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

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Abstract

We test the long-standing hypothesis that agricultural households in low-income contexts engage in intermittent enterprise activity as a way to mitigate shocks. We link panel data on smallholder coffee farmers in Tanzania with a time series of global coffee prices. We first verify that global coffee prices matter for these households, through their effects on farm-gate prices, quantity of coffee sold, farm revenues and, consequently, household expenditures. We then show that enterprise ownership increases by 5 percentage points (22 percent) during coffee price busts. Surprisingly, "persistent" entrepreneurs–those households whose businesses stay open during booms and busts–increase input intensity when the coffee price is high, and reap large rewards in terms of profits and business survival. Our results suggest that policymakers should 1) encourage smoothing mechanisms like savings, commodity storage, and price floors to better insulate households from global commodity market fluctuations; and 2) help intermittent household enterprises by reducing geographical and informational barriers to trade during busts.

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JEL Classification Codes: D22, D92, L26, M13, O12

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1 Introduction

Agricultural households in low-income countries often own and operate informal, non-farm enterprises (ILO 2002).[1] 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.[2]

In part due to their smallness and transience, and perhaps to what many perceive as a lack of growth potential, little academic or policy attention has been paid to household enterprises, despite their high prevalence in low-income contexts. Even 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.[3] Household enterprises, particularly transient businesses in agricultural contexts, are thus often excluded from these studies by design.

Yet, economists have long realized that even transient enterprise may hold value for households as a means of smoothing.[4] Shocks to income in agricultural settings are frequent and often large, and households in low-income contexts have persistent difficulty protecting themselves from their negative effects. For example, weather shocks–e.g., late, insufficient, or highly variable rainfall–are common to all households in a particular region at a particular time; thus the effectiveness of formal and informal risk-sharing is blunted. Many households are smallholder suppliers to global export markets for agricultural commodities. As price-takers in the global market, particularly where government protections are weak, farm households are often at the mercy of market fluctuations a world away.

Nevertheless, households do undertake a variety of measures to mitigate these shocks, including savings (Paxson 1992), wage labor (Kochar 1999), insurance (Mobarak and Rosenzweig 2013), and temporary migration (Bryan, Chowdhury, and Mobarak 2013; Dinkelman 2013; Morten 2013). In this study, we test the long-standing hypothesis that household enterprise serves a potentially important role as a way to weather agricultural income shocks. Specifically, in a sample of coffee-farming households in northwest Tanzania, we study the effects of shifts in the global

[1] For example, household enterprises are important economic activities for more than half the households in Tanzania (Kweka and Fox (2011)). In our data, 56% of households own and operate a household enterprise at least once during the 3.5 year survey period.

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

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

[4] 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.

coffee price on enterprise ownership and operations.[5]

To fix ideas, we develop a simple model of sectoral participation and resource allocation on the basis of entrepreneurial ability. We show that, under some reasonable restrictions, households near an ability cutoff defined by the maximization problem should choose to operate an enterprise when the coffee price is low, and shut down when the price is high. High-ability households should persist in enterprise even when the coffee price is high. These "persistent" entrepreneurs, the model predicts, should keep their businesses open even when the price goes up, but should decrease labor and capital investment into enterprise on the intensive margin in these periods, because returns to farming are high.

We test these predictions using a panel of households in a coffee-farming region of northwest Tanzania. The panel is a World Bank survey covering about 3.5 years in the early-to-mid 1990s. Each household is surveyed up to four times. The resulting socioeconomic data include detailed modules on agriculture and other income-generating activities, household demographics, expenditures, health, etc. We match the time series of global coffee prices to this household data set using the date on which each household was interviewed in each survey round.

We first verify that farmgate prices, coffee revenues, and household expenditures in our sample vary significantly with the global price of coffee. As hypothesized, many of these households start up enterprises when the global price of coffee drops, allocating a large proportion of their productive time towards self-employment activity. When the coffee price rebounds, these "intermittent" household enterprises shut down, and households return to agricultural activity.

For "persistent" entrepreneurs, however, the data do not support the basic model's predictions. These entrepreneurs scale up labor inputs to their enterprises, and are more likely to earn positive profits, when the coffee price is high. Capital inputs do not appear to respond to the coffee price, suggesting that the presence of capital constraints may not be a salient explanation for the profits result. We present evidence that global coffee prices and the local Laspeyeres price index are positively correlated, suggesting that coffee price shocks may drive shifts in aggregate demand that might account for the procyclical performance of persistent entrepreneurs.

Finally, we explore the degree to which ability and financial characteristics of households predict participation in household enterprise, as well as heterogeneity in enterprise responses to coffee price shocks along these characteristics. We present evidence, consistent with recent results in the microenterprise literature, that both ability and access to financial resources appear to be important for small business ownership. Financial activity appears important for both

[5]Coffee farming has some important features that help us generate unbiased estimates of the effects of agricultural profitability on enterprise ownership. 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.

intermittent and persistent entrepreneurship. On the other hand, high ability predicts only persistent, non-merchant entrepreneurship, and corresponds to a limited response to coffee price shocks.

Taken together, our results provide evidence that household enterprise activity, at least in the agricultural context, falls into at least two distinct types: intermittent, smoothing enterprise and persistent enterprise. The results of previous literature on access to both financial and managerial capital suggest, perhaps, that a sizeable fraction of owners of microenterprises in developing contexts are not, in fact, looking for opportunities to grow their businesses, as many policy prescriptions presuppose.[6]

It is notable that recent studies on microfinance lending and grant interventions have found weak or confounding effects on business outcomes, but strong effects on consumption and expenditure. These patterns suggest that households may use capital windfalls not as investment but rather as smoothing.[7] Microfinance and training interventions have both also consistently met with low adoption and limited compliance. We propose in this paper that the smoothing value of "intermittent" enterprises may help to explain the observed unwillingness of most households to invest resources and effort in growing them into larger-scale businesses.[8]

This study makes two contributions to the literature. First, we add household enterprise to the list of means by which households mitigate agricultural income shocks. Ours is the first test (to our knowledge) of the long-standing hypothesis that intermittent enterprises serve as a means of weathering shocks to agricultural incomes.[9]

Second, our results contribute to the ongoing debate on the existence of heterogeneous entrepreneur types in the fast-growing literature on microenterprises in low-income countries. We show that households' enterprise responses to agricultural income shocks vary markedly even in a fairly homogeneous sample. We postulate, with some help from the simple theoretical model, that the difference between the "intermittent" enterprise owners and the "persistent" ones has to do with differences in entrepreneurial ability. We believe our approach–using optimized behaviors in response to shocks over time to reveal these types–is new to the literature, and complements previous studies that have classified entrepreneurs based on surveyed characteristics (see, e.g., de Mel, McKenzie, and Woodruff (2008) and Schoar (2009)).[10]

[6]There are many important studies in this literature. Studies of financial access provision are reviewed in McKenzie (2010), and the literature on business skills training is reviewed in McKenzie and Woodruff (2012).

[7]See, for example, Crepon et al. (2011), Banerjee et al. (2010), and Fafchamps et al. (2011).

[8]Of course, we make this interpretation with caution, given that our results are applicable only to smallholder households in agricultural contexts, and not to the urban or semi-urban microenterprises studied in much of this literature.

[9]This study relates closely to Adhvaryu and Nyshadham (2013), which explores the household enterprise activity and intra-household labor reallocation in response to acute health shocks.

[10]This approach is similar in spirit to Nyshadham (2013), which uses optimized histories of household enterprise responses to productivity shocks in Thailand to test the roles of ability and financial constraints in determining entrepreneurial entry.

The remainder of the paper is organized as follows. Section 2 develops a simple model to formalize our intuition about household enterprise ownership and operation during booms and busts. 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.

2 Model

We develop a simple model meant to capture some salient features of households' decisions to engage in entrepreneurship. Households in our model are "primarily" farmers–a fact that is modeled through a land endowment and land-labor complementarity–but can also choose to operate a business. Households differ in entrepreneurial ability, which drives differences in enterprise sector participation. We show that when farm prices are low, households are more likely to participate in the business sector; when prices are high, they shut their businesses to spend more time on the farm.

