Tuscan Universities Joint PhD Programme in Economics

Essays on Risk and Time Preferences, Vulnerability to Shocks and the Joint Choice for Financial Products in Ghana

Kwaku Amakye

Cycle XXXII

Doctoral Advisor:
Professor Nicola Dimitri

Thesis submitted in partial fulfillment of the requirements for the award of Doctor of Philosophy degree in Economics

Program Coordinator:
Prof. Ugo Pagano
University of Siena, Italy

Acknowledgements

"…with God all things are possible" Matthew 19:26.

I thank the Almighty God for the strength he provided to me to undertake this study.

I would like to express my profound gratitude to my advisor Professor Nicola Dimitri and also a special thanks to Professor Giorgia Giovannetti for their useful comments in helping shape this thesis. In writing the first chapter of the thesis, Professor Francesca Gagliardi gave some advice on the development of the shock index and I wish to thank her.

A word of appreciation is of essence to my PhD colleagues of the 32nd cycle for the warmth provided and the constant interaction as I journeyed to a new land. Of special mention are Gissell Huaccha, Thiago Oliviera and Michelle Rings. Other equally important members of the group are Ramiro Alvarez, Eugenio Vicar, Jessica Reale, Elisa Benedette, Gusella Filippo and Gabriele Lombardi. Friends outside the PhD programme including but not limited to Dr. Philip Adom, Dr. Justice Tei-Mensah and Isaac Koomson were on some occasions consulted for advice; I am grateful. I am also thankful to participants of the Next Generation, Lunch Seminar Series at the Department of Economics and Management of the University of Pisa and those at the 2017, 2018 and 2019 Annual meetings at Pontignano for important feedback on my presentation of the initial drafts of the papers in this thesis.

It will not be out of place to thank my parents, Mr. Kwadwo Amakye and Madam Comfort Boahen, my brother and his wife, Colonels Francis and Jemima Amakye, who have all played key roles throughout my life. To Beatrice Serwaa Okyere and Dennis Amakye, whom I shared a major part of my formative years with, I say, it was worth it. A special friend, Adelaide Baidoo, deserves a mention for her invaluable support throughout the three years of my study in Italy.

Contents

Introduction iv
1.1 Introduction 1
1.2 Literature Review 4
1.2.1 Shocks and households' vulnerability 4
1.2.2 Impact of Shocks and Coping Strategies of households 6
1.3 Methodology 9
1.3.1 Polychoric Principal Component Analysis 10
1.3.2 Probit model 13
1.3.3 Data 15
1.4 Results 16
1.4.1 Summary Statistics 16
1.4.2 Vulnerability to Shocks 17
1.4.3 Coping Strategies 22
1.5 Conclusion 29
References 31
Chapter 2 40
2.1 Introduction 40
2.2 Literature Review 43
2.3 Methodology 46
2.3.1 Description of Data and Variables 48
2.4 Results and Discussion 53
2.4.1 Life Cycle Effect and Bequest Motive 53
2.4.2 Risk Preferences 54
2.4.3 Other Factors 55
2.4.4 Comparing Household Members 59
2.5 Conclusion 61
References 63
Appendix 66
Chapter 3 68
3.1 Introduction 68
3.2 Literature Review 69
3.2.1 Elicitation of Preferences: Real versus hypothetical Rewards 71
3.2.2 Determinants of Risk Preferences 72

3.2.3 Determinants of Time Preferences 74
3.3 Methodology 76
3.3.1 Data and Description of Variables 78
3.4 Results and Discussion 82
3.5 Conclusion 85
References 87

Introduction

This thesis consists of three empirical papers on Ghana, focusing on risk and time preferences, vulnerability to shocks and the choice for savings, insurance and credit among household members.

The first paper discusses the vulnerability of households in the three northern regions, Upper East, Upper West and Northern, to shocks. Though the country has impressively reduced the level of poverty over the years, achieving the then millennium development goal on poverty well ahead of schedule, regional disaggregation points to the three regions having more than twice the national poverty incidence. Households in these areas are largely engaged in agriculture which is subject to persistent shocks and may affect their future poverty risk as well as the general level of welfare depending on the coping strategies adopted.

