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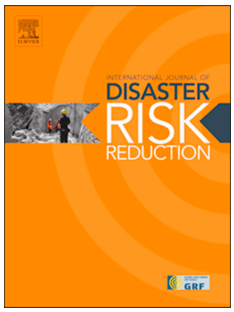

Financial decisions and risk management of low-income households in disaster-prone areas: Evidence from the portfolios of Ethiopian farmers

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TITLE : Financial Decisions and Risk Management of Low-Income Households in Disaster-Prone Areas: Evidence from the Portfolios of Ethiopian Farmers

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Financial Decisions and Risk Management of Low-Income Households in Disaster-Prone Areas: Evidence from the Portfolios of Ethiopian Farmers

ABSTRACT

Designing optimal financial products for rural households in poor countries remains a challenge, especially in a risk management perspective in disaster-prone areas. In addition to financial intermediaries' difficulties with reaching potential customers efficiently, information asymmetries prevent fully understanding customers and developing suitable products for them. The clientele's weak information systems, coupled with cultural aspects often unfamiliar to the supplier of financial services, make the analysis difficult and costly. This article builds on a financial statement approach to empirically explore the combination of farmers' financial and non-financial strategies, in a portfolio risk management perspective, with a focus on shock-type risk exposure. It emerges that farmers' decisions follow a sequential process with different combinations of savings, credit, and insurance that interact with non-financial strategies to help managing risks. The study relies on panel data collected in Ethiopia. The empirical analysis confirms the vulnerability of sample households to natural systemic shocks and entails that the conclusions of this paper can be considered part of the broad literature on the disaster risk management of low-income households.

Keywords: rural finance, microfinance, portfolio risk management, Ethiopia

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1. INTRODUCTION

RURAL HOUSEHOLD RISK MANAGEMENT: THEORY AND RESEARCH QUESTIONS

Risk exposure limits the potential for growth of rural households in poor countries. Strategies such as the sale of assets, consumption reduction or switching to low-cost food, borrowing from different local sources, relying on relief food, gifts, charity or remittances are commonly considered *ex-post*, risk-coping measures, aimed at limiting the impact of negative events when they occur. *Ex-ante*, risk-reducing strategies include choices related to farming and animal husbandry, real and financial asset building as buffer stocks, or risk-sharing with others through social networks like savings groups, labour or risk-pooling arrangements (Brown and Churchill, 2000; Dejene, 2001; Viganò, ed, 2007; Zeller et al., 1997; more recently, Nikilosky et al., 2018). Despite several successful examples, these mechanisms have limitations and do not assure full immunization; for example, informal and self-insurance mechanisms may be ineffective in case of covariant shocks (Dercon, 2005).
Local policy-makers, development agencies, and other actors involved in poverty alleviation continue to search for innovative approaches aimed at revenue stabilization and at improving rural households' life standards. The growing frequency and impact of natural disasters have increased the interest in risk management strategies. Rural development projects of the recent past have focused on the provision of subsidized credit as a means of fostering entrepreneurship and the farmers' ability to cope with the negative consequences of risk exposure. Widespread failures of such an approach to accomplish the intended task depended quite often on several weaknesses in the project conception: scarce attention to sustainability of the system and to the distortive effects of concessionary conditions and, more important, the excessive emphasis on credit provision as the sole effective tool (Adams et al., 1984). Notably, local savings mobilization has been portrayed since the early failures of such

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projects as one of the missing pieces in the puzzle and some academicians and practitioners have focused on the role of savings in rural areas as a means of revenue stabilization and growth promotion (among the first contributions: Mauri, 1969). However, the importance of savings has been underestimated, even by the first Microcredit Summit of 1997 (www.stateofthecampaign.org). The name and main recommendations of this summit only referred to credit and resulted in a debate between the supporters of the savings-first and credit-first perspectives in microfinance. Over time, the limitations of the sole credit provision approach led to a resurgence of the importance of the role of savings as the fuel of entrepreneurship, as a base for sound local development of financial intermediaries, and as a risk management tool (among others, Kendall, 2010). Since then, several success stories have confirmed the intuition regarding the potential for savings, even in low-income areas of the world (Mukherjee and Wisniwski,1998; Radcliffe, 2010). Regarding disasters risk management, savings is considered a mitigating factor (Ullah et al, 2015). Nonetheless, credit is also considered an ex-post disaster strategy (as in e Saquib et al, 2016). In particular, innovative, small-scale, marked-based approaches, coupled with the provision of credit together with other essential measures, such as business development services, have proven successful (for example, Sievers and Vandenberg, 1997). However, access to credit remains a challenge in remote, poor, rural areas. This phenomenon is also due to the inability of lenders to take extensive cumulative risk embedded in loan portfolios not sufficiently diversified (Christen and Pierce, 2005).

To alleviate this constraint, the introduction of traditional and innovative formal insurance may be considered. The design of a sustainable insurance scheme, especially against low-frequency but high-impact events, such as natural disasters, is particularly complex in low-income countries (Brown, 2001). On one side, farmers may not find the conditions suitable; contrary to common but misleading beliefs, farmers, although not familiar with the contract

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technicalities, can assess the key decisional factors, such as basis risk (Castellani et al., 2014; Elabed et al., 2013; Sarris, 2013) or multiple risk exposure. On the other side, insurers look for large numbers and risk types that can technically be insured to offer sustainable products and for appropriate delivery channels. These elements may be absent in rural areas. Moral hazard is also a major impediment but innovative, index-based insurance may help to overcome this limitation and to reduce the ex-post verification costs (Hill and Robles, 2011). However, it entails basis risk exposure. Recent studies have attempted to improve the understanding of the dynamics and factors behind the Willingness To Pay (WTP) for insurance, especially focussing on index-based contracts. These factors include, but are not limited to, technical characteristics (for example, soil quality or agro-climatic zones or the nature and types of different natural or man-made disasters, as in Castellani et al., 2014; Hill and Robles, 2011; Sakurai and Reardon, 1997), behavioural elements related to age and to the level of (financial) education (Akter et al., 2009; Giné et al., 2008), and the choice of the distribution channels (Cole et al., 2009; Hill et al., 2013).