Finally, we focus on households with high entrepreneurial ability, who tend to stay in business even when the farm price is high. For these "persistent" entrepreneurs, the model predicts that changes in the farm output price should generate decreases in capital, labor, and enterprise production on the intensive margin. As it turns out, this prediction is at odds with what we find in the data. In our context, persistent entrepreneurs spend *more* time in enterprise when the coffee price is high and do not reduce their capital inputs. In section 6, we discuss informally two ways in which our model could be modified to accommodate the observed trends.

2.1 Setup

Consider a household whose preferences for consumption are represented by the utility function $u(c)$. Suppose u is differentiable and increasing in consumption. The household generates income by participating in up to two sectors: farm production and (non-farm) enterprise. The farm production function, f, takes labor (l_f) and land (or in our context, trees, T) as inputs. We assume that T is fixed in the short run.[11] The enterprise production function, e, takes as inputs labor (l_e) and capital (k); the latter can be rented at rate r. We assume enterprise production is scaled by an ability parameter $\alpha \in (0, \infty)$, which is meant to capture entrepreneurial or managerial skill. For parsimony's sake, we assume leisure is not valued; the household's time constraint is thus $l_f + l_e = \Omega$, where Ω is the endowment of time. The price of farm output is p_f and the

[11] This is in keeping with much of the sub-Saharan African context: land markets are thin, if at all existent. In our context, households during the early 1990s in Tanzania were forbidden by law from uprooting coffee trees, and newly planted trees take 3-5 years to grow to maturity before producing coffee cherries. We verify in our results that acreage under coffee does not change with the coffee price.

price of business output is p_e. Given these parameters, the household's utility maximization problem is:

$$max_{c,l_f,l_e,k} \qquad u(c) \qquad s.t. \tag{1}$$

$$c \quad \leq \quad p_f f(l_f, T) + p_e e(l_e, k, \alpha) - rk, \tag{2}$$

$$l_f + l_e = \Omega. \tag{3}$$

We render this general problem slightly more specific to be able to formalize the impacts of farm (coffee) price booms and busts on entrepreneurship. Suppose that both production functions are Cobb-Douglas, with weights on farm and enterprise labor equal to γ and δ, respectively:

$$f(l_f, T) \quad := \quad l_f^{\gamma} T^{1-\gamma} \tag{4}$$

$$e(l_e, k, \alpha) \quad := \quad \alpha l_e^{\delta} k^{1-\delta}. \tag{5}$$

2.2 Optimal Allocation of Labor and Capital

2.2.1 Interior Solution

At an interior solution to the above maximization problem, the necessary first order conditions for l_f and k must be satisfied (we denote solutions to the maximization problem by *):[12]

$$l_f : \qquad p_f \gamma \left(\frac{T}{l_f^*}\right)^{1-\gamma} = \quad p_e \alpha \delta \left(\frac{k^*}{\Omega - l_f^*}\right)^{1-\delta} \tag{6}$$

$$k : \qquad p_e \alpha \left(1-\delta\right) \left(\frac{\Omega - l_f^*}{k^*}\right)^{\delta} = \quad r \tag{7}$$

Combining equations 6 and 7, with some tedious algebra we can show that at an interior solution,

$$l_f^* \quad = \quad T \left(\frac{p_f \gamma (1-\delta)}{\delta r} \left(\frac{r}{p_e \alpha (1-\delta)} \right)^{\frac{1}{\delta}} \right)^{\frac{1}{1-\gamma}} \tag{8}$$

$$l_e^* \quad = \quad \Omega - T \left(\frac{p_f \gamma (1-\delta)}{\delta r} \left(\frac{r}{p_e \alpha (1-\delta)} \right)^{\frac{1}{\delta}} \right)^{\frac{1}{1-\gamma}} \tag{9}$$

[12]Note that only two first order conditions are necessary once we substitute for consumption using the budget and time constraints.

$$k^* = \left(\frac{p_e\alpha(1-\delta)}{r}\right)^{\frac{1}{\delta}} \left(\Omega - T\left(\frac{p_f\gamma(1-\delta)}{\delta r}\left(\frac{r}{p_e\alpha(1-\delta)}\right)^{\frac{1}{\delta}}\right)^{\frac{1}{1-\gamma}}\right). \quad (10)$$

The above expressions for optimal allocations of capital and labor across sectors have some intuitive implications. For example, as T, the endowment of trees, increases, farm labor should increase (because of land-labor complementarity in the farm production function), and labor and capital investment in enterprise should decrease. As entrepreneurial ability α increases, time spent in the entrepreneurial sector and capital invested in the household business increase, while time spent on the farm decreases.

2.2.2 Corner Solution

Of course, the endowment of land (trees) T, combined with the land-labor complementarity inherent in the Cobb-Douglas form of the farm production function, makes salient the possibility of a corner solution, in which the household works only in the farm sector, and does not operate a business (despite free entry into the enterprise sector). In this corner solution, the household devotes all its time to farm labor ($l_f = \Omega$), and no time to business activity ($l_e = 0$). Thus, utility at the corner is $u(p_f f(\Omega, T))$.

2.2.3 The Entrepreneurial Decision

The household, therefore, engages in entrepreneurship if and only if

$$u\left(p_f f(\Omega, T)\right) < u\left(p_f f(l_f^*, T) + p_e\alpha e(l_e^*, k^*) - rk^*\right). \quad (11)$$

Equivalently, since u is monotonically increasing in c, the household engages in enterprise activity if and only if

$$p_f f(\Omega, T) < p_f f(l_f^*, T) + p_e\alpha e(l_e^*, k^*) - rk^*. \quad (12)$$

2.3 Comparative Statics

Our main purpose is to investigate how the entrepreneurial decision and the optimal allocations of capital and labor conditional on business ownership change during coffee price booms (in terms of model parameters, increases in p_f). We will also use the model to study how coffee price booms and busts affect entrepreneurial choices along the ability distribution.

We first compute the comparative statics for the optimized quantities l_f^*, l_e^*, and k^*. From equations 8, 9, and 10, respectively, it is evident that for each household, an increase in p_f would

generate an increase in l_f^* and decreases in l_e^* and k^*.[13]

2.3.1 Who chooses to operate a business?

Suppose that each household i receives a draw α_i from an ability distribution A on the interval $(0, 1)$, with associated probability density function a. Household i decides to engage in the enterprise sector if and only if

$$\Delta\Gamma_i := p_f f(\Omega, T) - p_f f(l_f^*, T) - p_e \alpha_i e(l_e^*, k^*) + rk^* < 0. \tag{13}$$

The following lemma states that there exists an ability type cutoff such that all households with ability above the cutoff should participate in the enterprise sector, and all below should not.

Lemma 1 *There exists an ability cutoff $\tilde{\alpha}$ such that $\alpha_i > \tilde{\alpha} \Leftrightarrow \Delta\Gamma_i < 0$.*

Proof. Showing the existence of a cutoff value $\tilde{\alpha}$ as defined above is equivalent to demonstrating that $\Delta\Gamma$ is a monotonic function of α. Differentiating the left-hand side of the inequality in equation 13 with respect to α and rearranging terms, we obtain:

$$\underbrace{-p_e e}_{X_4} + \frac{\partial l_e^*}{\partial \alpha} \underbrace{(p_f f_1 - p_e \alpha e_1)}_{X_5} - \frac{\partial k^*}{\partial \alpha} \underbrace{(r - p_e \alpha e_2)}_{X_6}. \tag{14}$$

X_4 is negative, and, as above, X_5 and X_6 are equivalent to the necessary first order conditions, which must equal 0 at an optimum. Thus, the derivative above is negative, implying that $\Delta\Gamma$ is strictly decreasing in α. Therefore, there exists some $\tilde{\alpha}$ such that $\alpha_i > \tilde{\alpha} \Leftrightarrow \Delta\Gamma_i < 0$. ■

Thus, holding other parameter values fixed, the model makes the intuitive prediction that higher ability types will choose into entrepreneurship, while lower ability types will prefer the corner solution, devoting all their time to farm production.

