Use of financial diaries to understand smallholder investment finance a cross country analysis in Mozambique, Tanzania and Pakistan

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Abstract

Purpose – The purpose of this paper is to evaluate the relative importance of different sources of finance for agricultural and non-agricultural investments using unique Smallholder Financial Diaries collected by Consultative Group to Assist the Poor (CGAP) in Mozambique, Pakistan and Tanzania at the individual and household level.

Design/methodology/approach – Following the analytical framework of variance decomposition developed in Samphantharak and Townsend (2010), this study develops a method to quantify how much each cash deficit associated to investments and expenses of interest co-move with different financing sources.

Findings – This paper finds that self-finance, rather than formal or informal finance from external providers, is the main financing source for long-term and short-term smallholder agricultural investments. Further, the paper finds that the main source of self-finance varies depending on the economic opportunities faced by smallholders, with non-agricultural income as the dominant financing source for some, while agricultural income dominating for others.

Research limitations/implications – Given CGAP's Smallholder Financial Diaries is not nationally representative, research results should be interpreted carefully. However, to the best of the authors' knowledge, this is the first paper to analyze financing sources for smallholder households making use of high frequency financial data for individuals in developing countries.

Practical implications – These findings imply that financial inclusion policies specifically targeting smallholders and the agricultural sector would benefit from enabling the development of an ecosystem of diverse financial services that respond simultaneously to both agriculture and non-agriculture needs.

Originality/value – This is paper furthers the authors' knowledge on how smallholder households are financing their agricultural investments. Moreover, it applies methods in new ways to exploit a unique data set.

Keywords Financial inclusion, Agricultural finance, Smallholders, Financial diaries, Agricultural investment

Paper type Research paper

Introduction

The new sustainable development goals reflect a consensus that increasing agricultural investments in developing countries is critical to reducing poverty (UN, 2016). In the particular context of low-income economies, investments that enable an increase in agricultural GDP have a higher poverty-reducing effect than an equivalent growth in the

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non-agricultural sector, given the larger share of the poor employed in agriculture (Christiaensen *et al.*, 2011). Agricultural investments enable greater productivity that improves the competitiveness of domestic production, increases the income of rural households, lowers the cost of foods and raises demand for non-agricultural products and services which further contributes to wider economic growth (Kugelman and Levenstein, 2012; Byerlee and Deininger, 2013).

The bulk of agricultural investments in developing countries is made by private domestic investors mostly composed of smallholder families and the small and medium agribusinesses they engage with. Therefore, understanding their constraints to agricultural investments is critical to promote greater socio-economic development in low-income countries (FAO, 2012, 2017).

In this paper we make use of Consultative Group to Assist the Poor's (CGAP) Smallholder Diaries to analyze the relative importance of different sources of finance for agricultural and non-agricultural investments and suggest policy implications. This unique database captures year-long fortnightly income, expenses and financial transactions variables for 275 smallholder families distributed in specific areas in three different countries[1].

In a review of global agricultural census data, Graeub *et al.* (2016) found that small-scale family farms constitute over 98 percent of all farms and work on 53 percent of agricultural land worldwide. However, for most of these smallholders in developing countries, the transition from small-scale subsistence to commercial farming is fraught with difficulties (FAO, 2014). One of the binding constraints limiting the participation of smallholder families in expanding commercial agriculture – and their ability to benefit from this participation – is access to adequate financial services (Barrett, 2008).

Smallholders face many unmet financing needs that prevent them from optimally managing their cash flows, making investments, manage risks and smoothing consumption as they carry out those agricultural and non-agricultural activities that constitute their diverse livelihoods (Davis *et al.*, 2010; Dalberg, 2015). General financial services like savings accounts or short-term credit, for example, help these farming families manage the overall liquidity generated from their various livelihood activities. More specialized financial services, like agricultural investment credit, leasing or agricultural insurance, help smallholder families raise the capital required to invest in agriculture and manage and cope with implied risks. Better risk management is an important enabler of agricultural investments, as smallholder families feel confident they can deal with associated risks (Rosenzweig and Wolpin, 1993; Dercon and Krishnan, 1996; Fafchamps *et al.*, 1998; Karlan *et al.*, 2014).

Improvements in productivity deriving from agricultural investments can foster investments in non-agricultural investments and vice versa (Lipton, 1976). Given the strong covariance between those agricultural and non-agricultural activities carried out by smallholder families, the use of both types of general and agriculture-specific financial services enables a more efficient allocation of resources and more investments in those livelihood activities that are more rewarding given the household's context (FAO, 2017).

Haggblade *et al.* (2010) found that rural non-farm income (RNFI) is a main cash source for rural households in Sub-Saharan Africa, and Reardon *et al.* (1994) and Davis *et al.* (2010) show some evidence that RNFI is a key cash source and determinant for input purchases. Other authors (Adjognon *et al.*, 2016) also underline the importance of non-farm employment for agricultural input purchases, and suggest that agricultural investment and food security could be improved through rural development policies and programs that promote the development of the rural non-farm sector, like manufacture or services, as a complement to credit policies and programs

Despite the relevance of smallholders in the process of agricultural – and wider socio-economic – development, and their recognized limited access to formal financial services, there is little evidence of the financial management strategies they currently use in order to make different expenses and investments. This is specially so for those longer-term investments, and it is in part explained by the scarcity of detailed survey data on their financial transactions and behavior during longer periods of time. This information at the micro level is important to define those financial gaps and service features that would best fit their needs (Adjognon *et al.*, 2016; Morris *et al.*, 2007).

This scarce understanding of the financial lives of smallholders has partly contributed to the formal financial sector's lack of exposure to small-scale agriculture in developing countries. The high covariance risk between smallholder economic activities and the high transaction costs incurred in rural areas with low population densities has made it difficult for the formal financial sector to sustainably offer their services given the complexity of assessing the risk profile of these clients and the high delivery costs faced. This has resulted in the fragmentation of rural financial markets where several financial service providers coexist and those informal ones tend to dominate given the informational and logistical advantages they possess (Adams and Fitchett, 1992; Conning and Udry, 2007; FAO, 2017).

Data description and methodology

Financial diaries data

Household panel surveys such as the Living Standards Measurement Study have been the dominant choice to analyze household financial behavior and get a static snap shot of current financial services used for a nationally representative sample of the population. To get a more granular understanding of household financial behavior of smallholders, financial diaries allow for a dynamic view of all cash inflows and outflows and the financial instruments used during some period of time.

Other studies have relied on financial diaries to explore household financial behavior. Examples include Collins (2005) and Collins (2008), who studied the financial instruments and household debt held by the urban poor in South Africa; Kamath *et al.* (2008) used financial diaries in the province of Ramanagaran in India to understand credit repayment patterns; Stuart *et al.* (2011) use financial diaries data in Malawi to explore the type of financial instruments used by women, the use of formal vs informal financial services and household risk-coping abilities. Also Hannagan and Morduch (2015) and Buckland *et al.* (2013) use financial diaries to study the effects of financial literacy in the USA and Canada.