Important elements affecting the WTP for insurance are the type of risk management and diversification strategies that are often a function of wealth levels (Akter et al., 2009; Clarke and Kalani, 2011; Fonta et al., 2018; Sakurai and Reardon, 1997). Studies regarding the influence of wealth on risk attitude and the WTP have been contradictory: sufficiently well-off households may feel that they are strong enough to diversify (see the discussion in Ullah et al, 2015) with less need for insurance while poorer farmers may be more risk averse (as in e Saqib et al, 2016). However, the opposite may also occur: the greater the asset size, the higher the risk aversion might be, while poorer households do not have their wealth at stake and may not feel it necessary to insure (Viganò et al., 2013).

In addition to assessing the influence of overall wealth, authors have tested if specific asset or liability compositions affect the decision to insure. Cole et al. (2009) show that the demand by

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farmers is sensitive to cash on hand and to the related immediate purchasing power and that credit constraints, which limit cash availability, are observed to be an impediment to the purchase of insurance, as portrayed by Giné et al. (2008). However, being already indebted can negatively affect the WTP for insurance if cash is to be used to repay the loan. Cash holdings can also have contradictory roles depending on their origin. When in-cash grants are made available by donors with the aim of attracting households towards the insurance product, demand distortions occur (Sarris, 2013). Other types of subsidies, such as food aid, by contrast, have a significant negative effect on the demand for drought insurance and discourage self-insurance (Sakurai and Reardon, 1997).

These findings suggest that farmers do not consider insurance to be a stand-alone hedging instrument but a part of a wider portfolio risk management strategy. A portfolio perspective is not new in studies on risk management of rural / low-income customers (Collins et al., 2009; Hill et al. 2013, with specific reference to index-based insurance in Ethiopia). This perspective implies the analysis of the complementarity and interaction of different risk management strategies and a hypothesis on the household's decision-making process is, therefore, necessary. Ullah et al (2015), for example, assume the simultaneous adoption of risk management tools by Pakistani farmers. This paper assumes a stepwise decision process. We are indeed interested in how the adoption of one tool influences the adoption of other tools.

In most low-income rural areas, risk management financial tools competing with formal insurance are not abundant; as aforementioned, savings accumulation, borrowing, membership in social networks acting as informal insurers, or other local or external aid sources are the main available options. Although the availability of solutions is a crucial factor, options are not necessarily only complements or only substitutes, and a priority predefined ranking is difficult to achieve. Savings may be an alternative or a complement to

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borrowing and insurance. The absence of insurance may, in principle, reduce the chances to receive a loan, but loans may be considered substitutes for insurance or complementary when borrowing allows premium payment.

In this perspective, insurance is not seen by farmers exclusively as 'the only solution', 'the last solution' after having made their decisions regarding savings and credit or 'the alternative solution', when other strategies are unavailable. How insurance combines with other options indeed affects the overall success of risk management.

This perspective has no predefined last-comer in the combination of tools to manage risk exposure, but each instrument may be considered 'one among peer measures' that can represent the available portfolio of choices.

The actual combination depends on several factors, idiosyncratic to the household or external. Negative shocks can differ in terms of frequency and intensity (Fafchamps, 1999) and farmers perceive risk according to these two dimensions (for example, Ullah et al, 2015 and e Saquib et al, 2016). Despite the possible high frequency, when negative events have a low impact, households can manage to deal with their consequences using personal wealth (e.g. savings). The ability to regularly deal with these events depends on the occurrence rate and on the absolute level of wealth. As an alternative or as a complement, households can look for external finance in the form of loans or gifts. If high frequency is coupled with high impact, external insurance could become an interesting (and often the most suitable) option. High frequency may be an attractive factor for insurance companies because it allows for proper computation of the premiums. However, if impacts are too high, the loss ratio may also become too high. Insurance companies tend to position themselves on the low frequency and high impact segment (or ask for higher premiums to insure higher frequency events).

Therefore, even when insurance is available, households and insurance companies must each find their equilibrium between premiums paid / received and the expected indemnities.

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Households must then find other complementary strategies for those risks that they would not like to keep but cannot insure. Technical solutions to reduce risk exposure (for example, irrigation in the case of risk of drought) may help but are seldom available and must, therefore, be combined with financial solutions.

In this article, we expect that rural households' risk management would concern the combination of different financial tools—savings, credit, and insurance—and other financial and non-financial strategies, such as asset hoarding; the mix depends on the sequencing in the implementation of the different strategies. The hypothesis is that the role of insurance may become strategic depending on how this product combines with other portfolio elements; insurance is not an add-on solution. Confirming this conclusion will affect the development of new insurance solutions and delivery channels. The interest of the research is in shedding light on financial decisions in order to offer new perspectives to financial service providers. A specific interest on insurance derives from the recent focus on it in the context of rural finance. The empirical analysis confirms the vulnerability of sample households to systemic shocks (drought and flood) and entails that the conclusions of this paper can be considered part of the broad literature on the disaster risk management of low-income households.