2.3.2 Who "drops out" and who "stays in" during coffee price booms?

To understand what happens to entrepreneurial choice across the distribution of types during coffee price booms, we must determine how $\tilde{\alpha}$ changes in response to an increase in p_f.

We begin with the following lemma, which states that for each α_i, $\Delta\Gamma_i$–the value of choosing farming alone over farming and enterprise participation–is increasing in the coffee price.

Lemma 2 *$\Delta\Gamma_i$ is increasing in p_f.*

[13] The proof is quite simple and so is omitted.

Proof. Differentiating $\Delta\Gamma_i$ with respect to p_f and rearranging terms, we obtain:[14]

$$\underbrace{f(\Omega,T)-f(l_f^*,T)}_{X_1}+\frac{\partial l_f^*}{\partial p_f}\underbrace{(p_e\alpha_i e_1-p_f f_1)}_{X_2}-\frac{\partial k^*}{\partial p_f}\underbrace{(p_e\alpha_i e_2-r)}_{X_3}. \tag{15}$$

The term X_1 above is positive, since f is increasing in labor and $\Omega > l_f^*$. The terms X_2 and X_3 must equal 0 at an optimum, since l_f^*, k^*, and l_e^* are defined by exactly these necessary first order conditions (see equations 6 7). The derivative of $\Delta\Gamma_i$ is thus positive. ■

The following proposition states that the ability cutoff rises during coffee price booms.

Proposition 3 *$\tilde{\alpha}$ is increasing in p_f.*

Proof. Take $p_f^1 < p_f^2$, and define $\tilde{\alpha}_1$ and $\tilde{\alpha}_2$ as the solutions to the equations $\Delta\Gamma|_{p_f^1}(\tilde{\alpha}_1) = 0$ and $\Delta\Gamma|_{p_f^2}(\tilde{\alpha}_2) = 0$, respectively. By lemma 2, for each α_i, $\Delta\Gamma_i|_{p_f^2} > \Delta\Gamma_i|_{p_f^1}$. In particular, $\Delta\Gamma|_{p_f^2}(\tilde{\alpha}_1) > \Delta\Gamma|_{p_f^1}(\tilde{\alpha}_1) = 0$. Now, since $\Delta\Gamma|_{p_f^2}(\tilde{\alpha}_2) = 0$ by construction, and $\Delta\Gamma$ is decreasing in α by lemma 1, it must be that $\tilde{\alpha}_1 < \tilde{\alpha}_2$. ■

Since the ability cutoff $\tilde{\alpha}$ goes up during price booms, the mass of households participating in entrepreneurship declines. So, we learn from the above proposition that during price booms, there is, on average, exit from the enterprise sector, but the entrepreneurs who keep their businesses open are the higher-ability ones.

2.3.3 Labor, Capital and Revenue Impacts for "Persistent" Entrepreneurs

Finally, we examine what happens in this model to inputs, revenues, and profits for those (high-ability type) households who continue to own businesses during price booms. We define these "persistent" entrepreneurs to be households whose α_i is sufficiently high such that they remain in the enterprise sector even when the farm price increases, i.e., $\alpha_i > \tilde{\alpha} + \varepsilon$, where ε corresponds to the size of a given change in farm price. For each such household, enterprise labor (l_e^*) and capital (k^*) must decrease when p_f increases, and thus enterprise sector production and revenues will also decline.

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

[14] f_1, e_1, and e_2 denote, respectively, the partial derivatives of the farm production function with respect to labor, the enterprise production function with respect to labor, and the enterprise production function with respect to capital.

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.

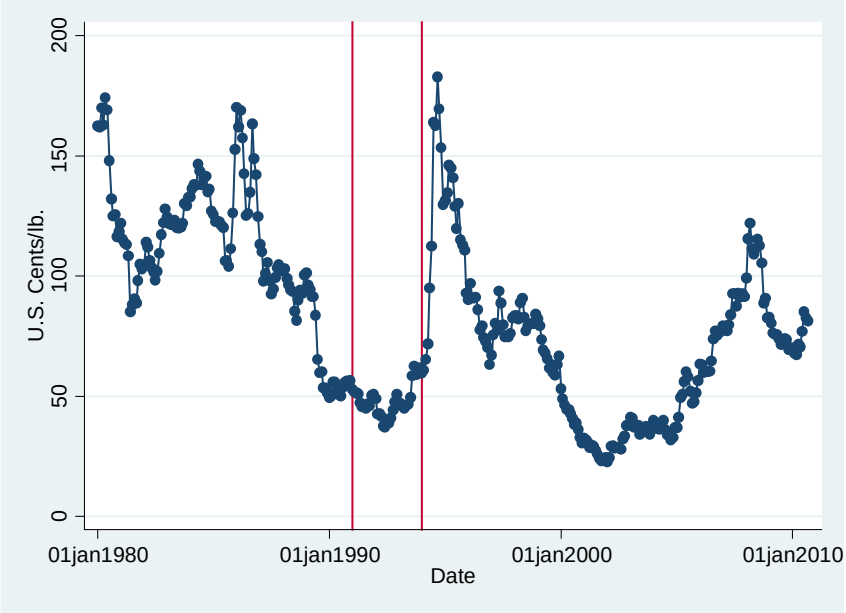
The monthly prices are robusta coffee prices, which is primarily the variety of coffee grown in the Kagera region. Figure 1 shows the graph of monthly prices from 1980-2010, and indicates the prices during the survey period. Prices during the entire survey period (1991-1994) were relatively low compared 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 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 cof-

FIGURE 1: ROBUSTA COFFEE PRICE TIME SERIES



fee 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.

Table 1

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

	(1)		(2)		(3)	
	Whole Panel Sample		*Households with a business during both high and low coffee prices (Persistent Entrepreneurs)*		*Households with a business in all 4 waves (Stayers)*	
Number of household-year observations	2,880		779		368	
Number of households	753		250		92	
	Mean	SD	Mean	SD	Mean	SD
Enterprise Activity (Conditional on owning a business)						
1(Household has a business)	0.377	0.485				
1(Household has a merchant business)	0.237	0.425	0.486	0.500	0.606	0.489
Months business has been operating	4.553	2.740	4.879	2.746	5.525	2.757
1(Business assets owned)	0.776	0.417	0.803	0.398	0.897	0.304
1(Business assets bought or sold)	0.187	0.390	0.192	0.394	0.215	0.411
1(Any household member helping with business)	0.359	0.480	0.370	0.483	0.394	0.489
1(Hired at least one worker)	0.177	0.382	0.200	0.400	0.266	0.443
1(Business had positive profit)	0.539	0.499	0.577	0.494	0.644	0.479
Number of weeks in self-employment	15.914	21.486	15.339	22.248	22.660	23.638
Household Head Characteristics						
1(Male)	0.735	0.441	0.809	0.393	0.837	0.370
1(Can write AND do math)	0.708	0.455	0.812	0.391	0.823	0.382
1(Some education)	0.813	0.390	0.896	0.306	0.880	0.325
Financial Resources						
1(Remittances received)	0.857	0.350	0.891	0.312	0.899	0.301
1(Remittances sent)	0.975	0.155	0.992	0.090	0.992	0.090
1(Positive savings)	0.851	0.356	0.936	0.246	0.943	0.232
1(Positive debt)	0.465	0.499	0.528	0.499	0.554	0.498
1(Above median financial stock)	0.507	0.500	0.647	0.478	0.677	0.468
1(Above median physical stock)	0.554	0.497	0.634	0.482	0.655	0.476

Notes: All variables are at the household level.

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. Table 1 presents the summary statistics. Area harvested for coffee is on average only about 10% of area harvested by households, but annual revenues from coffee sales comprise about 43% of agricultural revenues for the sample (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 households who operate an enterprise both when coffee prices are high and when they are low. We examine two categories of households. The first is households who own at least one enterprise when the coffee price is above its median value over the survey years, as well as when it is below its median value. We label these households 'persistent entrepreneurs'. There are 250 households in the sample, about 33%, who are persistent entrepreneurs.The second category is households who own at least one enterprise for all four waves. We label these households 'stayers'. About 12% of the households in the sample are these stayer households.