CGAP conducted financial diaries focusing exclusively on smallholder households. The first of its kind, the smallholder financial diaries capture year-long daily income, expenses and financial transactions variables for 275 families. The families in the sample are not nationally representative and live in northern Mozambique, western Tanzania and the Punjab province in Pakistan. The particularity of these diaries is the profile of the participants, who are defined as smallholders having 5 hectares of land or less and declaring that their agricultural activities were one of the most important sources of income. Fortnightly interviews were conducted for each smallholder household for the period between June 2014 and June 2015. The Financial Diaries data collection process consists of a recruitment phase, to maximize the range of household of interest for the study, and an enrollment phase, with three initial questionnaires, which include questions related to living standards, physical assets, income sources and financial instruments used by all household members. The diaries questionnaires capture individual cash flows from the preceding two-week period (Anderson and Ahmed, 2016)

The key limitation of the smallholder financial diaries analyzed is that the behavior observed does not necessarily reflect an average of the whole smallholder population in each country. However, the sample of smallholder households from each country presents a rare

and nuanced glimpse into the financial practices that smallholders can have, which are critical to inform policies that aim to promote smallholder investments. For more details on the methodology used to collect the smallholder financial diaries please see CGAP (2016).

The smallholder financial diaries illustrate all livelihood activities that determine income, investment, expenditure and financial decisions and how they can vary throughout the year, which is key to understand the financial behavior and needs of this particular population segment. Anderson and Wajiha (2016) categorized in good detail the smallholders from the three target countries as prevalently non-commercial smallholders in Mozambique; smallholders in loose value chains in Tanzania and smallholders in a relatively tight value chains in Pakistan.

Methodology and estimation strategy

The income, expenses and financial transaction information available in the CGAP smallholder financial diaries was classified into new variables to make it easier to answer a variety of research questions focused on sources of finance for different investments and expenses categories.

A total of 11 new variables were created to aggregate the diaries data. These variables are described in Table I. The new variables were classified into: consumption, agricultural

Variable	Description
1. Consumption	Consumption was disaggregated into e (emergencies) and c′ (consumption excluding emergencies). Flows associated with everyday expenses on goods and services (i.e. buying food, electricity, food from restaurants, groceries, medicines, transport, clothes and shoes, etc.)
2. Total agricultural investment	Total investment in agriculture (i.e. both long-term and short-term investments)
2.1 Long-term agricultural investment	Reported expenses to acquire farmland, livestock and farming tools (i.e. cattle, poultry, ploughs, water pumps, land, etc.)
2.2 Short-term agricultural investment	Reported expenses to pay for occasional farm labor, seeds and fertilizer
3. Total non-agricultural investment	Expenses associated with buying non-agricultural physical assets and other expenses like investments associated to a non-agricultural microbusiness
3.1 Self-employment investment	Expenses reported by a sole microbusiness proprietor related to a non-agricultural enterprise (i.e. inputs, stocks, tools)
4. Total income	Income from agricultural and non-agricultural activities
4.1 Agricultural income	Income from production and sale of agricultural goods (i.e. crops, livestock from an agricultural business, livestock byproducts like milk and eggs, etc.)
4.2 Non-agricultural income	Income from non-agricultural activities (i.e. self-employment, casual employment, other income, etc.)
5. Selling physical assets	Revenues from the sale of physical assets (i.e. sale of vehicles, tools, electronics, etc.)
6. Cash lost	Cash lost, stolen or missing from the household
7. Financial instruments	All inflows and outflows associated with saving, credit, insurance and payments. It includes formal and informal financial instruments[a]

Notes: [a]Formal financial instruments include: Checking or savings account, Individual loan from institution, Long-term investment account, Joint liability loan, Life insurance, Health insurance, mobile money, Tafu airtime credit. Informal financial instruments include: Agent credit, Wage advance from employer, Act as Moneyguard, Friends and family: Borrowing, Friends and Family: Lending, Keeping Money (Cash) at Home, Moneylender Borrowing, Use Moneyguard, Borrowing from an Informal Group, Hire/installment purchase, Informal credit at a store, Layaway, Pawning, Private investment in someone else's business, Rent arrears, Saving in a rotating savings group, Saving in an ASCA, Wage or rental arrears owed to respondents, Arrears owned by respondent, Supplier credit, Credit given to clients, Mortgage

Source: Authors

Table I. Construction of new variables

investment, non-agricultural investment, income from agricultural and non-agricultural production activities, selling physical assets, cash lost and financial instruments. They aggregate all forms of expenses and income.

The co-movement of such variables is assessed following the analytical framework of variance decomposition developed in Samphantharak and Townsend (2010). Variance decomposition quantifies how much each cash deficit associated to investments and expenses of interest co-move with each financing source along the whole time period observed. This allows us to rank the importance of each of the many financing sources for investments and expenses of interest.

Using the new variables created, we build an accounting identity that captures the evolution of cash management within a particular household for the whole time period. Clearly in such accounting identity, the sources of cash are equal to the uses of cash at any point in time:

$$i+gi+sp+fi+cb \equiv c'+lt+st+na'+se+cl+e. \quad (1)$$

The left side of the identitytakes into account all the variables that are sources of cash: *i* represents non-agricultural income, *gi* refers to agricultural income; *sp* is the sale of physical assets; *fi* is any cash inflow from the different financial instruments used and *cb* is any cash flowing[2]. In the other side of the identity there are all the variables that account for the use of cash, *c′* is consumption (without emergencies), *lt* is long-term agricultural investment, *st* is short-term agricultural investment, *na'* is non-agricultural investment (without non-farm self-employment investments), *se* represents non-farm self-employment investments, *cl* represents cash lost and *e* represents emergencies, quantifying medical expenses.

The new variables were created aggregating the amounts captured by the diaries, specifying in every case if this transaction was a cash inflow or a cash outflow. For a more detailed definition of each variable see Table I.

We consider cash and non-cash transactions in the analysis. For example, if a household consumed grain reserves given by another household as an in-kind loan, the framework used assumes the borrowing household received cash equivalent to the value of the grain consumed and used the cash to purchase this grain. Therefore, there would be a cash outflow for consumption and a cash inflow from the in-kind loan received, leaving the total cash held by the household unaltered.

Subsequently, we re-organize the original identity (1) maintaining the balance between sources and uses of cash. Keeping only the investment or expense variable of interest at one side of the identity we can isolate the sources of funds financing that particular variable. Moreover, this methodology can be applied to understand the relative importance of different sources of finance for other variables beyond investment, like loan repayments or savings, and has the potential to provide relevant insights to enhance the understanding of policymakers and financial service providers of smallholders' financial behavior.

We conduct this exercise for every household in the database in an iterative way during the whole time period observed. Isolating each one of these variables we estimate how that particular item is financed. By simply re-arranging (1) we can easily get four new identities:

$$lt \equiv i+gi+sp+fi+cb-(c+st+na+cl), \quad (2)$$

$$st \equiv i+gi+sp+fi+cb-(c+lt+na+cl), \quad (3)$$

$$e \equiv i+gi+sp+fi+cb-(c'+lt+na+cl+st), \quad (4)$$

$$se \equiv i + gi + sp + fi + cb - (c + lt + na' + cl + st). \quad (5)$$

Identity (6) shows the first step of the variance decomposition calculation with "D" representing any of the investment and expenses variables of interest (i.e. *lt, st, e* or *se* items in the left side) and F_i representing the rest of the variables in the right side of Equations (2)–(5) (i.e. *i, gi, sp, fi, cf, c, st, na, se, cl, e*). Therefore, F_1, F_2, F_3 or F_n represent any particular variable that might contribute to finance the activity D:

$$D \equiv F_1 + F_2 + \cdots + F_n. \quad (6)$$

In order to compute covariances, we subtracted the means from both sides of (6):

$$D_t - \overline{D} \equiv \left[F_{1,t} - \overline{F_1}\right] + \left[F_{2,t} - \overline{F_2}\right] + \cdots + \left[F_{n,t} - \overline{F}_n\right], \quad (7)$$

which implies:

$$\sum_t \left[D_t - \overline{D}\right]^2 \equiv \sum_t \left[F_{1,t} - \overline{F}\right]\left[D_t - \overline{D}\right] + \sum_t \left[F_{2,t} - \overline{F}\right]\left[D_t - \overline{D}\right] + \cdots + \sum_t \left[F_{n,t} - \overline{F}\right]\left[D_t - \overline{D}\right], \quad (8)$$

$$\mathrm{Var}(D) \equiv \mathrm{Cov}(D, F_1) + \mathrm{Cov}(D,\ F_2) + \cdots + \mathrm{Cov}(D,\ F_n). \quad (9)$$