In terms of data, we use a financial accounting approach. Given the absence of any type of book-keeping practices, we used the information collected through the field interviews to construct financial statements by re-organising the data into balance sheets and income statements. The most significant data elaborated in these statements are then used to model households' choices regarding savings, credit, insurance, and other assets, within a portfolio perspective. The manuscript is organized as follows. The next section describes the process of financial statement reconstruction. A description of the data set used and of the methodological aspects follows. The subsequent section presents the model and results. A final section concludes.

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2. METHODS

2.1 ORGANIZING DATA: FINANCIAL STATEMENTS FORMAT

The study of rural households' financial status in poor countries is relevant for different research purposes. Several articles in the literature are based on information on income and expenditures and asset amounts and composition but have often been based on secondary data[1]. As portrayed in Gustafsson et al. (2014), although the use of secondary data is time-saving, ad hoc studies have designed original information collection to be functional to the research target. Browne et al. (2007) investigate household consumption patterns in KwaZulu-Natal, in 2004–2005, with detailed categories of expenditures (food and non-food), differentiated by households' characteristics. Cavendish (2000) works on rural households and environmental resources in Zimbabwe. Leroy et al. (2001) study food security in South Africa through a formal, structured questionnaire and an informal questionnaire on household characteristics, food consumption and purchases, farm characteristics, production, farm and non-farm income, and qualitative issues. De Mel et al. (2007) collect data on Sri Lankan microenterprises in 2005 and 2006 to refine the strategies for measuring profits. Gustafsson et al. (2014) mention several surveys expressly designed for a specific research target in the case of China. Most of these studies have referred to a remarkable quantity of information, but some have emphasized the trade-off between the desired detail of specific information and the need to make the analysis smooth and suitable for eventual modelling. The generalized risk of information unavailability or poor quality is a common issue.

The mainstream literature has shown that, although abundant surveyed data have often been used, very few contributions have adopted a financial statement approach, which may be a challenging but effective tool to have a systematic view on the households' economic and financial structure. Financial statements can help improve the quality of the information:

[1] Among the literature analysed: Duncan et al. (1999) on Indonesia; Kebede (2008) on Ethiopia; Mensah et al. (2014) on Ghana; Mussa (2014) on Malawi; Skoufias and Katayama (2011) on Brazil.

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given the underlying balancing principle, an accounting system allows for the detection of mistakes and the filling of some of the gaps that data collections entail. Working on financial statements with rural households in low-income countries may appear to be a simple task, because of their apparently simple production structure, but represents a challenge for at least two reasons. The first reason relates to the actual complexity of rural households, in which the production and family components (and the associated financial data) are inseparable (Samphantharak and Townsend, 2010; Singh et al., 1986). The second reason is the need to incorporate data on stocks and flows in the analysis, most of which have estimated values (for example, in-kind consumption, exchanges, or loans, or even the estimation of the use of environmental resources such in Cavendish, 2000).

Samphantharak and Townsend (2010) published an original study based on a financial statement approach. These two authors analyse Thai households' investment and finance decisions as if these households were corporate companies. For example, they treat retained earnings as accrual net income and distribution of products among members as dividends. Although this approach is appealing, their choice to split the household's business into artificially separated activities requires reflection because, as explained, rural households and production units are often merged, and arbitrary distinctions among components may mislead financial analysis. Nevertheless, the authors are quite accurate in their measurement, even if they make strong assumptions when data are not available[2]. Samphantharak and Townsend (2010) investigate a sample of 720 households in rural and urban areas of Thailand by using an intensive monthly survey from January 1999 through December 2002. Monthly periodicity helps adjust the eventual data collection errors and allows for methodological refinements. They focus and elaborate on several dimensions: productivity, liquidity and insurance, financing and liquidity management, and wealth management.

[2] This is the case of their estimation of cost of goods sold and of initial endowment of cash or jewels, or the method used to classify people as household members.

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Based on Samphantharak and Townsend's (2010) strengths and limitations, with a sample half the size and a limited number of rounds (see the next section), we suggest a novel structure of simplified but complete and consistent financial statements to conduct a general assessment of the households' profitability, sources and uses of funds, and assets and liability composition while considering the trade-off between obtaining sufficiently reliable information based on available data and keeping the scheme simple. The variables used cover common relevant issues in rural households' surveys (e.g. sources of income and expenditures, household' characteristics, asset composition, debts and investments, and exposure to risks), but some items are specific to our analysis; for example, detailed characteristics of the financial aggregates (loans, savings, remittances, cash), the farmers' risk exposure and their attitude towards formal and informal insurance[3]. Tables a1 and a2 in the appendix represent the income and expenditures and the balance sheet structures we propose.

2.2 DATA AND METHODOLOGY

This empirical analysis is based on data collected in the Wolayta zone (southern Ethiopia) by XXXX research group, in the frame of the XXXXX project[4], on a sample of 360 households surveyed between March 2011 and November 2013. The sample size was determined on the base of the Cochran's formula for large populations (Cochran, 1963: p.75), assuming a confidence level of 95% and an error margin of 5%. Data on the geographical distribution of the rural households' characteristics in terms, for instance, of size, wealth or income sources, were not available at the time when the survey was conducted. This prevented us from using any stratified sampling approaches. To the best of our knowledge, the only available