The use of the household fixed effects model detailed in the next section then ensures that we are examining the impact of coffee prices on intensive margin household decisions in good years (high coffee prices) relative to bad years (low coffee prices). Restricting the analysis to these households ensures that we are not comparing households who owned a business only during times of high coffee prices, or only during times of low coffee prices. Furthermore, examining the stayers would be informative if the households who owned businesses in all four waves take decisions that are different in sign or magnitude in response to the higher liquidity that higher coffee prices provide.

The intensive margin variables studied comprise three categories of enterprise operations - capital assets, labor and performance. The first category includes a binary variable for whether the enterprise owns a capital asset and another binary variable for whether the enterprise bought

Table 2
Summary Statistics: Enterprise Histories and Coffee Price

	(1)	(2)
	Whole Panel Sample	
	Mean	SD
1(Enterprise Ownership)	0.377	0.485
Enterprise Histories		
1(Household has a business in wave 1)	0.278	0.448
1(Household has a business in wave 2)	0.371	0.483
1(Household has a business in wave 3)	0.439	0.497
1(Household has a business in wave 4)	0.432	0.496
1(Household ever switched enterprise status)	0.473	0.500
Proportion of Households with Enterprises in:		
0 waves	0.440	0.497
1 waves	0.179	0.383
2 waves	0.129	0.336
3 waves	0.138	0.345
4 waves	0.113	0.317
Persistent Entrepreneur: 1(Business during both high and low coffee prices)	0.339	0.474

	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

or sold a capital asset. The majority of enterprises - about 80% of persistent entrepreneurs and nearly 90% of the stayers - own a capital asset, although only about 20% of either sample bought or sold one in the reference period. The labor category comprises three variables - the first is the number of weeks spent in self-employment. On average, households spend about 15 weeks in self-employment, though stayer households spend about 22 weeks. The second is a binary variable for whether a household member helped in the enterprise, which on average was true for about 36% of the persistent entrepreneurs and 39% of the stayers. The third is a binary variable for whether a hired worker was employed in the enterprise. 20% of the persistent entrepreneurs and 26% of the stayers hired at least one worker on average.

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. Persistent entrepreneurs' businesses were operating for 4.8 months, and stayers' businesses for 5.5 months. Nearly 58% of the persistent entrepreneurs' enterprises were profitable, as were nearly 65% of stayer enterprises. 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.

In addition, we also consider characteristics of the household head and measures of financial resources of the household, and examine whether enterprise ownership is correlated with these household characteristics. These 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, persistent entrepreneurs and stayer households are more likely to have a male household head who is literate and numerate relative to the whole sample. Their measures of financial resources are also higher relative to the sample - for instance, they are about 15 percentage points more likely to have financial stocks that are greater than the median value in the sample.

Stayer households and persistent entrepreneurs are similar along certain dimensions such as household head characteristics and financial resources. However, 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.

3.3 Local Prices Variable

Since the majority of the farmers in the sample are coffee farmers, local prices are likely to be affected by international coffee prices. This link implies that enterprises operating during times of high international coffee prices may have higher revenues, through higher local prices caused by greater liquidity as well as greater local demand due to higher incomes.

To test if local prices are indeed responsive to international coffee prices, we use the cluster-level Laspeyres price index constructed using price data for all four waves. We match the mean month and year of the price interviews to the contemporaneous monthly coffee prices, as well as the lagged mean coffee prices described above. In particular, we test if the laspreyes index divided by its standard deviation is affected by either the lagged robusta price divided by its standard deviation or the contemporaneous robusta price divided by its standard deviation.

4 Empirical Strategy

The empirical analysis proceeds in six 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.[15] The following 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:

$$O_{hmy} = \alpha + \beta p_{my} + \mu_h + \delta_y + \theta_m + \epsilon_{hmy}. \tag{16}$$

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 ask 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 18. 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

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

of business ownership to coffee price fluctuations is different across business types.

Third, we examine the responses of capital investments, labor, and performance outcomes of enterprises to coffee price movements. For this analysis, we construct a panel of "persistent" entrepreneur households. We define this sample in a somewhat unconventional way: households qualify as "persistent" entrepreneurs if they operated a business at least once when the coffee price was high (above its sample median), and at least once when this price was low (below its sample median). Put another way, households are persistent enterprise owners when they operate businesses both in good *and* bad coffee years. This sample restriction is meant to capture households at the upper end of the (relative) entrepreneurial ability distribution, who continue to operate enterprises even when agricultural output prices rise. We investigate the impact of coffee price fluctuations on intensive margin enterprise outcomes in this sample, using the same model as shown in specification 18. In a similar analysis, we further restrict the sample to "stayers," or those households who own an enterprise in *every* wave.

Fourth, we explore the determinants of business ownership in the pooled sample, as well as determinants of inclusion in the persistent entrepreneur and entrepreneurial stayer samples, by regressing business ownership and sample inclusion dummies on a set of household characteristics meant to capture demographics, financial access, and ability. We estimate the following simple model, in which o is an ownership or sample dummy and h indexes households:

$$o_h = \alpha + \mathbf{X}_h'\beta + \epsilon_h. \tag{17}$$

Fifth, we examine heterogeneous business ownership responses to coffee price movements across various household characteristics. We estimate the following interaction specification, for household characteristics $\mathbf{X}_h$:

$$o_{hmy} = \alpha + \gamma\left(\mathbf{X}_h \text{ x } p_{my}\right) + \beta p_{my} + \kappa\mathbf{X}_h + \mu_h + \delta_y + \theta_m + \epsilon_{hmy}. \tag{18}$$

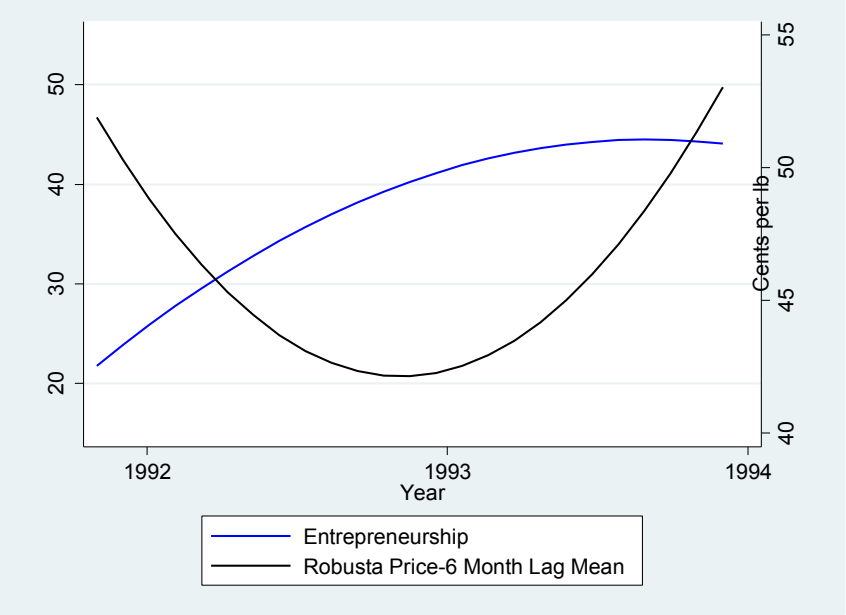
Finally, sixth, we estimate the relationship between coffee prices and a local, enumeration cluster-level Laspeyres price index. We use a balanced panel of all 51 enumeration clusters over the four waves of the survey. We regress the Laspeyres price index on coffee price, both standardized by their standard deviations, in the following specification (where c denotes cluster and L denotes the Laspeyres index):

$$L_{cmy} = \alpha + \beta p_{my} + \mu_c + \delta_y + \theta_m + \epsilon_{hmy}. \tag{19}$$

Standard errors in all regressions are clustered at the level of the enumeration cluster.