Finally, we have the normalized covariance as[3]:

$$1 \equiv \frac{\mathrm{Cov}(D, F_1)}{\mathrm{Var}(D)} + \frac{\mathrm{Cov}(D, F_2)}{\mathrm{Var}(D)} + \cdots + \frac{\mathrm{Cov}(D, F_n)}{\mathrm{Var}(D)}. \quad (10)$$

Namely, we decompose the variance of the items to be studied (*lt, st, e* or *se*) into its cross-covariances with the items that might be used to finance such variable. Further, we divide each of these cross-covariances by the variance of the variable of interest as shown in Equation (10) to obtain the co-movement between the variable of interest and each of the items in the identity.

The covariance terms in (10) are positive if the F variables contributes to the financing of item D (e.g. the household can finance D with the sale of an asset, a decrease in consumption, more borrowing or depleting a savings account). The covariances between any D and any F, normalized by the variance of the corresponding D variable, sum to 1. Therefore, the normalized covariance is a relative measure of how much the F side accounts for the variation in any of the different items D.

We weigh household observations to better reflect the financial behavior of all households in the sample. As an example, consider a household whose investment variable of interest is high in magnitude and mostly constant vs another household whose investment variable of interest is low but also quite constant during the observed period. Both households will display a similar variance for the variable of interest causing the variance decomposition analysis to overestimate the importance of financing decisions within households that invest very little and thus may not reflect how smallholder households tend to finance such investments.

To address this issue, we give a higher weight to households that present higher levels of the variable of interest since these are the households that can likely better explain how such variable is financed. Therefore, we suggest an index that weights each decomposed variance of a given household according to the "size" of their variable of interest. More precisely each decomposed variance of a given household is weighted by the ratio between the average of the variable of interest for that household and the average for all the households in that country. Evidently, by following this methodology, households that exhibit higher levels of the variable of interest relative to other households will be assigned a higher weight.

Limitations to the applications of the methodology are related to the size of the sample, which includes 275 households, and to the scarce use by the households of some of the variables of analysis, namely formal financial instruments. In this regard, in addition to the weighted average, we calculate the three quartiles of the normalized variance decomposition of each of the samples. This is done to be able to infer whether the weighted average is driven by a considerable share of households or just by few of them. Additionally, a strict accounting and recording is required throughout the whole period in order to match the cash inflows and outflows and minimize the mismatches between sources and uses of cash. Furthermore, the captured correlations are related to the period of aggregation of the cash flows, which in this specific case is limited to two-week periods.

Results

In this section we present our findings on the main financing sources for long-term agricultural investment, short-term agricultural investment, emergencies with medical expenses and self-employment investments, used by smallholders that have very different characteristics depending on the country where they live, smallholder profile and value chain in which they participate. Throughout, we adopt the smallholder segmentation framework proposed by CGAP, where smallholders in the sample can be categorized as non-commercial smallholders in Mozambique, commercial smallholders in tight value chains in Pakistan and commercial smallholders in loose value chains in Tanzania. This analysis allows us to determine which livelihood activities and financial instruments are used the most to finance smallholder investments and shock related expenses. In this section, we present results showing how the relative importance of financing sources for agricultural and self-employment investments and emergency investments vary by the different smallholder sub-segments in our sample.

Non-commercial smallholders in Mozambique

Table II shows how the smallholders in the Mozambique sample finance long-term agricultural investment. As in the rest of our analysis this table has five columns. In column 1 we report the name of the item that is a source of cash or expense in Equation (1) used to analyze the financing for long-term agricultural investments. In column 2 we report the weighted average of the normalized covariance, whose absolute value represents the relative importance of this item in financing long-term agricultural investments. Normalized covariances with a positive sign mean that the investment in question (in this case, long-term agricultural investments) is being financed by an increase in the item in column 1. Negative normalized covariances mean that a decrease in the value of the item in column 1 is used to finance this investment. Columns 3, 4 and 5, respectively, display the percentiles 25 (first quartile), 50 (median) and 75 (third quartile) of the distribution of such normalized covariances across households. These last three columns help understand the distribution of the normalized covariances over households.

Our findings in Table II show that smallholders in the Mozambique sample finance long-term agricultural investment almost exclusively with non-agricultural income (i.e. weighted average for this item is the highest: 3.92). Given the importance of non-agricultural income, we have dissected the components of this variable at the household level using data from the whole diaries sample for Mozambique. At the household level, non-agricultural income comes mainly from casual employment (34 percent), non-farm self-employment (25 percent) and other income like transfers (23 percent), and to a less extent from resources received from outside the household like subsidies (13 percent).

Similarly, as shown in Table III, most households in the Mozambique sample finance short-term agricultural investment with non-agricultural income (0.42), although for some

Table II.
Variance decomposition of long-term agricultural investment for sample in Mozambique

	Household A	Total LTAI	W. Average	25%	50%	75%
Cash flowing	0.15	−1.73	0.25	−0.66	0.65	2.26
Non-agricultural income	0.70	2.82	3.92	−0.65	0.59	2.39
Agricultural income	−0.27	0.21	0.69	−0.22	−0.06	0.00
Sale physical assets	−0.06	−0.35	0.34	−0.11	−0.04	−0.01
Decrease in consumption	0.36	−0.39	−0.75	−0.81	−0.06	0.48
Decrease in short-term agricultural investment	0.00	−0.07	−0.04	0.00	0.00	0.05
Decrease in non-agricultural investment	0.20	1.48	−1.41	−0.41	0.22	0.75
Cash lost	0.00	−0.06	−0.02	0.00	0.00	0.01
Act as Moneyguard	0.00	0.00	0.01	0.00	0.00	0.00
Friends and family borrowing	0.00	−0.46	−0.37	0.00	0.00	0.01
Keep money at home	0.04	−0.39	−0.40	−0.29	−0.01	0.29
Checking or savings account	0.00	0.11	−0.44	0.00	0.00	0.00
Long-term investment account	0.00	0.00	0.00	0.00	0.00	0.00
Use Moneyguard	0.00	0.00	0.00	0.00	0.00	0.00
Private investment in someone's else business	0.00	0.00	0.00	0.00	0.00	0.00
Layaway	0.00	−0.03	−0.02	0.00	0.00	0.00
Informal credit at a store	0.00	0.00	0.01	0.00	0.00	0.00
Supplier credit	0.00	0.00	0.00	0.00	0.00	0.00
Pawning	0.00	0.00	0.00	0.00	0.00	0.00
Borrowing from an informal group	0.00	−0.01	0.01	0.00	0.00	0.00
Mortgage	0.00	0.00	0.00	0.00	0.00	0.00
Individual loan from an institution	0.00	0.00	−0.14	0.00	0.00	0.00
Wage advance from employer	0.00	0.00	0.00	0.00	0.00	0.00
Friends and family lending	−0.13	0.07	−0.09	−0.01	0.00	0.00
Wage or rental arrears owed to respondents	0.00	0.00	−0.01	0.00	0.00	0.00
Credit given to clients	0.00	−0.08	−0.07	0.00	0.00	0.00
Saving in a ROSCA	0.00	−0.02	0.17	0.00	0.00	0.00
Saving in an ASCA	0.00	−0.11	−0.20	0.00	0.00	0.00