We contribute to the literature on household level shocks by developing a shock index which helps to classify households into vulnerable groups, which to the best of our knowledge is the first of a kind. We are thus able to utilize the relative information value of shocks to identify the level of vulnerability of households. Subsequently, we examine the coping strategies adopted by these classes of households. The dataset used for the analysis is the Ghana Africa Rising Baseline Evaluation Survey data, collected by the International Food Policy Research Institute (IFPRI). We find that over a five-year period, about 35.8 percent of the households can be classified as highly vulnerable to shocks with 40.6 percent being moderately vulnerable and 23.6 percent as less vulnerable. While the less vulnerable group experienced no shock, the moderately vulnerable group experienced fewer shocks than the highly vulnerable group.

When faced with shocks, households rely largely on their savings supplemented with crop stock and livestock sale as well as support from relatives. Comparing moderately vulnerable households to highly vulnerable households, it was observed that the former group were more likely to use savings than the latter. It was further noted that highly vulnerable households do not have access to support mechanisms to cope with shocks. Though government support and support from NGOs or religious institutions were not significant coping for the two vulnerable groups, moderately vulnerable households were more likely to use support from relatives unlike highly vulnerable households. Highly vulnerable households were therefore more likely to engage in religious sacrifices or prayers to respond

to some of the shocks that affect them which was not the case for moderately vulnerable households.

In the second paper, we investigate the joint choice for savings, insurance and credit using the Ghana Living Standards Survey 7 data. As individuals and households in developing countries are exposed to various shocks but with limited formal insurance to insure them, they may combine available financial products to reduce the impact of shocks on their welfare. This study deviates from earlier works that focuse on the head of the household as a representative agent of the household, by examining the choices of individual household members and comparing them to the head of the household.

We employ the trivariate probit model to compare the choices of the various categories of household members (head of household, Spouse, children and other members) and also examine how risk and time preferences affect their decisions. We find a complementarity between the three products as well as significant differences in the choices of household members, especially for savings and credit. What more, risk preferences significantly determine savings, confirming the existence of self-insurance, while time preference does not affect savings. These two observations give credence to the importance of precuationary measures over impatience in the decision to save in developing countries. We also find that ownership of mobile phones significantly affect the utilization of savings and insurance products; an indication that mobile money is helping to reduce the supply side contraints of financial services especially to the poor.

The third paper considers the determinants of risk and time preferences, introducing the role of trust in the family. Risk and time preferences have been identified as important elements in the decision-making process of economic agents. Studies on the two have usually focused attention on other institutions but the family. There is growing interest on the importance of the family in shaping economic preferences of individuals. We introduce trust in the family as a possible determinant of preferences of family members.

Estimation results show that though trust in the family has a positive relationship with patience it also reduces the risk tolerance of individuals. This may suggest that trust in the family increases collectivism as against individualism which has been found to increase optimism and risk tolerance. The negative effect of trust on risk tolerance does not necessarily mean trust in the family is not beneficial, since it makes people more patient. The implication however is that as families build trust among members, they should also have a more open discussion on the relevance of self-reliance which can generate among members

an enterprising spirit. In addition, family trust should increase the creation of insurance networks to engender risk tolerance.

Chapter 1

Vulnerability to Shocks and Coping Strategies of Agricultural Holder Households in Northern Ghana

1.1 Introduction

Ghana has steadily been making gains on its economic growth trajectory, making a sharp poverty reduction over the last three decades. The incidence of poverty in Ghana dropped from 51.7% in 1992 to 39.5% in 1999. It further inched down to 28.5% in 2006 and by 2013 hovered around 24.2% (GSS 2007; 2014). Noting the general decline in the incidence of poverty at the national level, the rate for rural Ghana in 2013 was 37.9 percent with that for urban Ghana being 10.6 percent. Despite poverty incidence being a rural phenomenon, as these figures point out, a disaggregation of poverty by economic activity points to agricultural holder households, which make up about 51.5 percent of all households in Ghana, having the highest rate of approximately 58 percent above the national average. Between 2006 and 2013 poverty reduction for agricultural households was 5.9 percent; an annual average reduction rate of less than 1 percent. Locational distribution of agricultural households indicates that while 82.5 percent of rural households own or operate a farm only 26.6 percent of urban households are engaged in agriculture (GSS, 2014). Thus, in as much as poverty in Ghana may be a rural phenomenon, the economic activity of these households may play an important role as it is also globally acknowledged. The world over, two-thirds of the poorest people are in rural areas and engaged in subsistence agriculture either as small farmers or as low-paid farmworkers (Todaro & Smith, 2012).

