and the probability of hiring outside workers is also less among switchers than among stayers. Finally, length of operation and probability of turning positive profits are also lower among switchers than stayers, even in low price periods.

In Table 9, we see that in low price periods these differences are still more pronounced between the enterprises of coper households and those of stayer households. In particular, column 1 shows that while all switchers are less likely to own business assets than stayers, even when restricting attention to low price periods, copers are significantly less likely than even other switcher households. This is true of weeks of self-employment, months of operation, and probability of turning positive profits as well, as indicated in columns 3, 7 and 8 respectively.

We interpret the results observed in Tables 8 and 9 as evidence that the differences between copers, switchers, and stayers in terms of enterprise inputs and performance are not entirely due to adverse economic environments, but rather might be at least in part due to a difference in enterprise-specific characteristics such as scale or ability, as well as access to capital and other determinants of entrepreneurial entry and success. That is, when comparing inputs and performance of household enterprises in similarly adverse environments, the enterprises of stayer households are significantly more input-intensive and successful than those of switcher and coper households.

5.5 Other Means of Coping

Finally, having shown that households use enterprise activity as a means of weathering income variations deriving from fluctuations in the global price of coffee, we investigate to what degree households in this empirical context utilize other common means of coping. Namely, the development literature has shown the use of savings, debt, and informal risk-sharing networks. In columns 1 through 4 of Table 10, we present results from regressions of total household savings, debt (from financial institutions), loans (informal), and net remittances received, respectively, on coffee price.

Note that in Table 5 we find strong evidence that savings, debt, and loans are determinants of heterogeneity in the enterprise response to coffee price shocks. However, we acknowledge the endogeneity of these household characteristics and accordingly refrain from estimating their main effects in the specifications presented in Table 5. In Table 10, we study the impact of price shocks on these dimensions and others explicitly. The results in columns 1 and 2 are consistent with households drawing down savings and increasing debt during coffee price busts, but neither coefficients are statistically significant. Estimates in columns 3 and 4 indicate that households actually increase their informal loans and receive more remittances on net during coffee booms, though these coefficients are also insignificant.

Lastly, we investigate the degree to which coffee price fluctuations drive households to use other sectoral participation or production decisions as coping mechanisms. In particular, we regress a binary for whether households worked in wage employment outside of the household and the household's total acreage under crops other than coffee on coffee price. Columns 5 and 6 show no evidence that households use wage employment or crop choice as means of weathering income shocks in this empirical context. Taken together, the results seem to suggest that intermittent enterprise activity is the most utilized means of weathering income shocks deriving from coffee price fluctuations in this setting.

6 Conclusion

We provide evidence for the hypothesis that agricultural households use enterprise activity as a means of mitigating income shocks. Using panel data from a sample of coffee growers in northwest Tanzania, we show that household enterprise ownership goes up by more than 5 percentage points (or about 13 percent above mean ownership) during coffee price busts. This response appears along both the extensive and intensive (labor supply) margins of enterprise and is driven by the merchant activities.

However, household enterprise appears to be a second-best coping mechanism. Enterprise responses are concentrated among households with lower financial and physical assets, indi-

cating that households with other means of weathering shocks do not choose to use household enterprise. Indeed, commonly studied coping mechanisms such as wage labor and informal insurance through income transfers appear infeasible or constrained in this context. Furthermore, intermittent, coper enterprises do poorly compared to stayers on a variety of business performance measures. This relationship is not wholly due to the fact that switchers often operate during busts, when local demand for goods and services is weak, suggesting that switchers and stayers are fundamentally different types of business owners (for example, in terms of entrepreneurial or managerial skill, access to capital, etc.).

Our results suggest two practicable policy prescriptions. First, it is obvious from our analysis of coffee production, revenues, and household expenditures that coffee farmers in our context are very poorly insulated from shocks to the global coffee market. Since smallholder commodity storage is often inadequate, if not altogether nonexistent, households must resort to other means of coping. Yet, despite these mitigation mechanisms, our results show that consumption and expenditure are far from fully insured, and thus welfare must surely suffer. Ways to protect households from global commodity market fluctuations, such as insurance or access to financial derivatives (e.g., price futures).

Second, if we take seriously the idea that there is a distribution of entrepreneurial ability, which governs in part the decision to engage in enterprise along with access to financial resources and production technologies, our results are consistent with the notion that during price busts, households who otherwise would not venture into the enterprise sector are compelled to do so as a means of shock mitigation. These relatively under-equipped households are thus thrust into enterprise despite a dearth of talent, and at a time when local demand is suppressed. For these households, other forms of shock mitigation may hold more value than enterprise activity. Policymakers should consider improving access to and encouraging the use of savings, credit, and insurance as alternate means of coping.