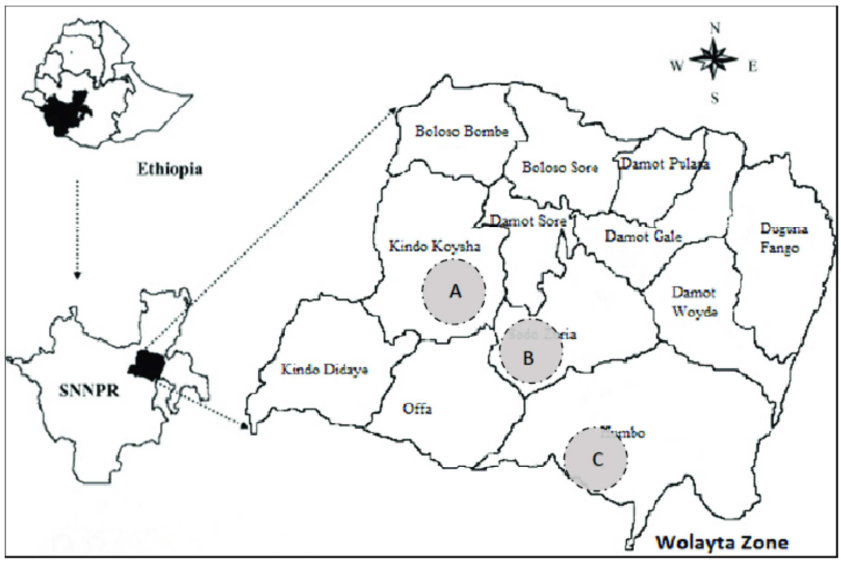
[3] Compared to the literature review presented in this article, we did not include some items. We did not specifically keep track of thefts (contrary to what is suggested by Thorsen, 2002 in his study in Burkina Faso), but they were declared by farmers among their shocks, and expenditure items are less detailed than in other researches. We did not foresee a question on environmental resources (as in Cavendish, 2000) but we recorded them when declared.

[4] XXXXX is a research project of: OMITTED FOR BLIND REVISION.

information was the estimated number of rural households (i.e. about 268 thousand), based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia[5].

The data collections were carried out twice per year: before the beginning of the 'small' rains (*Belg* season) and after the 'big' rains (*Meher* season) in three villages (120 households per village) with different agro-climatic characteristics (Figure 1)[6], which make them diversified in terms of vulnerability to climatic disaster risk, with prevailing events being droughts and floods, as explained below. Households were selected randomly based on the demographics in public records.

Figure 1: Areas of data collection



Source: Adapted from Kochare et al. (2018)

A questionnaire covering several aspects of rural households' socio-economic conditions was administered: personal information and family structure, characteristics of the dwelling and other real assets, land holdings and allocation, detailed information on farming and livestock activities, other income generating activities, participation in farmers' organizations or social

[5] http://www.csa.gov.et/census-report/complete-report/census-2007

[6] The three villages are located in the lowlands (about 1400 m a.s.l.), middlelands (about 1600 m a.s.l.) and highlands (about 1800 m a.s.l.), respectively. Altitude is the main determinant of the agro-climatic differences (based on interviews with the local office of the Ministry of Agriculture).

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networks, access and usage of formal and informal financial services, other inflows (among which aid) and outflows of money, shocks affecting the households and strategies adopted to manage them, and access to social infrastructures. To keep the usual problems of data quality at an acceptable level, we implemented ad hoc strategies such as cross-check questions and strict on-site supervision.

The first methodological step of the current research consists of cleaning the collected data and re-organising them into a Balance Sheet and an Income Statement scheme. Our original difficulties regarding items' classifications and estimates are overcome by some refinements in data elaboration. For example, the estimates of non-monetary items, the most critical, are based on market data, when available, rather than on personal statements. On this point, de Mel et al. (2007), in the estimation of profit levels in Sri Lanka, found better data quality based on the statements of the respondents compared with the use of detailed information on income and expenses. In our analysis, we, instead, analytically reconstruct the households' wealth and revenue and use declarations only when data are not quantifiable otherwise. The second step is to fill out with data on each household the financial statement schemes presented in the Appendix. A few items are dropped in case of unreliable or insignificant values. The last step is the aggregation of financial data into the main categories of incomes and expenses and assets and liabilities. These classified data are used as input in the model of interpretation of rural households' financial behaviour. A list of the input variables is reported in table 1 and grouped according to the main dimension covered.

Table 1: Input Variables Description

HOUSEHOLD'S CHARACTERISTICS
Age of household head (age may influence financial decisions)
School grade of household head (education affects knowledge of financial contracts)
HOUSEHOLDS FINANCIAL SIZE AND PROFITABILITY
Total assets (an indicator of size and asset building)
Gross revenue (profitability)

Wealth perceived level (subjective financial size)
RISK EXPOSURE AND MANAGEMENT
Shocks undergone (risk exposure)
Members of the households with problems: illness, death or loss of job (risk exposure)
Perceived risk exposure (risk perception and attitude)
Extension of irrigated land (larger extensions may affect risk exposure and risk copying strategies)
Number of activities run by the household (diversification effects)
Total number of diversification strategies (diversification effects)
Livestock diversification index (diversification effects)
Mitigation strategies based on livestock sale (a risk management strategy)
Mitigation strategies base on consumption and cost reduction (a risk-coping strategy)
Number of social infrastructures used (risk mitigation strategy)
Number of social networks accessed (risk mitigation strategy)
PORTFOLIO CHOICES (SAVINGS, LOANS, LIVESTOCKS, CASH COMPENSATIONS)
Number of savings accounts (an indicator of portfolio choices)
Amount of savings intended for asset building (an asset building strategy)
Amount of savings intended for risk management (a risk management strategy)
Total amount of savings (an indicator of portfolio choices)
Total amount of loan received (an indicator of portfolio choices)
Number of loans received (an indicator of portfolio choices)
Total value of livestock (an indicator of portfolio choices)
Cash compensation received (a substitute for insurance)
ATTITUDE TOWARDS INSURANCE
Knowledge of insurance (may affect willingness to pay)
Impediments to access to insurance (may affect willingness to pay)
WTP for insurance based on per cent of production (an indicator of latent demand for insurance)
WTP for specific oxen insurance (an indicator of latent demand for insurance)
WTP for insurance based on per cent of income (an indicator of latent demand for insurance)
WTP to pay for life insurance (an indicator of latent demand for insurance)