Figure 2: Entry and Exit

Entrepreneurship and Global Coffee Price



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 coffee price shocks. We compare the observed empirical patterns with the predictions of the model developed in section 2 and present evidence of possible explanations for any deviations.

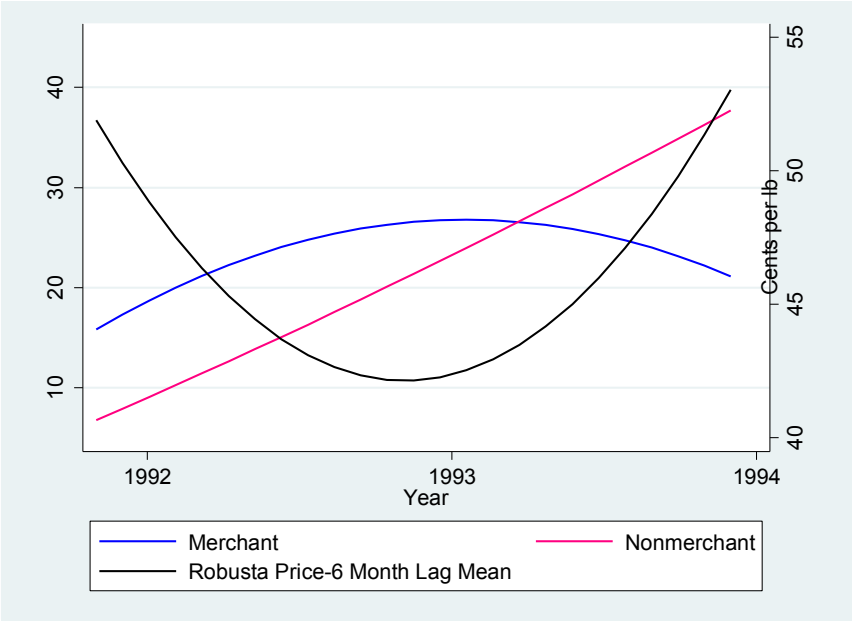
5.1 Preliminary Graphical Analysis

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 re-

Figure 3: Entry and Exit by Industry

Merchant and Non-Merchant Entrepreneurship and Global Coffee Price



port 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.

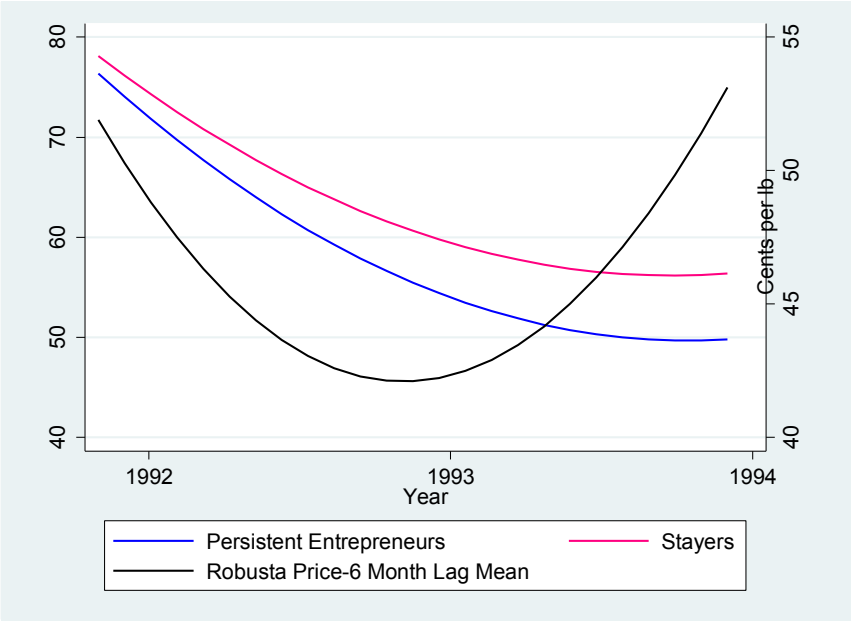
Though Figures 2 and 3 show that entrepreneurship rises during coffee busts and falls during coffee booms, the levels indicate that even in times of high coffee prices some households persist in their enterprise activity. In the analysis that follows, we study the enterprise inputs and performance of households in two subsamples. We study households that own enterprises in at least one above median coffee price period and at least one below median coffee price period and denote households in this subsample as persistent entrepreneurs. We also study households that own enterprises in all four waves of the survey and denote households in this sample as entrepreneurial stayers.

Figure 4 plots the percent of enterprises reporting positive profits in the persistent and stayer samples against the coffee price over time. The patterns suggest that enterprise profits among these households are *pro-* cyclical with coffee prices; that is, persistent enterprises are *more* likely to earn positive profits when coffee prices are high. This is counter to the predictions of the model.

To better understand the drivers of these patterns in enterprise performance, we also study

Figure 4: Performance

Enterprise Profitability and Global Coffee Price



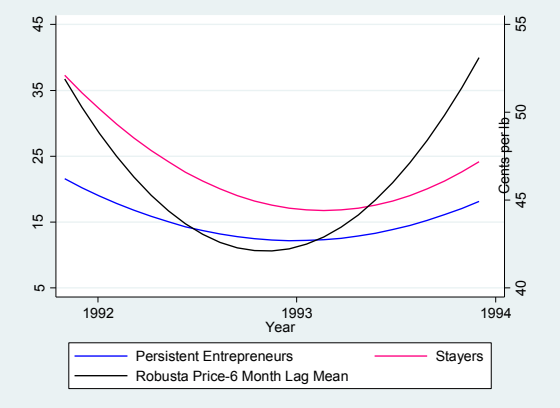
below the impacts of coffee price fluctuations on labor and capital inputs among these subsamples of persistent entrepreneurs and entrepreneurial stayers. Figure 5 shows preliminary evidence that labor inputs follow the same pro-cyclical pattern as enterprise profitability. Panel A shows total weeks of self-employment in the six months prior to survey reported by all members of the household. Panels B and C show the percent of households that have multiple members helping with one of their enterprises and the percent of households that have hired workers for one of their enterprises, respectively. Panels A and B show that household labor supply to enterprises appear to be pro-cyclical, while hired workers seem to be generally acylical.[16]

Figure 6 plots the percentage of households that own assets for their enterprises. Capital inputs appear to be acyclical or mildly counter-cyclical. Taken together, Figures 5 and 6 suggest that pro-cyclical performance among persistent entrepreneurs and entrepreneurial stayers is the result mostly of pro-cyclical household labor supply to enterprises. On the other hand, capital and hired labor do not appear to be central drivers of performance for persistent entrepreneurs and entrepreneurial stayers suggesting perhaps that financial constraints may not be particularly binding for these types of households.

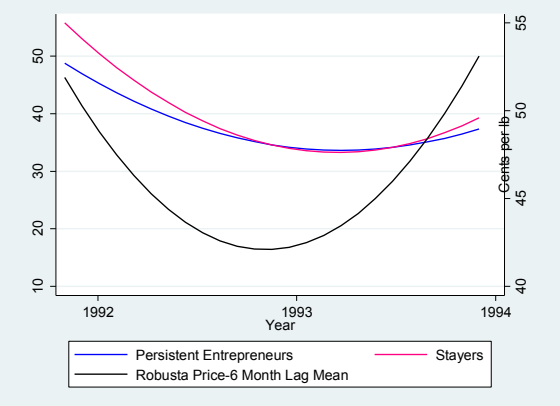
[16]The plot of the percent of households with hired workers among the entrepreneurial stayer sample in Panel C shows a slightly counter-cyclical pattern which is due mostly to an anomalously small number of interviewed households in November 1992 with enterprises.