	Total STAI	W. Average	25%	50%	75%
Cash flowing	−2.01	1.12	−0.91	0.21	2.04
Non-agricultural income	−0.08	0.42	−0.81	0.02	1.71
Agricultural income	0.00	−0.25	−0.31	−0.12	0.00
Sale physical assets	0.17	0.30	−0.08	−0.02	0.11
Decrease in consumption	−0.08	−0.13	−0.21	0.05	0.83
Decrease in long-term agricultural investment	0.01	−0.00	0.00	0.03	0.07
Decrease in non-agricultural investment	1.82	0.41	−1.41	0.00	0.49
Cash lost	−0.04	−0.08	0.00	0.00	0.00
Act as Moneyguard	0.00	−0.00	0.00	0.00	0.00
Friends and family borrowing	−0.00	0.00	0.00	0.00	0.01
Keep money at home	−0.03	−0.08	−0.14	0.00	0.40
Checking or savings account	−0.62	−0.34	0.00	0.00	0.00
Long-term investment account	0.00	0.00	0.00	0.00	0.00
Use Moneyguard	−0.15	−0.07	0.00	0.00	0.00
Private investment in someone's else business	0.00	0.00	0.00	0.00	0.00
Layaway	−0.03	0.01	0.00	0.00	0.00
Informal credit at a store	0.00	0.04	0.00	0.00	0.00
Supplier credit	0.00	0.00	0.00	0.00	0.00
Pawning	0.00	0.00	0.00	0.00	0.00
Borrowing from an informal group	0.01	0.00	0.00	0.00	0.00
Mortgage	0.00	0.00	0.00	0.00	0.00
Individual loan from an institution	1.83	0.85	0.00	0.00	0.00
Wage advance from employer	0.00	0.00	0.00	0.00	0.00
Friends and family lending	0.06	0.09	0.00	0.00	0.00
Wage or rental arrears owed to respondents	0.00	−0.01	0.00	0.00	0.00
Credit given to clients	−0.02	0.01	0.00	0.00	0.00
Saving in a ROSCA	0.01	0.02	0.00	0.00	0.00
Saving in an ASCA	0.14	0.14	0.00	0.00	0.00

Table III. Variance decomposition of short-term agricultural investment for sample in Mozambique

households, these short-term investments are financed by reducing non-agricultural investments and selling physical assets, as shown by the quartiles.

Table IV shows that the Mozambique sample uses different strategies to finance medical expenses, non-agricultural income (1.00) having a significant importance for some of the households.

Table V explores self-employment investments. The Mozambique sample finances self-employment investments using non-agricultural income (2.54) and to a less degree keeping money at home (0.21).

Formal and informal financial instruments are marginally used to finance any of the variables of interest.

Smallholders in tight value chains in Pakistan

Table VI analyzes long-term investment for the Pakistan sample. It shows that long-term agricultural investment is funded primarily with the sale of physical assets (0.92), borrowing from friends and family (0.48) and to a less extent using agricultural income (0.14). The sale of physical assets and borrowing from friends and family is a strategy used by many households in the sample, and for fewer households agricultural income is also an important financing source.

Households in the Pakistan sample (unlike in Mozambique) have two major annual harvests; in October (cotton and rice) and in May (wheat). Thus, we divide the year into two periods: from July to October (we refer to this period as Season 1), and from November to May (we refer to this period as Season 2) and assess how short-term investment is financed in each period. Table VII reports the results over the time period of Season 1, while Table VIII does the same for Season 2. The Pakistan sample finances short-term agricultural investment in Season 1 using credits from informal agents known as "Arthi" (0.43) and agricultural income (0.31), while it finances these short-term investments in Season 2 mainly with agricultural income (1.10), followedby non-agricultural income (0.12) and selling physical assets (0.48) (see Tables VII and VIII).

Table IX shows that most of the Pakistan sample finances medical expenses with the use of informal financial instruments like money kept at home (0.12) and using store or agent credit (0.33 and 0.32), and cutting down expenses related to agricultural and non-agricultural investments (1.16 and 0.59).

Table X finds that a large proportion of the Pakistani sample finances self-employment expenses with mainly with non-agricultural income (1.98)[4]. While agricultural income (0.56), selling physical assets (0.79) and informal financial instruments like borrowing from friends and family (0.34) and store credit (0.13), are used for this purpose by a smaller portion of the smallholder sample.

Using data from the whole diaries sample for Pakistan, at the household level, non-agricultural income comes mainly from casual employment (28 percent), self-employment and other income (both 23 percent), and to a less extent from resources received from outside the household (12 percent).

For Pakistani smallholders in the sample, formal financial services show no significant influence in financing any of the variables of interest. Several informal financial services (borrowing from friends and family, agent and store credits, keeping money at home) are used to finance some of these variables.

Smallholders in loose value chains in Tanzania

Table XI shows that most of the Tanzanian sample finances long-term agricultural investment mainly with non-agricultural income (1.67) and a smaller portion of the sample uses agricultural income (3.26).

At the household level in Tanzania, non-agricultural income comes from self-employment (33 percent), resources received from outside the household (27 percent) and casual employment (25 percent), and to a less extent from other income (8 percent).

	Household A	W. Average	25%	50%	75%
Cash flowing	0.01	1.41	−3.16	−0.08	1.86
Non-agricultural income	−0.27	1.00	−1.83	−0.20	2.51
Agricultural income	−0.15	0.01	−0.56	−0.07	0.00
Sale physical assets	−0.03	0.85	−0.26	−0.02	0.08
Decrease in consumption (without medical expenses)	−0.01	−1.29	−2.25	−0.38	0.98
Decrease in long-term agricultural investment	0.02	−0.00	0.00	0.02	0.21
Decrease in non-agricultural investment	0.11	−2.82	−0.71	0.40	2.39
Cash lost	0.00	0.04	0.00	0.00	0.00
Decrease in short-term agricultural investment	0.00	0.04	0.00	0.00	0.04
Friends and family borrowing	0.00	−0.01	0.00	0.00	0.01
Keep money at home	1.39	0.18	−0.50	0.00	1.21
Checking or savings account	0.00	0.71	0.00	0.00	0.00
Long-term investment account	0.00	0.00	0.00	0.00	0.00
Use Moneyguard	0.00	−0.01	0.00	0.00	0.00
Private investment in someone's else business	0.00	0.00	0.00	0.00	0.00
Layaway	0.00	−0.03	0.00	0.00	0.00
Informal credit at a store	0.00	0.01	0.00	0.00	0.00
Supplier credit	0.00	−0.03	0.00	0.00	0.00
Pawning	0.00	−0.00	0.00	0.00	0.00
Borrowing from an informal group	0.00	0.01	0.00	0.00	0.00
Mortgage	0.00	0.00	0.00	0.00	0.00
Individual loan from an institution	0.00	−0.22	0.00	0.00	0.00
Wage advance from employer	0.00	0.00	0.00	0.00	0.00
Friends and family lending	−0.07	0.97	0.00	0.00	0.00
Wage or rental arrears owed to respondents	0.00	0.01	0.00	0.00	0.00
Credit given to clients	0.00	0.02	0.00	0.00	0.00
Saving in a ROSCA	0.00	0.17	0.00	0.00	0.00
Saving in an ASCA	0.00	0.08	0.00	0.00	0.00
Act as Moneyguard	0.00	−0.06	0.00	0.00	0.00