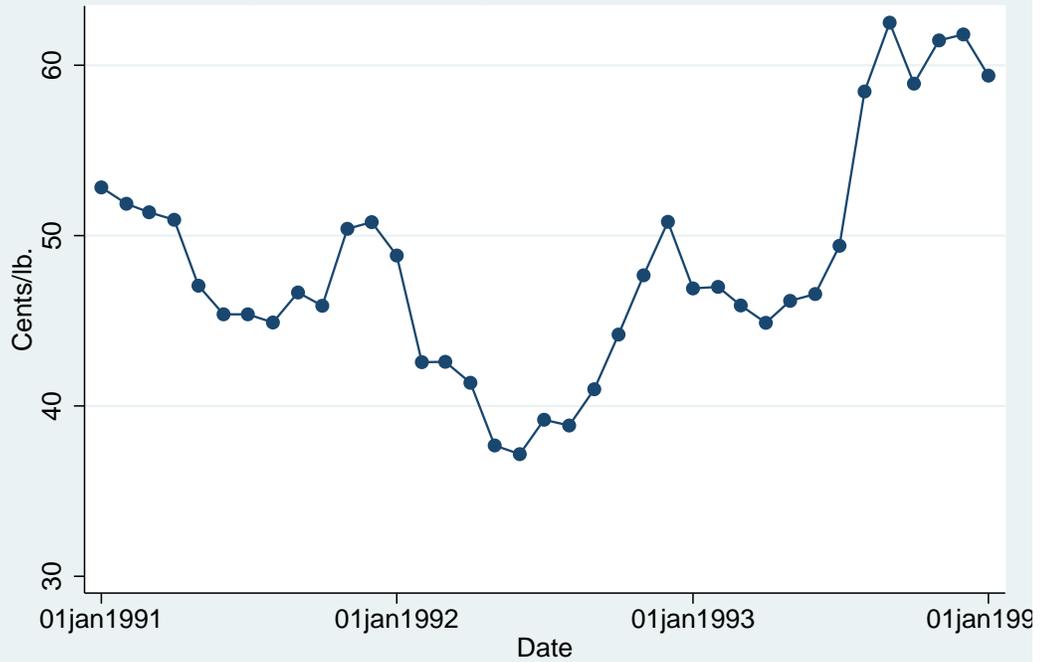Figure 1: Monthly Robusta Coffee Prices

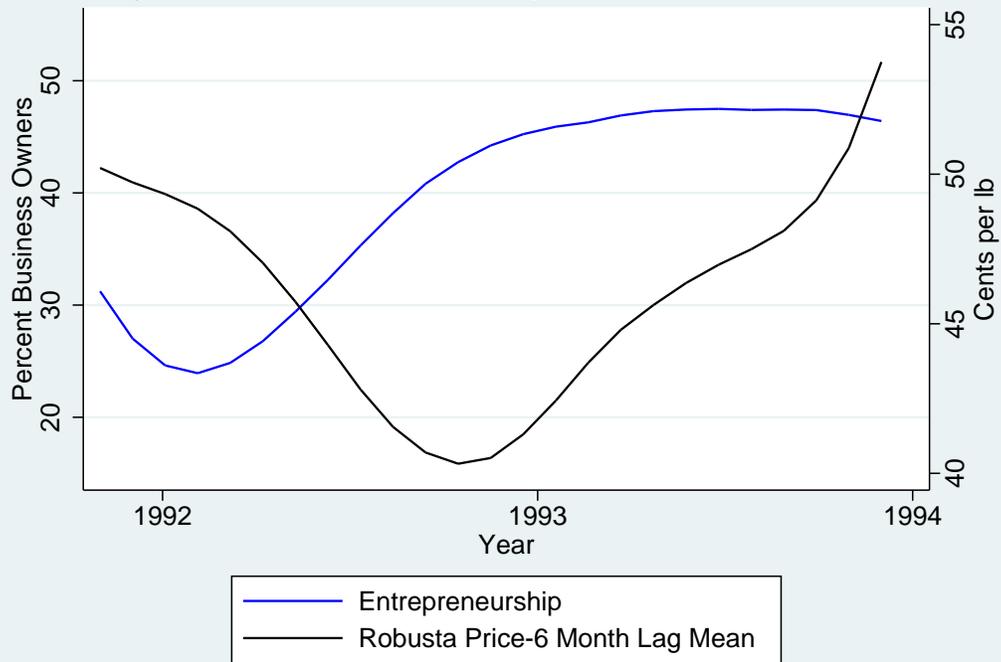Figure 2: Household Enterprise and Coffee Prices