Figure 5: Labor Inputs and Global Coffee Price

Panel A: Weeks in Self-Employment



Panel B: Percent with Household Workers



Panel C: Percent with Hired Workers

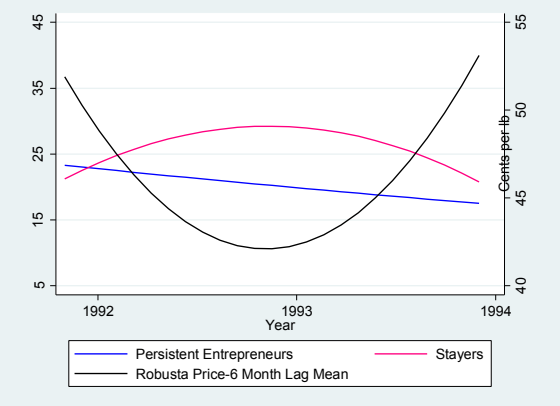
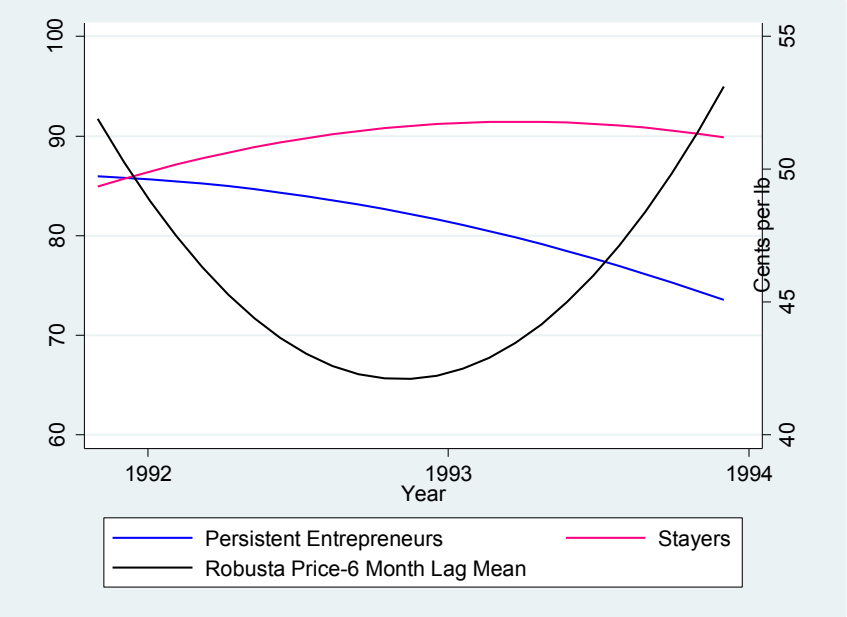


Figure 6: Capital Inputs

Percent Owning Assets



Of course, these graphical analyses are descriptive at best. 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 begin by looking at 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 nearly 29 Tanzanian Shillings (compared to a mean of 46.21 TSh).[17]

Next, we examine quantity sold and revenues for coffee. These results, reported in columns 2 and 3, show that both quantity and revenue increase with the global price (by more than 3.5 kgs

[17] 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.

Table 3
Effects of Coffee Price Changes on Coffee Production and Household Expenditures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
					Total Expenditure			
	Price Received by Households	Quantity Sold	Coffee Revenues	Total Expenditure	Food Expenditure	Non Food Expenditure	Coffee Grower	Harvest Area Under Coffee
Price/SD(Price)	28.52**	3.514	1,028**	45,485***	9,107***	12,206***	-0.00701	0.0307
	(11.74)	(3.852)	(491.3)	(4,889)	(813.3)	(2,136)	(0.00687)	(0.0313)
Fixed Effects				Household, Year & Month				
Observations	1,723	1,778	2,879	2,812	2,817	2,807	2,879	2,879
Number of Households	710	711	753	753	752	751	753	753
Mean of Dependent Variable	46.21	42.22	25,069.49	2,21,549	39,976.00	75,943.00	0.933	0.605

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). 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 price received is Tanzanian

and 1000 TSh, respectively, for a one SD change in the global price), consistent with an upward-sloping supply of coffee. Though the impact on quantity sold is insignificant at conventional levels, the impact on coffee revenues is significant at the 5 percent level.

Lastly, we look at household expenditures, to explore the extent to which households are able to smooth consumption in the face of coffee price fluctuations. We 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 growing some amount of coffee by .7 percentage points; while column 8 reports that the same price increase drives households to plant only .03 acres more of coffee.

We interpret both results as evidence of no relationship between coffee price and coffee-growing. A lack of response in coffee-growing on the part of households is likely due to the long time to yield for coffee (3 to 5 years) and a law prohibiting the uprooting of coffee trees during several of the years covered by this study. 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 ownership among coffee-growing households. Results of this analysis are reported in Table 4. Column 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, an increase of about 13 percent above the mean. 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

Table 4
Does Household Enterprise Activity Respond to Coffee Price Fluctuations?

	(1)	(2)	(3)
	1(Houshold Owns a Business)	1(Houshold Owns a Merchant Business)	1(Houshold Owns a Non-Merchant Business)
Price/SD(Price)	-0.0511***	-0.0428***	-0.0148
	(0.00991)	(0.0118)	(0.0111)
Fixed Effects		Household, Year & Month	
Observations	2,879	2,879	2,879
Number of Households	753	753	753
Mean of Dependent Variable	0.377	0.237	0.217

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

results show quite strongly that households are much more likely to "smooth" 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.

5.4 Enterprise Inputs and Performance Among Persistent Entrepreneurs

We have shown that when coffee prices drop, some households startup 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.

The model developed in section 2 predicts that, for households with sufficiently high entrepreneurial ability, running a non-agricultural enterprise will be optimal even at high agricultural output prices. Accordingly, we next explore what happens to these households whose businesses stay open during coffee price booms. In Panel A of Table 5, we restrict the sample to include households that owned an enterprise in at least one above median coffee price period and at least one below median coffee price period. In Panel B, we restrict the sample to households that owned an enterprise in all 4 waves of the survey.

Table 5
Do Enterprise Inputs and Performance Respond to Coffee Price Fluctuations?

Panel A: Persistent Entrepreneurs (Business during both and high and low coffee prices)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Capital		Labor			Performance	
	1(Business Assets Owned)	1(Business Assets Bought or Sold)	Weeks of Self-Employment Amongst Household Members	1(Any Household Member Helping in the Business)	1(Hired Worker(s))	Mos. Business Operating	1(Business Had Positive Profits)
Price/SD(Price)	-0.0135	-0.000479	3.365**	0.0187	0.0267	0.889***	0.0721***
	(0.0202)	(0.0229)	(1.388)	(0.0223)	(0.0181)	(0.189)	(0.0239)
Fixed Effects				Household, Year & Month			
Observations	744	779	779	779	779	776	779
Number of households	250	250	250	250	250	250	250
Mean of Dependent Variable	0.801	0.190	18.70	0.370	0.200	4.879	0.576

Panel B: Entreneurial Stayers (Business in all 4 waves)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Capital		Labor			Performance	
	1(Business Assets Owned)	1(Business Assets Bought or Sold)	Weeks of Self-Employment Amongst Household Members	1(Any Household Member Helping in the Business)	1(Hired Worker(s))	Mos. Business Operating	Business Profits
Price/SD(Price)	0.0124	0.00615	4.825***	0.0586**	0.0215	0.964***	0.0689**
	(0.0182)	(0.0383)	(1.517)	(0.0288)	(0.0257)	(0.239)	(0.0267)
Fixed Effects				Household, Year & Month			
Observations	359	368	368	368	368	366	368
Number of households	92	92	92	92	92	92	92
Mean of Dependent Variable	0.897	0.215	22.66	0.394	0.266	5.525	0.644

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

We begin by exploring, in columns 1 and 2, capital input responses to price shocks among these persistent entrepreneurs (Panel A) and entrepreneur stayers (Panel B). Next, we report effects of price shocks on weeks spent in entrepreneurial activity (self-employment), a dummy for whether household members helped in the business, and a dummy for whether the household hired workers for its enterprise in columns 3 through 5, respectively. Lastly, we report effects on enterprise performance, namely months of business operation and the probability of positive profits in columns 6 and 7, respectively.