Table IV.
Variance decomposition of medical expenses for sample in Mozambique

	Household A	W. Average	25%	50%	75%
Cash flowing		1.49	−0.17	0.19	0.48
Non-Agricultural Income		2.54	0.52	0.96	1.26
Agricultural income		−0.03	−0.09	0.00	0.01
Sale physical assets		−0.08	−0.11	−0.02	0.00
Decrease in consumption		−0.53	−0.33	−0.00	0.41
Decrease in long-term agricultural investment		−0.00	0.00	0.01	0.08
Decrease in non-agricultural investment (without self-employment expenses)		−0.18	−0.17	0.04	0.39
Cash lost		−0.02	0.00	0.00	0.01
Decrease in short-term agricultural investment		0.00	0.00	0.00	0.08
Friends and family borrowing		−0.03	−0.00	0.00	0.02
Keep money at home		0.21	−0.27	0.00	0.12
Checking or savings account		−0.07	0.00	0.00	0.00
Long-Term investment account		0.00	0.00	0.00	0.00
Use Moneyguard		0.00	0.00	0.00	0.00
Private investment in someone's else business		0.00	0.00	0.00	0.00
Layaway		0.00	0.00	0.00	0.00
Informal credit at a store		0.01	0.00	0.00	0.00
Supplier credit		−0.01	0.00	0.00	0.00
Pawning		0.00	0.00	0.00	0.00
Borrowing from an informal group		−0.06	0.00	0.00	0.00
Mortgage		0.00	0.00	0.00	0.00
Individual loan from an institution		−0.08	0.00	0.00	0.00
Wage advance from employer		0.00	0.00	0.00	0.00
Friends and family lending		0.23	−0.00	0.00	0.01
Wage or rental arrears owed to respondents		−0.00	0.00	0.00	0.00
Credit given to clients		0.01	0.00	0.00	0.00
Saving in a ROSCA		0.06	0.00	0.00	0.00
Saving in an ASCA		−0.02	0.00	0.00	0.00
Act as Moneyguard		0.00	0.00	0.00	0.00

Table V. Variance decomposition of self-employment expenses for sample in Mozambique

Similarly, Table XII shows that short-term agricultural investments are mainly financed with income from agricultural income (0.96), and to a lesser extent, non-agricultural activities (0.30). No formal nor informal financial service plays any significant role.

Table XIII suggests that the financing of medical expenses for the Tanzanian sample is mainly financed by agricultural income (1.06) followed by non-agricultural income (0.62).

As for self-employment expenses, our findings are presented in Table Table XIV. The Tanzanian sample finances self-employment expenses mainly with both non-agricultural income (1.21), followed by agricultural income (0.32) and savings kept at home (0.23).

Formal and informal financial instruments are rarely used to finance any of the variables of interest, except for the minor use of money kept a home to finance self-employment investments.

Conclusions

Our results show that smallholders sampled in the three counties make short and long-term agricultural investments, medical expenses and non-farm self-employment investments mainly by self-financing rather than using formal or informal financial services from external providers. The sources of self-finance are both agricultural and non-agricultural income. However, the dominant source of income used to finance such investments varies significantly with the opportunities smallholders face given their country context and value chains in which they participate.

	Household B	Total LTAI	W. Average	25%	50%	75%
Cash flowing	−0.46	0.05	−0.02	−0.79	−0.02	0.65
Non-agricultural income	−0.02	0.04	0.09	−0.15	−0.01	0.03
Agricultural income	0.51	0.17	0.14	−1.28	−0.10	0.01
Sale physical assets	1.31	0.50	0.92	−0.37	−0.00	0.67
Decrease in consumption	0.00	−0.01	−0.01	−0.12	0.00	0.09
Decrease in short-term agricultural investment	−0.04	−0.02	−0.03	−0.09	0.03	0.29
Decrease in non-agricultural investment	0.01	−0.07	−0.08	−0.33	0.00	0.04
Cash lost	0.00	−0.00	−0.00	0.00	0.00	0.00
Act as Moneyguard	0.00	−0.00	−0.00	0.00	0.00	0.00
Friends and family borrowing	0.62	0.31	0.48	−0.00	0.09	0.99
Keep money at home	−0.51	0.04	0.02	−0.03	0.00	0.01
Checking or savings account	0.00	−0.00	−0.01	0.00	0.00	0.00
Use Moneyguard	0.00	−0.03	0.05	0.00	0.00	0.00
Private investment in someone's else business	0.00	0.00	0.00	0.00	0.00	0.00
Layaway	0.00	−0.00	−0.00	0.00	0.00	0.00
Informal credit at a store	−0.00	−0.00	−0.01	−0.01	0.00	0.06
Supplier credit	0.00	0.00	0.00	0.00	0.00	0.00
Pawning	0.00	−0.00	−0.00	0.00	0.00	0.00
Borrowing from an informal group	0.00	0.00	0.00	0.00	0.00	0.00
Individual loan from an institution	0.00	−0.00	0.07	0.00	0.00	0.00
Wage advance from employer	0.00	0.00	0.00	0.00	0.00	0.00
Friends and family lending	−0.43	0.06	0.05	−0.00	0.00	0.00
Wage or rental arrears owed to respondents	0.00	0.00	0.00	0.00	0.00	0.00
Credit given to clients	0.02	−0.01	−0.01	0.00	0.00	0.00
Saving in a ROSCA	0.00	0.00	−0.00	0.00	0.00	0.00
Saving in an ASCA	0.00	−0.00	−0.00	0.00	0.00	0.00
Life insurance	0.00	0.00	0.00	0.00	0.00	0.00
Joint liability loan	−0.00	0.00	0.00	0.00	0.00	0.00
Agent credit	0.00	−0.01	0.00	−0.01	0.00	0.10
Loan from employer	0.00	0.00	0.00	0.00	0.00	0.00
Moneylender borrowing	0.00	0.00	0.00	0.00	0.00	0.00

Table VI. Variance decomposition of long-term agricultural investment for sample in Pakistan