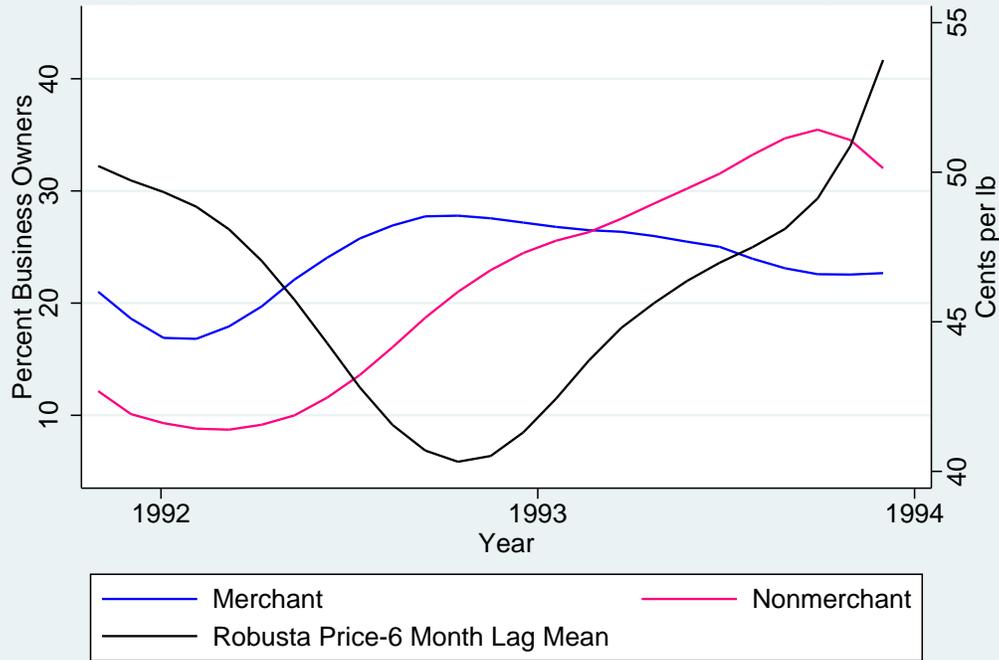Figure 3: Merchant and Non-Merchant Enterprises

Table 1

Summary Statistics: Enterprise Activity, Demographic Characteristics, and Financial Resources

	(1)		(2)		(3)		(4)		(5)	
	All		*Stayers* (households with a business in all four waves)		*Switchers* (households switching enterprise status)		*Copers* (households with a business in low-price periods only)		*Other Switchers* [(3)-(4)]	
Number of household-year observations	2,880									
Number of households	753		102		376		47		329	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Enterprise Ownership										
1(Household has a business)	0.396	0.489	1.000	0.000	0.501	0.500	0.285	0.45	0.537	0.499
Enterprise Activity (Conditional on owning a business)										
1(Household has a merchant business)	0.603	0.490	0.603	0.490	0.601	0.490	0.608	0.493	0.596	0.491
Months business has been operating	4.553	2.740	5.502	2.794	3.964	2.513	2.824	1.873	4.050	2.535
1(Business assets owned)	0.776	0.417	0.874	0.332	0.652	0.477	0.429	0.500	0.668	0.471
1(Business assets bought or sold)	0.215	0.411	0.270	0.444	0.184	0.388	0.118	0.325	0.189	0.392
Total input expenditure	2,961.236	10,034.550	5,071.233	13,529.910	1,790.304	7,164.156	585.504	1,861.204	1,881.064	7,404.277
1(Any household member helping with business)	0.359	0.480	0.397	0.490	0.337	0.473	0.274	0.45	0.342	0.475
1(Hired at least one worker)	0.177	0.382	0.262	0.440	0.124	0.330	0.14	0.35	0.123	0.329
1(Business had positive profit)	0.539	0.499	0.657	0.475	0.474	0.500	0.333	0.476	0.485	0.500
Number of weeks in self-employment	14.985	19.139	21.571	21.764	11.349	16.444	5.705	9.673	11.773	16.771
Household Head Characteristics										
1(Male)	0.735	0.441	0.811	0.392	0.777	0.416	0.744	0.437	0.781	0.413
1(Can write AND do math)	0.708	0.455	0.813	0.390	0.772	0.420	0.682	0.467	0.785	0.411
1(Some education)	0.813	0.390	0.877	0.329	0.871	0.335	0.784	0.413	0.884	0.321
Financial Resources										
1(Remittances received)	0.857	0.350	0.897	0.304	0.872	0.335	0.831	0.376	0.876	0.329
1(Remittances sent)	0.975	0.155	0.993	0.086	0.980	0.139	0.966	0.181	0.982	0.131
1(Positive savings)	0.851	0.356	0.946	0.226	0.896	0.313	0.827	0.379	0.899	0.301
1(Positive debt)	0.465	0.499	0.534	0.499	0.504	0.500	0.430	0.496	0.515	0.500
1(Above median financial stock)	0.525	0.499	0.706	0.456	0.571	0.496	0.469	0.500	0.586	0.493
1(Above median physical stock)	0.554	0.497	0.667	0.472	0.572	0.495	0.492	0.501	0.583	0.493