The results in columns 1 and 2 of both Panels A and B show that capital inputs among both persistent entrepreneurs and entrepreneurial stayers do not seem to respond to coffee price fluctuations. The results in columns 3 through 5 on the other hand of both panels show positive and significant responses to increases in the global price of coffee. Column 3 shows that a one SD increase in the coffee price drives persistent entrepreneurs to increase their time spent in self-employment by nearly 3.4 weeks (from a mean of 18.7) and entrepreneurial stayers to increase their self-employment by more than 4.8 weeks (from a mean of 22.66). These results are significant at the 5 and 1 percent level, respectively.

Results in column 4 show an insignificant increase of nearly 2 percentage points in the probability of household members helping in the enterprise for households in our persistent entrepreneur sample, but a one SD increase in the coffee price leads to a nearly 6 percentage point rise among entrepreneurial stayer households (from a mean of 39.4 percent). This result is significant at the 5 percent level. Column 5 shows insignificant increases of between 2 and 3 percentage points in the probability of enterprises having hired workers among both persistent entrepreneurs and entrepreneurial stayers.

Lastly, the results in columns 6 and 7 of both panels provide strong evidence of a positive impact of coffee price on both the number of months the enterprise has been operating and the probability that the enterprise earns positive profits. A one SD rise in the coffee price leads to .889 more months of operation among persistent entrepreneurs and .964 more months among entrepreneurial stayers (from means of 4.879 and 5.525, respectively). A positive price shock leads to a 7.21 percentage point increase in the probability of earning positive profits among persistent entrepreneurs and a 6.89 percentage point increase among entrepreneurial stayers (from means of .576 and .644, respectively). These point estimates are all significant at the 1 or 5 percent levels.

These positive effects on labor inputs and enterprise performance are consistent with the patterns depicted in Figures 4 through 6, but are counter to the predictions of the model. The model suggests that high ability entrepreneurs will indeed persist in their enterprise activity, but will scale down their inputs and show reduced profits in response to an increase in the global price of coffee. The empirical patterns observed among persistent entrepreneurs and entrepreneurial stayers could be due to deviations from the model environment such as capital

constraints or general equilibrium effects in localized village markets. The lack of evidence of capital input responses to coffee price fluctuations suggest that capital constraints are not likely the explanation. On the other hand, we provide suggestive evidence below that localized general equilibrium effects might be part of the explanation. We discuss both possibilities further in section 6 below.

5.5 Which households own a business?

Given the empirical evidence discussed above of dichotomous enterprise responses to coffee price shocks among coffee-growing households, we next describe which types of households own businesses of different types and which characteristics predict persistent entrepreneurship. We do so by regressing dummy variables corresponding to enterprise ownership and merchant and non-merchant business ownership, as well as dummies for inclusion in our persistent entrepreneur and entrepreneurial stayer samples, on demographic characteristics of the household head and financial characteristics of the household from the first wave.

In column 1 through 3, we estimate pooled regressions using the whole sample of coffee-growing households (across all waves). We include the following characteristics of household heads: gender (male dummy); numeracy and literacy dummy (need both for dummy to equal 1); and a dummy for greater than 0 years of grade completion. For the household, we include the following financial characteristics (all dummies): any remittance activity (sent or received); positive savings; positive debt; and above-median financial stock.[18]

The coefficient estimates from the regressions are reported in Table 6. In column 1, we see that numeracy/literacy is strongly positively related to business ownership. Households with heads that are both numerate and literate are about 12 percentage points more likely to engage in entrepreneurial activity, from a mean of about 0.38 (i.e., nearly a 1/3 increase above the mean). Though numeracy/literacy is likely a very noisy predictor of entrepreneurial ability, the result here is consistent with the small but growing literature emphasizing the importance of dimensions of ability in business ownership and success.

Household financial variables are highly predictive of ownership, and interestingly, all variables we include positively predict ownership. Remittance activity increases likelihood of business ownership by about 8 percentage points; positive savings by 11 percentage points; positive debt by 6 percentage points; and above median financial stock by more than 8 percentage points. These results are consistent with the literature on financial deepening and microenterprise growth: financial constraints may play a major role in limiting enterprise development in this context.

Finally, perhaps surprisingly, conditional on numeracy/literacy status, education is not sig-

[18] Please see the data appendix for details on the construction of these and other variables used in analysis.

Table 6
Which Households Own a Business?

	(1)	(2)	(3)	(4)	(5)
	1(Household Owns a Business)	1(Household Owns a Merchant Business)	1(Household Owns a Non-Merchant Business)	Persistent Entrepreneur: 1(Business during both high and low coffee prices)	Stayer: 1(Business in all 4 Waves)
1(Male)	0.0476	-0.00731	0.0655***	0.0321	0.0402
	(0.0334)	(0.0293)	(0.0232)	(0.0434)	(0.0274)
1(Can Write and Do Math)	0.117**	0.0548	0.0655*	0.104*	0.0890***
	(0.0443)	(0.0337)	(0.0334)	(0.0566)	(0.0273)
1(Some Education)	-0.0133	0.0133	0.00726	-0.00207	-0.0756**
	(0.0369)	(0.0371)	(0.0304)	(0.0506)	(0.0289)
1(Any Remittances)	0.0799**	0.0189	0.0761***	0.0946**	0.0392
	(0.0341)	(0.0305)	(0.0225)	(0.0410)	(0.0255)
1(Positive Savings)	0.113***	0.0412	0.0740***	0.135***	0.0609**
	(0.0272)	(0.0250)	(0.0213)	(0.0378)	(0.0256)
1(Positive Debt)	0.0556**	0.0582**	0.0145	0.0815**	0.0321*
	(0.0264)	(0.0275)	(0.0182)	(0.0351)	(0.0186)
1(Above Median Financial Stock)	0.0842***	0.0819***	0.0345	0.103***	0.0490**
	(0.0274)	(0.0199)	(0.0254)	(0.0363)	(0.0240)
Observations	2,876	2,876	2,876	752	752
Mean of Dependent Variable	0.377	0.237	0.217	0.332	0.122

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Household characteristics are from wave 1.

nificantly related to ownership: the coefficient is -0.01 and the standard error band is fairly tight around 0. Households with male heads are slightly more likely to own a business (5 percentage points), but this relationship is statistically insignificant.

In columns 2 and 3 of Table 6, we break down enterprises into merchant and non-merchant businesses, and look at partial correlations separately across the two categories. One should think of the main delineations as size and fixed cost. Merchant businesses are very small, and usually involve very little capital input or fixed costs of operation (e.g., many merchants are vendors that sell fruits, vegetables, and bread on the roadside). Non-merchant businesses are larger and usually involve bigger capital inputs to production (e.g., a construction business or a drug shop with a "brick and mortar" location).

Literacy/numeracy coefficient estimates are imprecisely estimated for both merchant and non-merchant enterprise ownership, but this measure of ability appears to predict non-merchant business ownership more strongly and significantly than merchant business. Education conditional on literacy/numeracy status continues not to play a role in determining ownership. Interestingly, households with male heads are much more likely to own non-merchant businesses, but no such relationship exists for merchant businesses. Remittances and savings matter for non-merchant businesses but not for merchants, whereas for debt and financial stock, the opposite is true.

Column 4 presents determinants of persistent entrepreneurship defined as owning an enterprise in both above and below median coffee price periods. In column 5, we examine predictors of inclusion in the entrepreneurial stayers sample defined as those households that operate businesses in all four waves of the panel. The results in both columns 4 and 5 are overall similar to those in column 1: numeracy/literacy is strongly positively related to persistent entrepreneurship, and financial variables are also all positively related. Education conditional on literacy/numeracy is *negatively* related to persistent enterprise, suggesting that perhaps households with high innate ability but low grade completion are the most likely to be persistent entrepreneurs in this context.

Although only descriptive in nature, the results in Table 6 are consistent with hypotheses in the microenterprise literature that both ability and access to financial resources are important drivers of entrepreneurship. While financial activity seems to predict both intermittent and persistent entrepreneurship, ability appears to more strongly predict persistent, non-merchant enterprise ownership.

5.6 Heterogeneous Effects

Last, we explore heterogeneity in the enterprise ownership response to coffee price movements across various household characteristics. Table 7 reports results of these interaction specifications. Recall that the main effect from Table 4 showed that households engaged in more en-

Table 7
Are Household Enterprise Activity Responses Heterogeneous by Household Characteristics?