	W. Average	25%	50%	75%
Cash flowing	0.07	−0.25	0.03	0.43
Non-agricultural income	0.01	−0.15	0.01	0.14
Agricultural income	0.31	−0.30	0.00	0.61
Sale physical assets	0.07	−0.01	0.00	0.10
Decrease in consumption	0.02	−0.18	−0.02	0.18
Decrease in long-term agricultural investment	−0.01	0.00	0.00	0.00
Decrease in non-agricultural investment	0.01	0.00	0.00	0.01
Cash lost	−0.00	0.00	0.00	0.00
Act as Moneyguard	0.00	0.00	0.00	0.00
Friends and family borrowing	−0.01	−0.06	0.01	0.35
Keep money at home	−0.03	−0.00	0.00	0.04
Checking or savings account	−0.01	0.00	0.00	0.00
Use Moneyguard	0.00	0.00	0.00	0.00
Private investment in someone's else business	0.00	0.00	0.00	0.00
Layaway	0.00	0.00	0.00	0.00
Informal credit at a store	0.02	−0.04	0.00	0.12
Supplier credit	0.00	0.00	0.00	0.00
Pawning	−0.00	0.00	0.00	0.00
Borrowing from an informal group	0.00	0.00	0.00	0.00
Individual loan from an institution	0.13	0.00	0.00	0.00
Wage advance from employer	0.00	0.00	0.00	0.00
Friends and family lending	−0.03	0.00	0.00	0.00
Wage or rental arrears owed to respondents	0.00	0.00	0.00	0.00
Credit given to clients	−0.01	0.00	0.00	0.00
Saving in a ROSCA	−0.00	0.00	0.00	0.00
Saving in an ASCA	−0.00	0.00	0.00	0.00
Life insurance	0.04	0.00	0.00	0.00
Joint liability loan	−0.00	0.00	0.00	0.00
Agent credit	0.43	0.14	0.44	0.80
Loan from employer	−0.00	0.00	0.00	0.00
Moneylender borrowing	0.00	0.00	0.00	0.00

Table VII. Variance decomposition of short-term agricultural investment in season 1 for sample in Pakistan

For the smallholder sample in Mozambique – where there is little commercial participation in highly fragmented agriculture markets and subsistence farming is the norm – the dominant source of finance for their agricultural and non-agricultural investments is non-agricultural income. For the more commercial smallholders sampled in Pakistan, long-term agricultural investments are mainly financed by the sale of assets, informal loans from friends and family and agricultural income. While short-term agricultural investment is mainly financed by informal trader loans if the crop is more commercial (like cotton or rice) or agricultural income if the crop is more of a staple (like wheat).

Those smallholders in the Tanzania sample, who are commercial but participate in less structured value chains, finance their long-term agricultural investments mainly with non-agricultural income. While short-term agricultural investment is mainly financed by agricultural income.

Financial instruments offered by external providers are not a major source of finance for any type of agricultural investments. When they do play a somewhat important role, like in the case of smallholders studied in Pakistan, these loans are informal coming from families, friends, and crop traders. These informal financial services can also be used to help finance self-employment investments (Tanzania), and health expenses (Mozambique and Pakistan). Formal financial services did not play an important role in financing those investments of interest in any of the country samples.

	W. Average	25%	50%	75%
Cash flowing	−0.10	−0.41	−0.02	0.35
Non-agricultural income	0.12	−0.11	0.01	0.23
Agricultural income	1.10	0.35	1.05	1.92
Sale physical assets	0.48	−0.02	0.14	0.39
Decrease in consumption	−0.01	−0.12	0.01	0.11
Decrease in long-term agricultural investment	−0.18	0.00	0.00	0.01
Decrease in non-agricultural investment	−0.09	−0.06	0.00	0.05
Cash lost	0.00	0.00	0.00	0.00
Act as Moneyguard	−0.00	0.00	0.00	0.00
Friends and family borrowing	−0.08	−0.14	0.00	0.19
Keep money at home	−0.04	−0.01	0.00	0.03
Checking or savings account	0.00	0.00	0.00	0.00
Use Moneyguard	−0.03	0.00	0.00	0.20
Private investment in someone's else business	0.00	0.00	0.00	0.00
Layaway	−0.00	0.00	0.00	0.00
Informal credit at a store	−0.04	−0.13	−0.01	0.03
Supplier credit	−0.00	0.00	0.00	0.00
Pawning	0.00	0.00	0.00	0.00
Borrowing from an informal group	0.00	0.00	0.00	0.00
Individual loan from an institution	−0.02	0.00	0.00	0.00
Wage advance from employer	0.00	0.00	0.00	0.00
Friends and family lending	0.03	0.00	0.00	0.00
Wage or rental arrears owed to respondents	0.00	0.00	0.00	0.00
Credit given to clients	0.00	0.00	0.00	0.00
Saving in a ROSCA	−0.00	0.00	0.00	0.00
Saving in an ASCA	0.00	0.00	0.00	0.00
Life insurance	0.00	0.00	0.00	0.00
Joint liability loan	−0.09	0.00	0.00	0.00
Agent credit	−0.06	−0.17	0.00	0.18
Loan from employer	−0.00	0.00	0.00	0.00
Moneylender borrowing	0.00	0.00	0.00	0.00

Table VIII. Variance decomposition of short-term agricultural investment in season 2 for sample in Pakistan

The dominant practice of self-financing agricultural investments with own resources reveals a sub-optimal scenario where smallholder households have to deplete asset endowments, or wait longer periods of time before they can save enough to make bulky agricultural investments. This would imply that there are likely feasible agricultural investment opportunities that are not currently being seized as self-financing prevents their capture. Examples would include the larger investments or those investments that do not match smallholders' cash flows, which would translate into an underinvestment scenario in smallholder agriculture.

The fact that formal financial services are not used for any type of agriculture investments while informal finance can in some instances, suggests there are important unmet finance needs among smallholders in all three countries. Financial inclusion policies specifically targeting smallholders and the agricultural sector could be more effective when focusing on enabling the development of an ecosystem of financial services that respond simultaneously to both agriculture and non-agriculture financing needs. Such policies would recognize the strong interdependence between diverse smallholder livelihoods and would enable agricultural investments that have a high poverty-reducing effect and promote household diversification into the non-agricultural sector. This contrasts with a sectoral approach focused exclusively on developing agricultural finance in rural markets. The dominant practice of self-financing among smallholders sampled also suggests there is a latent demand for agricultural and non-agricultural financial services which represents a market opportunity for formal financial institutions. The diverse demand for smallholder

Table IX.
Variance decomposition of medical expenses for sample in Pakistan

	Household B	W. Average	25%	50%	75%
Cash flowing	0.65	0.56	−1.10	0.50	2.94
Non-agricultural income	1.76	−0.26	−1.25	−0.13	0.67
Agricultural income	−6.36	−0.80	−4.73	−0.98	1.45
Sale physical assets	−8.69	−0.57	−2.62	−0.48	0.33
Decrease in consumption (without medical expenses)	−0.41	−0.17	−0.98	0.19	1.14
Decrease in long-term agricultural investment	4.79	1.16	0.00	0.00	0.66
Decrease in non-agricultural investment	0.48	0.59	−0.07	0.09	0.70
Cash lost	0.00	0.00	0.00	0.00	0.00
Decrease in short-term agricultural investment	−0.99	0.22	−1.11	0.16	1.96
Friends and family borrowing	1.75	−0.12	−1.56	0.17	1.24
Keep money at home	0.91	0.12	−0.08	0.00	0.21
Checking or savings account	0.00	0.01	0.00	0.00	0.00
Use Moneyguard	0.00	−0.52	0.00	0.00	0.00
Private investment in someone's else business	0.00	0.00	0.00	0.00	0.00
Layaway	0.00	0.00	0.00	0.00	0.00
Informal credit at a store	1.28	0.33	−0.17	0.06	0.72
Supplier credit	0.00	0.01	0.00	0.00	0.00
Pawning	0.00	0.00	0.00	0.00	0.00
Borrowing from an informal group	0.00	0.00	0.00	0.00	0.00
Individual loan from an institution	0.00	0.23	0.00	0.00	0.00
Wage advance from employer	0.00	0.00	0.00	0.00	0.00
Friends and family lending	0.62	−0.09	−0.08	0.00	0.00
Wage or rental arrears owed to respondents	0.00	0.00	0.00	0.00	0.00
Credit given to clients	0.11	0.01	0.00	0.00	0.00
Saving in a ROSCA	0.00	0.01	0.00	0.00	0.00
Saving in an ASCA	−0.00	0.01	0.00	0.00	0.00
Life insurance	0.00	−0.10	0.00	0.00	0.00
Joint liability loan	1.33	0.02	0.00	0.00	0.00
Agent credit	3.78	0.32	−0.34	0.10	0.84
Loan from employer	0.00	0.04	0.00	0.00	0.00
Moneylender borrowing	0.00	0.01	0.00	0.00	0.00
Act as Moneyguard	0.00	0.00	0.00	0.00	0.00