Note: in brackets, the specific choice rationale

Some variables requested re-elaborations. For example, the variable of the total number of shocks has been transformed into a dummy that takes the value of 1 if the household suffered more than six negative shocks (0 otherwise). This indicator was selected because of its higher degree of variability, as most households were affected by several similar shocks at the same time. However, results of the factor analysis show that this indicator is not economically significant. The perceived wealth level and the risk exposure, originally ordinal variables that take values between 1 and 10, have been transformed into continuous variables using the Johnson system of distributions. We have also taken the log of gross revenues and cash

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compensations received to account for outliers and potential survey errors. Age and education are measured on male household heads because males represent the largest majority in the sample.

Some of the variables selected appear obvious, and others deserve further background explanations. The inclusion of livestock in the portfolio choices is derived from the importance that livestock has as a marketable asset in Ethiopia. The number of savings accounts or outstanding loans indicates that personal savings opportunities and/or access to credit are provided by different actors: informal market networks, savings and credit cooperatives or the regulated microfinance institutions (MFIs). Very often, households chose more than one savings or credit provider. Other access to formal credit is limited because of the scarce presence of formal institutions, the limited size of the transactions, and the risk perceived by the lender. The information on cash compensations is useful because these grants may be considered substitutes for insurance even if access to these forms of compensation is seldom under the control of the household. No formal insurance is available in the area under study, but Ethiopia provides striking examples of informal insurance named *Iddir* (Dejene, 2001), which are included in the social networks. Information requested regarding formal insurance, therefore, was related to households' intentions and considered the latent demand for insurance.

The risk exposure of the sample farmers influences the interpretation of the empirical results. The questionnaire included a set of questions about 25 different potential shocks. The collected information suggests that the sample households are mainly concerned with natural-disaster-type shocks- droughts (which we distinguish from late rains, considered as normal climatic events) and floods. Table 2 shows the proportions of households affected by droughts and floods over the three years.

Table 2: Percent of households affected by main disasters

Type of disaster	Nov 2011	Nov 2012	Nov 2013

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Drought (% of farmers considering drought as the most serious shock)	70.57% (45.27%)	38.38% (24.65%)	4.72% (2.81%)
Flood (% of farmers considering flood as the most serious shock)	43.71% (6.59%)	19.05% (13.03%)	39.17% (30.34%)

Source: survey data

The households who suffered from one or both shocks or late rain represent 74.21% of the observations. This general result demonstrates that the sample farmers are particularly vulnerable to weather-related disasters. As a matter of fact, farmers have a risk perception which seems to attenuate the disaster-type characteristics of the events they are subject to. In fact, when requested to grade their risk exposure with reference to their peers, their risk exposure becomes mitigated in their perception, as seen in Graph 1. Most of the interviewees feel they are in the mid-range of exposures. Nonetheless, this proves that they believe they are subject to covariant risks. Different from other studies (for example, Ullah et al, 2015), in our research, risk perception contributes to the choice but, given its distribution in the sample, is considered among the potential determinants of choices but is not expected to be significant.

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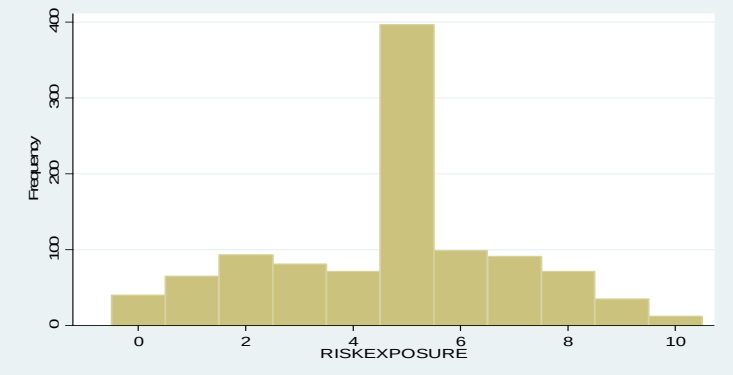
Graph 1: Perception of risk exposure as compared to peers



Note: 0 = much less; 10 = much more
Source: survey data

Some variables are complementary in explaining a specific dimension of the analysis (such as the attitude towards insurance). Therefore, on the whole input variables set, factor analysis was run to obtain a limited number of factors reflecting the main dimensions of the analysis: portfolio composition, attitude towards insurance, and some other household's characteristics. Table 3 shows the six selected factors and the loadings of the most relevant variables in each one, which determine the factors' meanings.