Notes: All variables are at the household level. Total input expenditure is in Tanzanian shillings. A coper household is a household that owned a business only during low coffee price periods, defined by when the coffee price is below its 25th percentile - it is thus a time-invariant characteristic. Other switcher households comprise either households that owned businesses only during relatively high price periods (i.e. when the coffee price was above its 25th percentile) or during high and low periods both, but not in all 4 waves. It is also a time invariant household characteristic. All intensive margin outcomes are for the last 12 months in the first wave and the last 6 months for all other waves.

Table 2

Summary Statistics: Enterprise Histories and Coffee Price

	(1)	(2)
	Whole Panel Sample	
	Mean	SD
1(Enterprise Ownership)	0.396	0.489
Enterprise Histories		
1(Household has a business in wave 1)	0.278	0.448
1(Household has a business in wave 2)	0.384	0.487
1(Household has a business in wave 3)	0.459	0.497
1(Household has a business in wave 4)	0.474	0.499
Proportion of Households with Enterprises in:		
0 waves	0.423	0.494
1 waves	0.173	0.378
2 waves	0.139	0.347
3 waves	0.140	0.348
4 waves	0.124	0.330
Swticher Households (Household owned an enterprise at least once but not in all four waves)	0.502	0.500
Coper Households: Household owned an enterprise during low price periods only	0.062	0.241

	Whole Panel Sample	
	Mean	SD
Coffee Price		
International Robusta Coffee Price	49.344	6.309
International Robusta Coffee Price in 1990	53.603	2.760
International Robusta Coffee Price in 1991	48.621	2.980
International Robusta Coffee Price in 1992	42.658	4.451
International Robusta Coffee Price in 1993	52.497	7.335

Table 3

Do Coffee Price Fluctuations Affect Coffee Production and Revenues and Household Expenditures?

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Farmgate Price/SD(Price)	1(Positive Coffee Quantity Sold)	1(Positive Coffee Revenues)	Total Expenditure	Total Expenditure		Coffee Grower	Harvest Area Under Coffee
					Food Expenditure	Non Food Expenditure		
Price/SD(Price)	0.104**	0.0893***	0.0553**	45,485***	9,107***	12,206***	-0.00701	0.0224
	(0.0428)	(0.0246)	(0.0212)	(4,889)	(813.3)	(2,136)	(0.00687)	(0.0261)
Fixed Effects	Household, Year & Month							
Observations	1,723	1,778	2,851	2,812	2,817	2,807	2,879	2,857
Number of Households	710	711	753	753	752	751	753	752
Mean of Dependent Variable	0.168	0.398	0.477	2,21,549	39,976.00	75,943.00	0.933	0.549

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). The price received is Tanzanian shillings/kg. Quantity sold is in kg. Coffee revenues and all expenditure variables are in Tanzanian shillings. Coffee grower is a dummy variable that is 1 if a household reported harvesting coffee in that wave. Harvest area under coffee is the number of acres harvested in the last 12 months if the household is surveyed in the first wave, and the number of acres harvested in the last 6 months if the household is surveyed in any subsequent wave. The sample sizes reflect the number of household-year observations in which the household reports non-missing values of the dependent variables (e.g., the number of household-year observations in which the household reports having farm acreage under coffee cultivaiton, observations for which the household reports a specific quantity, revenue and/or price for coffee harvests, etc.).

Table 4

Does Household Enterprise Activity Respond to Coffee Price Fluctuations?