Table X. Variance decomposition of self-employment expenses for sample in Pakistan

	Household B	W. Average	25%	50%	75%
Cash flowing	2.82	−0.09	−0.26	0.04	0.25
Non-agricultural income	2.68	1.98	0.19	0.60	1.22
Agricultural income	−2.23	0.56	−0.44	−0.01	0.49
Sale physical assets	−5.50	0.79	−0.61	−0.01	0.15
Decrease in consumption	1.04	−0.06	−0.12	−0.01	0.43
Decrease in long-term agricultural investment	2.60	−0.81	0.00	0.00	0.33
Decrease in non-agricultural investment (without self-employment expenses)	0.11	−0.04	−0.01	0.00	0.06
Cash lost	0.00	0.00	0.00	0.00	0.00
Decrease in short-term agricultural investment	−2.09	−0.02	−0.10	0.03	0.28
Friends and family borrowing	−0.12	0.34	−0.31	0.01	0.32
Keep money at home	0.20	−0.05	−0.01	0.00	0.03
Checking or savings account	0.00	−0.02	0.00	0.00	0.00
Use Moneyguard	0.00	−0.01	0.00	0.00	0.02
Private investment in someone's else business	0.00	0.00	0.00	0.00	0.00
Layaway	0.00	−0.01	0.00	0.00	0.00
Informal credit at a store	−0.11	0.13	−0.05	0.00	0.19
Supplier credit	0.00	0.00	0.00	0.00	0.00
Pawning	0.00	−0.00	0.00	0.00	0.00
Borrowing from an informal group	0.00	0.00	0.00	0.00	0.00
Individual loan from an institution	0.00	−0.05	0.00	0.00	0.00
Wage advance from employer	0.00	0.00	0.00	0.00	0.00
Friends and family lending	1.45	0.06	−0.00	0.00	0.00
Wage or rental arrears owed to respondents	0.00	0.00	0.00	0.00	0.00
Credit given to clients	−3.01	−0.06	−0.05	0.00	0.00
Saving in a ROSCA	0.00	−0.01	0.00	0.00	0.00
Saving in an ASCA	0.01	0.00	0.00	0.00	0.00
Life insurance	0.00	0.03	0.00	0.00	0.00
Joint liability loan	−0.02	0.08	0.00	0.00	0.00
Agent credit	3.16	−0.14	−0.30	−0.03	0.03

Table XI.
Variance decomposition of long-term agricultural investment for sample in Tanzania

	Household C	Total LTAI	W. Average	25%	50%	75%
Cash flowing	0.06	0.01	−0.36	−0.13	0.00	0.23
Non-agricultural income	1.24	1.20	1.67	−0.17	0.12	1.03
Agricultural income	1.15	0.79	3.26	−0.40	−0.06	0.14
Sale physical assets	0.28	0.11	0.08	−0.21	−0.02	0.00
Decrease in consumption	−0.25	−0.14	−0.49	−0.74	−0.10	0.14
Decrease in short-term agricultural investment	−0.20	−0.21	−0.24	−0.14	0.03	0.28
Decrease in non-agricultural investment	−0.07	−0.21	0.11	−0.07	0.04	0.48
Cash lost	0.00	0.00	0.00	0.00	0.00	0.00
Act as Moneyguard	0.00	0.03	−0.02	0.00	0.00	0.00
Friends and family borrowing	−0.03	−0.07	−0.19	−0.03	0.00	0.00
Keep money at home	−1.16	−0.45	−1.25	−0.33	0.35	1.36
Checking or savings account	0.00	0.00	0.00	0.00	0.00	0.00
Use Moneyguard	0.00	−0.00	0.35	0.00	0.00	0.00
Layaway	0.00	0.00	−0.10	0.00	0.00	0.00
Informal credit at a store service provider	−0.00	−0.00	0.18	−0.00	0.00	0.00
Tafu airtime credit	0.00	0.00	0.00	0.00	0.00	0.00
Supplier credit	0.00	0.00	0.00	0.00	0.00	0.00
Borrowing from an informal group	0.00	−0.06	−0.27	−0.07	0.00	0.02
Individual loan from institution	0.00	0.00	−0.00	0.00	0.00	0.00
Friends and family lending	−0.01	0.02	−0.01	0.00	0.00	0.00
Wage or rental arrears owed to respondents	0.00	0.00	0.00	0.00	0.00	0.00
Credit given to clients	0.00	0.00	0.01	0.00	0.00	0.00
Saving in a ROSCA	0.00	0.07	0.21	0.00	0.00	0.00
Saving in an ASCA	−0.00	−0.07	−0.03	−0.09	0.00	0.00
Mobile money	0.00	0.00	0.03	0.00	0.00	0.00
Health insurance	0.00	0.00	0.00	0.00	0.00	0.00
Agent credit	0.00	0.00	−0.01	0.00	0.00	0.00
Hire/installment purchase	0.00	0.00	0.00	0.00	0.00	0.00
Moneylender borrowing	0.00	0.00	−0.01	0.00	0.00	0.00
Arrears owned by respondent	0.00	0.00	0.00	0.00	0.00	0.00

	Household C	Total STAI	W. Average	25%	50%	75%
Cash flowing	0.10	−0.15	−0.04	−0.05	0.02	0.12
Non-agricultural income	0.80	0.41	0.30	−0.18	0.10	0.64
Agricultural income	0.72	1.27	0.96	−0.03	0.41	1.05
Sale physical assets	−0.01	0.09	0.05	−0.02	−0.00	0.01
Decrease in consumption	−0.34	−0.16	−0.10	−0.46	−0.06	0.10
Decrease in long-term agricultural investment	−0.07	−0.03	−0.02	0.00	0.00	0.00
Decrease in non-agricultural investment	−0.70	−0.56	−0.29	−0.07	0.02	0.14
Cash lost	0.00	−0.00	−0.00	0.00	0.00	0.00
Act as Moneyguard	0.00	−0.01	−0.00	0.00	0.00	0.00
Friends and family borrowing	0.24	0.03	0.06	0.00	0.00	0.01
Keep money at home	0.30	0.00	0.09	−0.22	0.10	0.71
Checking or savings account	0.00	−0.01	0.00	0.00	0.00	0.00
Use Moneyguard	0.00	0.01	0.01	0.00	0.00	0.00
Layaway	0.00	0.01	0.01	0.00	0.00	0.00
Informal credit at a store service provider	−0.00	0.03	0.06	0.00	0.00	0.00
Tafu airtime credit	0.00	0.00	0.00	0.00	0.00	0.00
Supplier credit	0.00	0.00	0.00	0.00	0.00	0.00
Borrowing from an informal group	0.00	−0.03	−0.03	0.00	0.00	0.07
Individual loan from institution	0.00	0.00	0.00	0.00	0.00	0.00
Friends and family lending	−0.06	−0.01	−0.01	0.00	0.00	0.00
Wage or rental arrears owed to respondents	0.00	0.00	0.00	0.00	0.00	0.00
Credit given to clients	0.00	0.01	0.01	0.00	0.00	0.00
Saving in a ROSCA	0.00	0.01	0.00	0.00	0.00	0.00
Saving in an ASCA	0.00	0.03	0.03	−0.02	0.00	0.00
Mobile money	0.00	0.01	0.02	0.00	0.00	0.00
Health insurance	0.00	−0.00	−0.00	0.00	0.00	0.00
Agent credit	0.00	0.03	−0.01	0.00	0.00	0.00
Hire/installment purchase	0.00	0.00	0.00	0.00	0.00	0.00
Moneylender borrowing	0.00	0.00	−0.00	0.00	0.00	0.00
Arrears owned by respondent	0.00	0.00	0.00	0.00	0.00	0.00