Table 3: Factor Analysis and Main Results

FACTOR 1 SAVINGS (0.28) *factorsavings*	FACTOR 2 WEALTH (0.17) *factorwealth*	FACTOR 3 INSURANCE (0.15) *factorinsur*	FACTOR 4 LOANS (0.14) *factorloans*	FACTOR 5 PROFITABILTY (0.13) *factorprofit*	FACTOR 6 HOUSEHOLDS CHARACTERISTICS (0.12) *factorhhchar*
Savings for asset building 0.82	Total assets 0.62	WTP for insurance in % of production 0.68	Amount of loan received 0.68	Gross revenue 0.61	Education of household head 0.60
Savings for risk management 0.82	Total livestock 0.55	WTP for insurance in % of income 0.67	Total number of loans received 0.65	Number of different activities run by the households 0.56	Age of household head -0.59
Total savings 0.68	Wealth perceived level 0.47				
	Livestock diversification 0.41				

Notes: proportions of total variance in parentheses; rotated (orthogonal Varimax rotation) factor loadings ≥ 0.40 under each variable name
Source: survey data

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3. RESULTS

3.1 THE MODEL

To capture the coexistence of portfolio choices, we modelled a system of Seemingly Unrelated Regression Equations (SURE), with panel data based on three observations per household over time (November 2011, November 2012, November 2013)[7]. In a portfolio management perspective, every risk management strategy is selected and carried out along with other risk management strategies. Each equation of the system represents one of the main portfolio choices, and the dependent variables are measures of each of the main dimensions considered in the portfolio choice:

- Insurance: WTP for insurance based on per cent production the household would be ready to pay to be compensated for risk, given awareness of basis risk (*WTP*)
- Savings: percentage of total savings/total assets (*Savonas*)
- Loans: percentage of total loans received/total assets (*Loanonas*)

The explanatory variables are the factors (table 3). We also include a variable related to livestock investment (total livestock/total assets: *livestonas*) which did not emerge explicitly as a specific investment choice in the output of the factor analysis. Only in the equation explaining insurance we add, as an explanatory variable, the degree of knowledge of insurance products (*knowins*).

To reduce the problem of endogeneity, in each equation, the factor related to the specific dimension is omitted. For example, in equation 1, *factorinsur* is omitted to appreciate the relationship with other dimensions of the portfolio choice.

The model specification is the following:

[1]

[7] The rounds of November contain more information than the rounds of March.

[3]

$$WTP_{i,v,t} = \alpha_1 + \beta_{1,1} factorsavings_{i,v,t} + \beta_{1,2} factorwealth_{i,v,t} + \beta_{1,3} factorloans_{i,v,t} + \beta_{1,4} factorprofit_{i,v,t} + \beta_{1,5} factorhhchar_{i,v,t} + \beta_{1,6} livestonas + \beta_{1,7} knowins + \varepsilon_{i,v,t}$$

$$Savonas_{i,v,t} = \alpha_2 + \beta_{2,1} factorinsur_{i,v,t} + \beta_{2,2} factorwealth_{i,v,t} + \beta_{2,3} factorloans_{i,v,t} + \beta_{2,4} factorprofit_{i,v,t} + \beta_{2,5} factorhhchar_{i,v,t} + \beta_{2,6} livestonas + \theta_{i,v,t}$$

$$Loanonas_{i,v,t} = \alpha_3 + \beta_{3,1} factorsavings_{i,v,t} + \beta_{3,2} factorwealth_{i,v,t} + \beta_{3,3} factorinsur_{i,v,t} + \beta_{3,4} factorprofit_{i,v,t} + \beta_{3,5} factorhhchar_{i,v,t} + \beta_{3,6} livestonas + \vartheta_{i,v,t}$$

Results are presented in table 4.

Table 4: Estimates of the SURE Model with Random Effects

	(1) *WTP*	(2) *Savonas*	(3) *Loanonas*
factorsavings	**0.624*** **	-	0.109
	(0.071)		(0.231)
factorloans	**1.086*** **	**-0.4592*** **	-
	(0.116)	(0.113)	
factorinsur	-	**5.029*** **	**-3.431*** **
		(0.106)	(0.360)
factorwealth	**-0.714*** **	0.067	**- 0.650** **
	(0.134)	(0.141)	(0.343)
livestonas	**27.350*** **	**-2.855*** **	**13.413*** **
	(0.431)	(0.447)	(1.157)
factorprofit	**- 0.638*** **	-0.045	**-1.137*** **
	(0.131)	(0.121)	(0.305)
factorhhchar	**-0.633*** **	0.169	-0.193
	(0.144)	(0.148)	(0.366)
knowins	**4.932*** **	-	-
	(0.157)		
Observations		776	

Note: std. errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

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3.2 DISCUSSION

The first remarkable outcome is that all the considered dimensions in portfolio choices are reciprocally influenced by at least some of the other variables, even if effects are not always bidirectional. More specifically, the WTP for insurance (specification 1) is positively related to loans and savings, which means that the choice to insure is not offset by the choice of other more traditional financial contracts. The relationship with livestock assets is strongly positive: livestock, in addition to representing a risk copying strategy per se, being itself subject to risk, is also one factor of attraction for insurance. Wealth has a negative effect on insurance; with reference to the description in the introductory section, the contradictory effect of wealth on insurance is verified: households' fear to lose their assets at stake is not a sufficient incentive to buy; as a matter of fact, a prevailing discouraging factor is the diversification allowed by large assets. What also reduces the propensity to insure is the current revenue level, and this may occur when profitable households overcome ongoing problems by themselves through risk retention strategies. A negative relationship between WTP and personal characteristics requires caution because in factor analysis the interpretation of the sign of the single loadings may be less meaningful. Education is generally expected to encourage take-ups because it is considered a factor favouring the understanding of insurance and, in general, risk management decisions. However, Giné et al. (2008) find contradictory results in two of their studies since the effects of education also change in relation to previous experience with insurance. The age effect is also contradictory in the literature: e Saquib et al (2016) find older farmers more willing to use agricultural credit as a post-disaster measure. Also Ullah et al (2015) find older farmers more willing to adopt risk management strategies, such as diversification. While access to credit may be a function of experience, in the case of insurance, a higher WTP of older farmers may be explained by their ex-ante higher risk aversion; however, this relationship would contradict what Castellani and Viganò (2017)

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found in a previous study (on livestock index-based insurance). In our case, the variable education may not actually reflect the different school levels of people but is leveraging the age effect because young people are normally more educated. In terms of policy implications, the school level may not influence WTP but specific knowledge of an insurance contract has a strong incentive effect to buy.