	(1)	(2)	(3)	(4)
	1(Houshold Owns a Business)	1(Houshold Owns a Merchant Business)	1(Houshold Owns a Non-Merchant Business)	1(Participation in Non-Farm Self-Employment)
Price/SD(Price)	-0.0515***	-0.0428***	-0.0159	-0.0483***
	(0.0112)	(0.0118)	(0.0109)	(0.0118)
Fixed Effects	Household, Year & Month			
Observations	2,879	2,879	2,879	2,879
Number of Households	753	753	753	753
Mean of Dependent Variable	0.396	0.237	0.217	0.413

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Merchant businesses comprise enterprises that undertake trading or other non-farm informal business. 1(Participation in Non-Farm Self-Employment) is a dummy that equals 1 if any member of the household reported working in self-employment in that week or last 12 months in the first wave, or in that week or last 6 months in the subsequent waves. Non-Merchant Businesses comprise the following categories - stall keeping, shopkeeping, restaurant owner, garage owner, bus driver, blacksmith, plumber, carpenter, tailor, repair work, mechanic, mason, painter, hair dresser, shoemaker, butcher, handicrafts, photographer, and doctor.

Table 5

Does Household Enterprise Activity Responses to Coffee Price Fluctuations Differ by Financial Access?

	(1)	(2)	(3)	(4)	(5)
	1(Household Owns a Business)	1(Household Owns a Business)	1(Household Owns a Business)	1(Household Owns a Business)	1(Household Owns a Business)
Value of Total Asset Stock/SD	-0.210				
	(0.130)				
(Price/SD)*(Value of Total Asset Stock/SD)	0.0185*				
	(0.0108)				
Value of Physical Asset Stock/SD		-0.219			
		(0.135)			
(Price/SD)*(Value of Physical Asset Stock/SD)		0.0192*			
		(0.0113)			
Saving/SD			-0.0434*		
			(0.0234)		
(Price/SD)*(Saving/SD)			0.00425**		
			(0.00178)		
Loan/SD				-0.166**	
				(0.0668)	
(Price/SD)*(Loan/SD)				0.0132**	
				(0.00510)	
Debt/SD					-0.120*
					(0.0633)
(Price/SD)*(Debt/SD)					0.0113*
Price/SD	-0.0587***	-0.0586***	-0.0562***	-0.0560***	-0.0555***
	(0.0117)	(0.0117)	(0.0116)	(0.0117)	(0.0115)
Fixed Effects			Household, Year & Month		
Observations	2,837	2,742	2,837	2,837	2,837
Number of Households	753	734	753	753	753
Mean of Dependent Variable	0.396	0.396	0.396	0.396	0.396

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Savings, Debt, Loan, Total Stock and Physical Stock are in Tanzanian shillings. All regressors of interest are divided by their standard deviations so as to allow coefficients to be interpreted as the effect of one SD unit change. Total stock is the sum of phsycial and financial asset stock. Physical stock comprises land, farm equipment, farm buildings, livestock, business assets, fishing equipment, owner-occupied dwellings, other dwellings, durables, farm inventories, and business inventories. Financial stock equals the sum of savings and loans given less debt incurred. Debt is the stock of total debt owed by the household, and loans are the stock of loans owed to the households. Outside employment is employment outside the household farm or household enterprise. All outcome variables are for the last 12 months in the first wave and the last 6 months for all other waves. Sample sizes reflect the number of houseohld-year observations for which both non-farm enterprise activity and financial variables are reported.

Table 6
Do Switcher Enterprises Differ from Stayer Enterprises in Inputs and Performance?

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Capital and Working Capital			Labor			Performance	
	1(Business Assets Owned)	1(Business Assets Bought or Sold)	Total Input Expenditure	Weeks of Self-Employment Among HH Members	1(Any HH Member Helping in the Business)	1(Hired Worker(s))	Mos. Business Operating	1(Business Had Positive Profits)
1(Switcher Household)	-0.217***	-0.0763***	-3,423***	-9.604***	-0.0573	-0.138***	-1.196***	-0.173***
	(0.0288)	(0.0270)	(1,121)	(1.558)	(0.0418)	(0.0317)	(0.186)	(0.0304)
Fixed Effects				Year & Month				
Observations	1,126	1,140	1,132	1,133	1,140	1,140	1,140	1,140
Number of households	474	478	477	478	478	478	478	478
Mean of Dependent Variable	0.732	0.215	2961	14.98	0.359	0.174	4.515	0.539

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). A switcher household is a household that owned a business at least once during the four waves but not for all four waves - it is thus a time-invariant characteristic. All intensive margin outcomes are for the last 12 months in the first wave and the last 6 months for all other waves. Sample sizes reflect non-missing responses at the household-year level for the relevant dependant variable (e.g., business assets, input expenditure, asset transactions, labor allocations, etc.) among the sub-sample of households ever reporting operating a non-farm enterprise.