Table XII.
Variance decomposition of short-term agricultural investment for sample in Tanzania

Table XIII. Variance decomposition of medical expenses for sample in Tanzania

	Household C	W. Average	25%	50%	75%
Cash flowing	−2.93	0.69	−0.29	0.05	0.68
Non-agricultural income	−0.78	0.62	−1.33	−0.15	3.08
Agricultural income	−0.61	1.06	−1.58	−0.15	1.84
Sale physical assets	−0.74	0.59	−0.30	−0.03	0.00
Decrease in consumption (without medical expenses)	0.94	−0.60	−1.29	−0.10	0.95
Decrease in long-term agricultural investment	0.80	0.12	0.00	0.00	0.05
Decrease in non-agricultural investment	2.85	−0.08	−0.17	0.04	0.93
Cash lost	0.00	0.00	0.00	0.00	0.00
Decrease in short-term agricultural investment	1.18	−0.15	0.00	0.32	1.05
Friends and family borrowing	−0.32	−0.05	−0.01	0.00	0.01
Keep money at home	0.61	0.04	−1.82	−0.00	1.12
Checking or savings account	0.00	−0.15	0.00	0.00	0.00
Use Moneyguard	0.00	0.23	0.00	0.00	0.00
Layaway	0.00	0.05	0.00	0.00	0.00
Informal credit at a store service provider	−0.02	0.10	0.00	0.00	0.00
Tafu airtime credit	0.00	0.00	0.00	0.00	0.00
Supplier credit	0.00	−0.00	0.00	0.00	0.00
Borrowing from an informal group	0.00	0.00	0.00	0.00	0.63
Individual loan from institution	0.00	−0.00	0.00	0.00	0.00
Friends and family lending	−0.11	−0.08	−0.06	0.00	0.00
Wage or rental arrears owed to respondents	0.00	0.00	0.00	0.00	0.00
Credit given to Clients	0.00	−0.02	0.00	0.00	0.00
Saving in a ROSCA	0.00	−0.01	0.00	0.00	0.00
Saving in an ASCA	0.13	0.08	−0.28	0.00	0.00
Mobile Money	0.00	−0.01	0.00	0.00	0.00
Health insurance	0.00	0.00	0.00	0.00	0.00
Agent credit	0.00	−0.44	0.00	0.00	0.00
Hire/installment purchase	0.00	0.00	0.00	0.00	0.00
Moneylender borrowing	0.00	−0.41	0.00	0.00	0.00
Arrears owned by respondent	0.00	0.00	0.00	0.00	0.00
Act as Moneyguard	0.00	0.01	0.00	0.00	0.00

	Household C	W. Average	25%	50%	75%
Cash flowing	0.34	0.09	−0.12	0.02	0.37
Non-agricultural income	0.04	1.21	0.23	0.99	1.39
Agricultural income	1.17	0.32	−0.64	−0.13	0.55
Sale physical assets	−0.06	0.03	−0.05	−0.00	0.03
Decrease in consumption	−0.34	−0.14	−0.61	−0.09	0.17
Decrease in long-term agricultural investment	0.11	−0.01	0.00	0.00	0.00
Decrease in non-agricultural investment (without self-employment expenses)	0.12	0.05	−0.02	0.06	0.26
Cash lost	0.00	0.00	0.00	0.00	0.00
Decrease in short-term agricultural investment	−0.22	−0.18	−0.23	0.05	0.20
Friends and family borrowing	−0.04	0.01	−0.01	0.00	0.09
Keep money at home	−0.13	0.23	−0.29	−0.02	0.20
Checking or savings account	0.00	0.00	0.00	0.00	0.00
Use Moneyguard	0.00	0.01	0.00	0.00	0.00
Layaway	0.00	0.00	0.00	0.00	0.00
Informal credit at a store service provider	−0.00	0.02	0.00	0.00	0.00
Tafu airtime credit	0.00	−0.00	0.00	0.00	0.00
Supplier credit	0.00	0.02	0.00	0.00	0.00
Borrowing from an informal group	0.00	−0.02	−0.03	0.00	0.14
Individual loan from institution	0.00	0.00	0.00	0.00	0.00
Friends and family lending	−0.01	−0.01	0.00	0.00	0.00
Wage or rental arrears owed to respondents	0.00	0.00	0.00	0.00	0.00
Credit given to Clients	0.00	0.00	0.00	0.00	0.00
Saving in a ROSCA	0.00	−0.02	0.00	0.00	0.00
Saving in an ASCA	0.02	0.03	−0.16	0.00	0.00
Mobile money	0.00	−0.04	0.00	0.00	0.00
Health insurance	0.00	0.00	0.00	0.00	0.00
Agent credit	0.00	−0.07	0.00	0.00	0.00
Hire/installment purchase	0.00	0.00	0.00	0.00	0.00
Moneylender borrowing	0.00	−0.00	0.00	0.00	0.00
Arrears owned by respondent	0.00	0.00	0.00	0.00	0.00
Act as Moneyguard	0.00	−0.00	0.00	0.00	0.00

Table XIV.
Variance decomposition of self-employment expenses for sample in Tanzania

finance suggests that formal financial providers could develop a rural portfolio with several income streams from different services, thereby exploiting economies of scale and scope that reduce obstacles related to high delivery costs.

Notes

1. Other studies have relied on financial diaries to explore household financial behavior and literacy (see, inter alias, Collins, 2005, 2008; Kamath *et al.*, 2008; Stuart *et al.*, 2011; Buckland *et al.*, 2013; Hannagan and Morduch, 2015).
2. Some mismatches were found between the sources and uses of cash, given that the information is self-reported by the household members. Respondents may simply not want to disclose some of their expenses or use of financial instruments, or perhaps could not remember, or not know about them. Interviewers were instructed to probe for a while, but they also had to maintain a positive relationship with the respondents. "Cash flowing" accounts for these mismatches.
3. Note that the normalized covariances in the equation above could also be interpreted as OLS coefficients of multiple regressions (i.e. for each n) of F_n on D (without the constant). In addition, since such coefficients add up to 1, they can also be viewed as relative weights.
4. Note that this item is positive across households.

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