Savings (specification 2) are positively related to the WTP for insurance. This finding confirms the complementarity hypothesis. By contrast, it appears that indebted households are less willing or able to save, and this phenomenon is possibly due to the stringent need to repay their loans. Furthermore, livestock investment is also negatively related to savings because livestock may be a substitute for other types of investments, such as savings. Some authors stress the contradictory results on precautionary savings in the literature (as in Ullah et al, 2015). Our portfolio approach not only invites to consider complementarity and substitution effects with other assets (such as livestock) or with other strategies, but it also stresses the role of sequential decisions.

The equation explaining borrowing choices (specification 3), by contrast, shows that households willing to insure, who are wealthier and with higher-income tend to be less indebted. Investments in livestock are positively related to borrowing, which can be explained by several factors. For example, the use of borrowing to buy livestock or the more favourable attitude of lenders, who may use the cattle as a guarantee. Savings apparently does not affect borrowing.

The discussion shows that the main elements of a portfolio approach to risk management are related. Some are characterised by a bidirectional consistent influence, and, in other cases, a significant effect only operates in one direction. This result means that there might be some sequencing in the determination of portfolio choices and some prevailing preferences.

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Indeed, specification 1 shows that insurance would not be offset by savings and livestock hoardings, but it is rather complementary. Moreover, specification 1 and 2 show that insurance and savings depend on one another, which is consistent with the portfolio view. The role of loans, by contrast, is more complex to analyse and suggests, rather than a simultaneous choice perspective, a sequencing approach. On the one side, borrowing positively affects the WTP for insurance, and this probably occurs because, as suggested in the introductory section, it increases (at least temporarily) the financial resources available to pay for the premium. On the other side, insurance offers a backup for loan repayment and secures a means of payment in case of negative events. However, being willing to insure reduces the tendency to borrow. Therefore, in this case, the sequence of the choice of the financial contract affects the pro-tempore composition: those already indebted are more willing to buy insurance but their choice to be indebted is negatively affected by their WTP for insurance, probably because of a more risk-averted attitude. Insurance, then, may be considered as an ex-ante alternative to borrowing but becomes an ex-post complementary solution.

Additionally, the role of savings is contradictory compared with borrowing but also can be explained by sequencing. Although being indebted reduces the ability to save, the opposite does not hold. The amount of savings does not affect the decision to borrow. This phenomenon can be explained by the average amount of savings in the sample (about 50 USD). Thus, the amount of savings does not allow for the implementation of relatively large productive projects or investments in real assets. A decision in this respect, therefore, requests external funding. Once indebted, the households can accumulate a limited amount of savings.

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4. CONCLUSIONS AND WAYS FORWARD

This article was inspired by the use of a conceptual framework based on a portfolio approach to study rural households' risk management strategies and had a particular interest in the potential demand for insurance. The structure of the sample shows that, while several risks are affecting the households, a large percentage of the interviewees declared to suffer of disaster-type events: droughts and floods.

The outcome of the current analysis confirms the results of previous, simplified, attempts to prove that although insurance is often considered an alternative measure to farmers' own risk-coping strategies, it may be a complementary solution. The information obtained by using a system analysis (in this case, the SURE methodology) is that the main dimensions of a portfolio approach to risk management can be analysed in their reciprocal relationships. Based on the findings, insurance and savings decisions are affected by the overall composition of risk management strategies (savings, insurance, loans, livestock), and borrowing decisions depend on all factors but savings. Another finding is that the direction of the influence in some cases is constant (always positive, suggesting complementarity), and in other cases, the direction changes according to the sequence of the portfolio choice. This phenomenon is evident in the case of borrowing. Contrasting effects also characterise livestock investment, which appears to be a substitute for other portfolio elements (savings) or a complement to them (insurance and loans).

These outcomes may suggest interesting proactive and innovative strategies for developing financial products for low-income rural households. For example, although encouraging savings in financial forms is a target of financial service providers and policy-makers, given the effects that savings may have on the propensity to insure, combined 'savings+insurance' products may potentiate the acceptance rate by customers. Similarly, offering

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'loans+insurance' may be effective. In microfinance, life insurance is often offered together with loans, which contributes to lower the lender's risk (Ledgerwood, ed., 2013). In fact, in case of death of the borrower, the insurance indemnity is transferred to the bank in order to pay off the loan. Our suggestion is that non-life insurance products may be offered as well, bundled with lending: in the case of weather insurance, for example, the insurance company provides an indemnity that assures the loan settlement if the customer is not able to repay due to adverse climate conditions. In this case, as explained, knowledge of sequential decision-making may be crucial. If being keen to insure discourages borrowing, a simultaneous offer of an attractive combination of the two products may offset this negative influence. The offer of financial products, in turn, should consider the effects on investments in livestock, and products should be designed accordingly. In particular, because livestock investment seems to offset monetary savings, offering livestock insurance may encourage households to secure the livestock asset value and to divert part of investments in livestock made for precautionary purpose (to contrast the negative impact of single animal losses) to monetary savings; in doing so, households diversify their risk management choices.