Table 7

Do Coper Enterprises Differ from Stayers and Other Switchers in Inputs and Performance?

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Capital and Working Capital			Labor			Performance	
	1(Business Assets Owned)	1(Business Assets Bought or Sold)	Total Input Expenditure	Weeks of Self-Employment Among HH Members	1(Any HH Member Helping in the Business)	1(Hired Worker(s))	Mos. Business Operating	1(Business Had Positive Profits)
1Coper Household)	-0.424***	-0.149***	-4,607***	-14.65***	-0.111	-0.120*	-2.244***	-0.380***
	(0.0685)	(0.0463)	(1,155)	(1.944)	(0.0724)	(0.0633)	(0.361)	(0.0816)
1(Other Switcher Households)	-0.197***	-0.0702***	-3,331***	-9.170***	-0.0518	-0.140***	-1.102***	-0.153***
	(0.0277)	(0.0271)	(1,131)	(1.582)	(0.0426)	(0.0314)	(0.181)	(0.0293)
Fixed Effects				Year & Month				
Wald test p-value Null: β[Coper] = β[Other Switcher]	0.0003***	0.0491**	0.0456**	0.0024***	0.3791	0.7158	0.0002***	0.0026***
Observations	1,126	1,140	1,132	1,133	1,140	1,140	1,140	1,140
Number of households	474	478	477	478	478	478	478	478
Mean of Dependent Variable	0.732	0.215	2961	14.98	0.359	0.174	4.515	0.539

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). A coper household is a household that owned a business only during low coffee price periods, defined by when the coffee price is below its 25th percentile - it is thus a time-invariant characteristic. Other switcher households comprise either households that owned businesses only during relatively high price periods (i.e. when the coffee price was above its 25th percentile) or during high and low periods both, but not in all 4 waves. It is also a time invariant household characteristic. All intensive margin outcomes are for the last 12 months in the first wave and the last 6 months for all other waves. Sample sizes reflect non-missing responses at the household-year level for the relevant dependant variable (e.g., business assets, input expenditure, asset transactions, labor allocations, etc.) among the sub-sample of households ever reporting operating a non-farm enterprise.

Table 8

Do Switcher Enterprises Differ from Stayer Enterprises in Inputs and Performance During Low Price Periods?

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Capital and Working Capital			Labor			Performance	
	1(Business Assets Owned)	1(Business Assets Bought or Sold)	Total Input Expenditure	Weeks of Self-Employment Among HH Members	1(Any HH Member Helping in the Business)	1(Hired Worker(s))	Mos. Business Operating	1(Business Had Positive Profits)
1(Switcher Household)	-0.269***	-0.182***	-4,917***	-9.631***	-0.0627	-0.122***	-1.257***	-0.200***
	(0.0556)	(0.0513)	(1,664)	(2.152)	(0.0561)	(0.0378)	(0.251)	(0.0635)
Fixed Effects				Year & Month				
Observations	346	352	350	352	352	352	352	352
Number of households	325	330	329	330	330	330	330	330
Mean of Dependent Variable	0.671	0.196	2680	11.64	0.332	0.156	3.776	0.560

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). A switcher household is a household that owned a business at least once during the four waves but not for all four waves - it is thus a time-invariant characteristic. All intensive margin outcomes are for the last 12 months in the first wave and the last 6 months for all other waves. Sample sizes reflect non-missing responses at the household-year level for the relevant dependant variable (e.g., business assets, input expenditure, asset transactions, labor allocations, etc.) among the sub-sample of households ever reporting operating a non-farm enterprise for low-price periods.

Table 9

Do Coper Enterprises Differ from Stayers and Other Switchers in Inputs and Performance During Low Price Periods?

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Capital and Working Capital			Labor			Performance	
	1(Business Assets Owned)	1(Business Assets Bought or Sold)	Total Input Expenditure	Weeks of Self-Employment Among HH Members	1(Any HH Member Helping in the Business)	1(Hired Worker(s))	Mos. Business Operating	1(Business Had Positive Profits)
1(Coper Household)	-0.406***	-0.203***	-5,579***	-12.36***	-0.0764	-0.101	-1.835***	-0.341***
	(0.0784)	(0.0636)	(1,663)	(2.431)	(0.0795)	(0.0662)	(0.388)	(0.100)
1(Other Switcher Households)	-0.234***	-0.177***	-4,742***	-8.936***	-0.0592	-0.128***	-1.105***	-0.164***
	(0.0541)	(0.0520)	(1,685)	(2.222)	(0.0589)	(0.0376)	(0.245)	(0.0624)
Fixed Effects				Year & Month				
Wald test p-value Null: β[Coper] = β[Other Switcher]	0.0100***	0.5797	0.0688*	0.0620*	0.8168	0.6623	0.0244**	0.0388**
Observations	346	352	350	352	352	352	352	352
Number of households	325	330	329	330	330	330	330	330
Mean of Dependent Variable	0.671	0.196	2680	11.64	0.332	0.156	3.776	0.560