	(1)	(2)	(3)
	1(Houshold Owns a Business)	1(Houshold Owns a Merchant Business)	1(Houshold Owns a Non-Merchant Business)
1(Male) x Price/SD(Price)	-0.0190	0.00953	-0.0230
	(0.0152)	(0.0170)	(0.0158)
1(Can write AND do math) x Price/SD(Price)	0.0411**	0.0573***	-0.00640
	(0.0197)	(0.0177)	(0.0182)
1(Some Education) x Price/SD(Price)	-0.0129	-0.0363**	0.0242
	(0.0166)	(0.0160)	(0.0168)
1(Any Remittances) x Price/SD(Price)	-0.00485	0.00196	-0.0125
	(0.0246)	(0.0216)	(0.0166)
1(Positive Savings) x Price/SD(Price)	-0.0142	-0.0309*	0.0245*
	(0.0160)	(0.0168)	(0.0143)
1(Positive Debt) x Price/SD(Price)	0.0211	0.000842	0.00910
	(0.0138)	(0.0146)	(0.0102)
1(Above median financial stock) x Price/SD(Price)	-0.0198	-0.00806	-0.0226*
	(0.0131)	(0.0128)	(0.0130)
Price/SD(Price)	-0.0394	-0.0333	-0.0153
	(0.0286)	(0.0277)	(0.0232)
Fixed Effects		Household, Year & Month	
Observations	2,875	2,875	2,875
Number of Households	752	752	752
Mean of Dependent Variable	0.377	0.237	0.217

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Coffee grower is a dummy variable that is 1 if a household reported harvesting coffee in that wave. Coffee sample is a dummy variable that is 1 if a household reported harvesting coffee in any one of the 4 waves, and 0 otherwise. Household characteristics are from wave 1.

trepreneurial activity during coffee price busts, and shut down enterprise during booms. Interestingly, we find in Table 8 (column 1) that "high-ability" household heads (those with literacy and numeracy) are *less* likely to change ownership status with coffee price movements. That is, it seems that high-ability households seem less likely to be intermittent entrepreneurs. The impact of coffee price changes does not appear to be significantly different across financial activity indicators.

When we break down ownership into merchant v. non-merchant categories (columns 2 and 3, respectively), we find that ability mitigates the relationship between ownership and coffee prices only for merchant businesses. Further, higher financial activity and access magnify the impact of coffee price on ownership during price busts, suggesting that financial constraints may hamper the establishment of even these "intermittent" enterprises.

5.7 General Equilibrium Effects and Local Prices

Our final analysis explores the possibility that large fluctuations in the global price of coffee might drive shifts in aggregate demand in areas in which a majority of households depend on coffee as an important source of income. The fact that persistent entrepreneurs and entrepreneurial stayers increase labor inputs and display increases in enterprise performance dur-

Table 8
Do Local Prices Respond to Coffee Price Fluctuations?

	(1)	(2)	(3)
	Dependent Variable: Laspeyres Index of Local Prices/SD		
Price/SD(Price)	0.113***		0.103***
	(0.0116)		(0.0235)
Lagged Price/SD(Price)		0.147***	0.0193
		(0.0206)	(0.0381)
Fixed Effects		Cluster, Year & Month	
Observations	204	204	204
Number of Clusters	51	51	51
Mean of Dependent Variable	4.968	4.968	4.968

Notes: Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

ing coffee booms could be due in part to a general increased demand for goods driven by greater liquidity in the local market. Table 8 presents suggestive evidence in support of general equilibrium effects of coffee price shocks.

We present results from regressions of the Laspeyres index of local prices on the usual coffee price measure, the 6 month lag of this measure, and both the current and lagged coffee prices in columns 1 through 3, respectively. Both the Laspeyres index and the global coffee price measures are normalized by their standard deviations. The results show that both the current and lagged coffee price measures are significantly positively correlated with local prices. A one SD rise in the moving average measure of the global coffee price and a one SD rice in its 6 month lagged value lead to sizable increases of roughly .11 and .15 in the Laspeyres index of local prices, as presented in columns 1 and 2 respectively. Column 3 suggests that coffee prices over the 6 months before survey drive local demand more than do prices 6 months to a year before survey. This is consistent with the notion that the price that prevails during the most recent harvest is most important for local demand.

6 Conclusion

We test, and verify, the long-standing hypothesis that households use enterprise activity as a means to mitigate income shocks. Using panel data from a sample of coffee growers in north-

west Tanzania, we show that household enterprise ownership goes up by more than 5 percentage points (or about 22 percent above mean ownership) during coffee price busts. "Persistent" entrepreneurs, those households who operate businesses in both booms and busts, respond surprisingly to price shocks: these households actually *increase* input intensity into their businesses, and reap substantial returns in terms of profits and business survival as a result.

We discuss two additions to the model that help explain our findings on "persistent" and "stayer" entrepreneurs. Recall that our model predicts that for sufficiently high-ability households, there is no extensive margin movement – these households persist in entrepreneurship even when the coffee price increases. On the intensive margin, labor and capital – and thus also revenues – should decrease for these households. But we find very clear evidence that labor and revenues *increase* for the persistent entrepreneurs when coffee price goes up. Why might this discrepancy exist?

The first explanation we submit is capital constraints. If coffee-farming households face binding borrowing constraints with regard to investment in their businesses, an increase in the coffee price could enable them to grow their businesses by investing in more capital. If this were the case, however, we should see increases in the reported business asset ownership and capital-related transactions. In fact, we estimate rather tightly bounded 0 coefficients for effects on capital inputs. These results suggest that at least in our context, capital constraints do not appear to be a germane explanation for the increase in enterprise activity following coffee price increases for "persistent" entrepreneurs.

The second explanation we submit is related to local general equilibrium price effects. When the coffee price increases, coffee farming areas tend to prosper: incomes increase, expenditures rise, and thus prices for local goods and services rise as well. Businesses selling these goods and services become more profitable as a result, and thus those who operate their enterprises during these periods will benefit, and may choose to scale up instead of scale down the intensity of operations. Indeed, we do find, from our cluster-level price index analysis, that the global coffee price certainly does drive local prices, which is consistent with this general equilibrium story. More work needs to be done, however, to be able to say definitively that this channel is salient.

Our results implicate several simple 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 smoothing. 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 price floors or centralized storage facilities, must therefore be considered.

Second, given the prevalent use of household enterprise as a means of smoothing, more must

be done to strengthen the profitability of intermittent businesses. The fact is that households are more likely to engage in these businesses during price busts, precisely when local purchasing power is low. Given dormant demand, profitability is elusive during busts, even for talented entrepreneurs, and so the smoothing capability of microenterprise is blunted. Easing access to more distant markets by removing physical or informational trade barriers would therefore help to boost the value of intermittent enterprise.

Finally, if we take seriously the idea that there is a distribution of entrepreneurial ability, which governs in part the decision to engage in enterprise, our results suggest 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 low-ability 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 encouraging the use of savings accounts and establishing local commodity storage cooperatives as alternate means of smoothing.

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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 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.

- Persistent Entrepreneurs: equals 1 if the household who owned at least one enterprise both when lagged coffee price (robustalag described above) was above its median value and when lagged coffee price was below its median value, 0 otherwise.
- Stayer: equals 1 if the household reported owning at least one enterprise in all 4 waves, 0 otherwise.

A.3 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.
- 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.4 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.5 Household's Financial Participation Variables

- 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.

A.6 Household 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.
- Quantity Sold: Quantity of household-level coffee sales reported in kg.
- Coffee revenues: Value of household-level coffee sales reported (in Tanzanian Shillings).

A.7 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.8 Community-Level Local Prices

– Laspeyres Index of Local Prices/SD: Cluster-level Laspeyres Index of Local Prices divided by its standard deviation. The KHDS price questionnaire collected data on 48 goods from each cluster, and constructed the index for all four waves. We use the mean month and year of all the price interviews within a cluster to constructed a monthly cluster-level price index.