In summary, since insurance does not offset and is not offset by the savings potentials of customers but is, instead, combined into different strategies, and because other potential joint offers of financial products can be envisaged, a flexible combination of such products allows to offer interesting packages to rural households. To this end, a targeted market analysis and segmentation must be put in place to improve the understanding of the rural clientele and their preference, to further explore the role of borrowing and savings in farmers' financial and insurance strategies. A segmentation of customers based on their savings capacity would also be advisable. Other criteria for segmentation relate to personal characteristics of the customer. We focused on the two main characteristics—age and education—but, based on the results of this study, other criteria may be drivers of customers' behaviours. In particular, the findings

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confirm that more than the number of years at school, a driver of the use appears to be the degree of knowledge of financial products. Thus, financial education must be fostered.

In terms of further development of the results, a substantial improvement would be to perform this analysis on specific types of risks characterised by different levels of frequencies and impacts; then, their assessment and the risk management strategies could be studied according to the 'keep, hedge, insure' approach described in the first section. Another improvement would be to further develop the model by applying advanced simultaneous determination techniques. These improvements are worthwhile for an ad hoc data collection, with the aim to obtain highly reliable data. The dataset shows a satisfactory reliability, but data quality, in most studies in low-income rural areas, continues to be a challenge.

Although the model and the approach deserve further refining, this contribution allows a clearer interpretation of the driving forces of rural households' choices regarding combinations of savings-credit-insurance products as risk management strategies, with special attention to disaster-prone areas. It provides insights for microfinance and microinsurance suppliers on product and process innovation for a more effective response to rural households' demand for financial services.

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APPENDIX

Table a1: Household Balance Sheet Structure

ASSETS	LIABILITIES AND EQUITY
REAL ASSETS: **Long-term investments** House property Land owned Production equipment **Short-term investments:** Furniture Production tools Other main house equipment Transportation equipment **Inventories:** Agricultural inputs: Seeds Agricultural inputs: Fertilizers and Pesticides Agricultural and dairy products Other raw materials Other intermediate products Final products Live animals for long-term production Other inputs stocks	**EQUITY** Estimation of the household's contribution Non-distributed income/loss
FINANCIAL ASSETS Cash at home Credits given in cash Credits given in kind Money invested in *Eqqub* (rotating association) Capital invested in cooperative Savings in bank Savings in MFI Savings in cooperative	**FINANCIAL LIABILITIES** Credits received in kind Money received from *Eqqub* (rotating association - net outstanding position may be in assets or liabilities) Outstanding loans from the bank Outstanding loans from MFI Outstanding loans from cooperative Other loans received

Table a2: Household Income Statement Structure

EXPENSES	REVENUES
AGRICULTURAL PRODUCTION DIRECT COSTS Rent paid for land Seeds bought Fertilizers bought Costs for self-produced compost (estimate) Pesticides bought Salaries paid on farming Household labour cost (estimate) Salaries paid on labour parties (estimate) Rent on animals Rent paid on shared animals (estimate)	**AGRICULTURAL INCOME** Rent received from land Crop harvested (including self-consumed and sold) Seeds sold Fertilizers sold Pesticides sold Rent from rented inputs
LIVESTOCK RAISING AND RELATED ACTIVITY Animals bought for sale (trading activity) Feeding expenses Veterinary expenses Salaries paid on livestock raising and trade Household labour cost for livestock activity (estimate) Meat and dairy products bought for sale Animals died (loss on investment)	**INCOME FROM LIVESTOCK AND RELATED ACTIVITY** Animals sold (trading and raising activity) Rent received on shared animals (estimate) Meat and dairy products sold Animal born (earnings on investment)

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EXPENSES OF SECONDARY ACTIVITIES Inputs purchased on secondary activities Products purchased on secondary activities Household labour on secondary activities (estimate) Salaries paid on other activities Other expenses on secondary activities Annual fees in cooperatives	**REVENUES OF SECONDARY ACTIVITIES** Salaries received on secondary activities Products sold on secondary activities Other revenues on secondary activities Salaries received on labour parties (estimate) Earnings from cooperative Environmental resources collected and consumed or sold
FOOD EXPENSES Meat and other dairy products bought for self-consumption Animals slaughtered for self-consumption (estimate) Crop harvested and consumed (estimate) Environmental resources self-consumed (estimate) Other food expenses	
FINANCIAL EXPENSES Interest on loans received Other fees on loans received Loss on loans given (defaults)	**FINANCIAL REVENUES** Interests on loans given Interest on savings
HOUSE EXPENSES Electricity Fuel and other services (grinding mill, water point) School fees Transportation costs Clothing Ceremonies	
RISK EXPOSURE AND PROTECTION Expenses for emergencies Health expenses Contribution to *Iddir* (premiums to informal insurance) Other insurance premiums Aid given out in cash Aid given out in kind	**RISK EXPOSURE AND PROTECTION** Compensation from *Iddir* (indemnity) Other insurance indemnities Aid received in cash Aid received in kind
DEPRECIATION Depreciation of house, land, equipment, other	**APPRECIATION** Appreciation of house, land, equipment, other
OTHER EXPENSES Taxes Other expenses	**OTHER REVENUES** Remittances Inheritances Technical assistance received (estimate) Other revenues
NET REVENUE	**NET LOSS**

Note: Animals died or born in the year are considered, respectively, as current physiologic losses and physiologic earnings. House improvement expenses are not included in costs because they are embedded in the current value of the house; however, they can be important for cash flow computation. The same applies to animals bought during the season for long-term investments, purchase of equipment during the season, and increases and decreases in savings and loans.

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