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). A coper household is a household that owned a business only during low coffee price periods, defined by when the coffee price is below its 25th percentile - it is thus a time-invariant characteristic. Other switcher households comprise either households that owned businesses only during relatively high price periods (i.e. when the coffee price was above its 25th percentile) or during high and low periods both, but not in all 4 waves. It is also a time invariant household characteristic. All intensive margin outcomes are for the last 12 months in the first wave and the last 6 months for all other waves. Sample sizes reflect non-missing responses at the household-year level for the relevant dependant variable (e.g., business assets, input expenditure, asset transactions, labor allocations, etc.) among the sub-sample of households ever reporting operating a non-farm enterprise for low-price periods.

Table 10

Do Households Use Other Mechanisms to Weather Coffee Price Fluctuations?

	(1)	(2)	(3)	(4)	(5)	(6)
	Savings	Debt	Loan	Net Remittances Received	1(Positive Weeks in Outside Employment)	Harvest Area Under Other Crops
Price/SD(Price)	20,581	-13,111	13,490	91.48	-0.017	-0.143
	(16,455)	(10,518)	(9,569)	(632.8)	(0.0105)	(0.181)
Fixed Effects			Household, Year & Month			
Observations	2,837	2,837	2,837	2,780	2,879	2,798
Number of Households	753	753	753	753	753	753
Mean of Dependent Variable	28,617	12,339	12,148	4,436	0.318	5.252

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Savings, Debt, Loan, and Net Remittances Received are in Tanzanian shillings. Debt is the stock of total debt owed by the household, and loans are the stock of loans owed to the households. Outside employment is employment ourtside the household farm or household enterprise. Harvest area under other crops is the area under crops other than coffee. All outcome variables are for the last 12 months in the first wave and the last 6 months for all other waves. Sample sizes reflect household-year observations in which coffee-growing households report non-missing values for dependant variables (e.g., 0 or positive values for savings, debt, loans, etc.).

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A Construction of Variables

The following list describes the construction of variables used in analysis. Please note that since the survey interviewed households about their decisions and outcomes in the 12 months preceding the interview in the first wave, and six months preceding the interview in the second, third and fourth wave, unless otherwise mentioned, all household-level variables are defined for these respective time-periods. Furthermore, with the exception of the regression containing the variable ?Coffee Grower? as the dependent variable, all other regressions are conditional on the household having reported harvesting coffee in at least one of the four waves.

A.1 Coffee Price Variables

- Robustalag: a household-level lagged international robusta coffee price. For the first wave, it is the mean price of the twelve months preceding the interview of the household, and for the remaining waves, it is the mean price of the six months preceding the household interview. Since different households were interviewed at different times, it varies across households within a wave, though households interviewed in the same month and year will have identical values of robustalag. This is done to align the outcome variables, which were asked for the previous twelve months in wave 1 and previous six months in the other waves, with the mean coffee price prevailing in the time-interval when the outcomes were determined. The monthly-level international robusta prices were obtained from the International Coffee Organization(ICO).

- Price/SD(Price): a primary independent variable. It equals robustalag divided by the standard deviation of robustalag. Thus, the coefficients on this variable in the regressions indicate the marginal impact of a one standard deviation increase in robustalag.

A.2 Household-level variables related to coffee cultivation

- Coffee Grower: equals 1 if the household reported harvesting coffee in a particular wave, 0 otherwise.

- Harvest Area Under Coffee: Number of acres the household reported harvesting under coffee.

- Price Received by Households: Value of coffee sales reported by the household divided by the quantity sold in Tanzanian Shillings/kg.

- Price Received by Households/SD(Price Received by Households): The price received by the household divided by its own standard deviation.

- 1(Quantity Sold): 1 if the household reported positive quantity of household-level coffee sales, 0 otherwise.

- 1(Coffee revenues): 1 if the household reported positive value of household-level coffee sales, 0 otherwise.

A.3 Household expenditure variables

- Total Expenditure: Total household expenditure, inclusive of food and non-food expenditure (detailed below), consumption of home production, remittances sent, and imputed expenditure for wage income in-kind(in Tanzanian Shillings).

- Food Expenditure: The sum of seasonal and non-seasonal food expenditure, inclusive of expenditure on meals and beverages consumed away from home, exclusive of consumption of home production(in Tanzanian Shillings).

- Non-Food Expenditure: The sum of expenditure on education, health, housing, utilities, funeral and other non-food expenses(in Tanzanian Shillings).

A.4 Enterprise Ownership and Intensive Margin Sample Restrictions

- 1(Household Owns a Business): equals 1 if the the household reported to owning at least one enterprise, 0 otherwise.

- 1(Household Owns a Merchant Business): equals 1 if the household reported owning at least one enterprise that undertook trading or other informal non-farm self-employment.

- 1(Household Owns a Non-Merchant Business): equals 1 if the household reported owning an at least one enterprise of the categories that require semi-skilled and skilled work. These comprise stall keeping, shopkeeping, restaurant owner, garage owner, bus driver, blacksmith, plumber, carpenter, tailor, repair work, mechanic, mason, painter, hair dresser, shoemaker, butcher, handicrafts, photographer, and doctor.

- 1(Positive Weeks in Non-Farm Self-Employment): 1 if the total number of weeks worked in enterprise by the household (aggregated from the individual-level) is greater than 0, 0 otherwise.

- 1(Switcher Household): 1 if the household owns an enterprise at least once, but not in all four waves, and 0 otherwise.

- 1(Coper Household): 1 if the household owns an enterprise only during low international coffee price periods (when the price is below its 25th percentile value), 0 otherwise.

- 1(Other Switcher Household): 1 if the household is a switcher household, but not a coper household. Thus, it includes households who either owned an enterprise only during higher price periods (when the price is above its 25th percentile value), or both during high and low price periods.

A.5 Household-level enterprise intensive margin variables

- 1(Business Assets Owned): equals 1 if the enterprise owns at least one of the following category of assets: a) buildings and land, b) vehicles or boats, c) tools, equipment or machinery, or d) other durable assets for use in the enterprise, 0 otherwise.

- 1(Business Assets Bought or Sold): equals 1 if any asset described above was bought for the enterprise or divested from the enterprise.

- Total Input Expenditure: Total expenditures on all enterprise inputs during the survey period.

- Weeks in Self-Employment: The number of weeks reported at the individual-level spent in non-farm self employment in the reference period described above, aggregated up to the household-level .

- 1(Any Household Members Helping in the Business): equals 1 if a household member worked in the enterprise, 0 otherwise.

- 1(Hired Worker(s)): equals 1 if the household hired any non-household members to work in the enterprise, 0 otherwise.

- Mos. Business Operating: The number of months in the reference period described above that the business was operating.

- 1(Business Had Positive Profits): equals 1 if the enterprise reported earning a profit, 0 otherwise.

A.6 Characteristics of the Head of the Household

- 1(Male): equals 1 if the head of the household is male, 0 otherwise.

- 1(Can Write and Do Math): equals 1 if the household head reported being able to write a letter and perform written calculations, 0 otherwise.

- 1(Some Education): equals 1 if the household head reported attending primary schooling or above for any length of time, including adult or Koranic education, 0 otherwise.

A.7 Household's Financial Participation Variables and Other Possible Smoothing Mechanisms

- Total Stock: The value of all household assets taken together. The two main categories comprising this is physical stock and financial stock.

- Physical Stock: The sum of values of physical assets, comprising land, farm equipment, farm buildings, livestock, business assets, fishing equipment, owner-occupied dwellings, other dwellings, durables, farm inventories, and business inventories.

- Financial Stock: Savings+Loan-Debt

- Savings: Household-level total stock of savings.

- Debt: Household-level total stock of debt owed to others.

- Loan: Household-level total stock of loans owed to the household.

- Net Remittances Received: Household-level remittances received (aggregated up from the individual-level) minus household-level remittances sent (aggregated up from the individual-level for all individuals over 15 years of age).

- 1(Positive Weeks in Outside Employment): 1 if the household reported positive weeks in outside employment, 0 otherwise. Outside employment is employment outside the family farm or family enterprise.

- Harvest Area Under Other Crops: Total harvest area in acres reported by the household for all crops other than coffee.

- 1(Any Remittances): equals 1 if the household reported either sending or receiving remittances.

- 1(Positive Savings):equals 1 if the household reported having saving greater than zero, 0 otherwise.

- 1(Positive Debt): equals 1 if the household reported having debt greater than zero, 0 otherwise.

- 1(Above Median Financial Stock): equals 1 if level of financial stocks (Savins + loan debt) reported by the household are greater than the median level of financial stocks over the entire sample, which is 2,000 TZS.