Even among rural households in Ghana, the rural savannah has the highest poverty rate of 55 percent compared to 30.3 percent for the rural coastal and 27.9 percent for the rural forest. The rural savannah essentially comprises of the three Northern regions of Ghana and some parts of the Volta region. The proportion of households in the rural savannah engaged in agriculture is 92.9 percent and the incidence of poverty in northern Ghana are 50.4, 44.4 and 70.7 percent for Northern, Upper East and Upper West regions respectively (GSS, 2014). The forgoing analysis brings to bear the income earning abilities of these households who are largely engaged in agriculture. What is unique about their main economic activity and the households themselves that make it a bit difficult to increase their income levels and lift them out of poverty? The standard explanation for this has been the subsistence nature

of agriculture in developing countries, reliance on basic tools, methods and low yielding seeds, among others, resulting in low output and productivity. The other side is the feedback mechanism emanating from their poverty status which prevents them from taking advantage of opportunities that could help pull them out of poverty (Todaro & Smith, 2012). For example, inadequate collateral prevents them from getting cheaper credit for the needed interventions to increase the scale of their activities, making them rely on family labour with minimal capital investment. Apart from these, agricultural incomes may be highly volatile due to risks. These risks may manifest themselves as shocks such as drought, flood, theft, high input prices, disease or pest infestation, commodity price fluctuations and several others which may affect output and income, depending on the risk mitigation strategies put in place before the shock and the risk reducing strategies adopted afterwards. Though risks can be anticipated by agricultural households, lack of information and missing markets can make it difficult for them to get insurance.

Shocks therefore may affect the income earning abilities of individuals and households and the level of consumption as well as the general level of welfare. Empirical evidence suggests that there can be, in some societies, the churning of households in and out of poverty with the possibility that temporary shocks causing these households to fall into poverty may have permanent consequences if they lead to irreversible asset losses (Baulch & Hoddinott, 2000). A household's currently observed poverty status may therefore not be a very good guide to its general poverty risk. Some households may only temporarily be poor, others currently non-poor might face a high risk to fall into poverty in the future and perhaps some might be trapped into chronic poverty (Harttgen & Gunther, 2009). In the event of shocks, households and individuals may device strategies to cope with the effects on their welfare. These include strategies that reduce households' exposure to risk, providing some kind of insurance against these risks, and also measures to share risks with the wider community. The strategies adopted may include, sale of assets, increasing labour supply, reducing expenditure on items such as food and health, taking children out of school, borrowing and risk-sharing at the community level. Households in Burkina Faso, for example, decreased their consumption to protect durable assets when they were hit by fluctuations in income (Kazianga & Udry, 2006). Knowing the poverty status of households therefore may not be enough in the fight against poverty. It will be equally important to know the risk factors of households and how they cope with the shocks they experience since this can also determine the success or otherwise in the fight against poverty. In line with this, it will be important to determine how shocks can be used to classify households

into vulnerable groups and the coping strategies they adopt. After this, one would also be interested in knowing if the coping strategies adopted by households differ depending on the extent of vulnerability.

There has been the emergence of studies on vulnerability to poverty in developing countries in recent years, showing interest in household behavioural response to shocks (Échevin & Tejerina, 2013). This has been achieved by surpassing panel data requirements, which were not readily available in developing countries, for analysing the sensitivity of consumption to shocks. Available cross-sectional data has been complemented with information on shocks and coping strategies as called for by Everitt and Dunn (2001). There have been studies in several developing countries that use households experience of shocks to determine their response and the possible effect on income, consumption and or assets. Such works include; Fafchamps, Udry and Czukas (1998), Christiaensen and Subbarao (2005), Hoddinott (2006), Carter & Lybbert (2012), Debebe et al. (2013) among others.

In Ghana however, there are some few known studies on household shocks and usually they tend to consider a single shock but not a multiplicity of shocks. Quaye (2008) looks at the coping strategies of farming households in northern Ghana during food insecure periods. Osei-Akoto, Adamba and Osei Darko (2013) estimates the impact of health shocks on agricultural productivity in Ghana. Novignon, Nonvignon, Mussa, & Chiwaula (2012) uses cross sectional consumption data to estimate vulnerability to poverty in Ghana and examines the relationship between health status and vulnerability to poverty. Oduro (2010) reviews different coping strategies adopted by households in selected African countries. The work, reviews reported shocks and coping strategies of two communities in Ghana, Builsa and Tema in addition to evidence from other African countries. The emphasis of Oduro is on the role formal and informal financial institutions can play in the event of shocks. There is no known study on shocks in Ghana that tries to classify households based on shocks into levels of vulnerability. Previous works on developing countries that estimate vulnerability have relied on cross-sectional data to determine vulnerable households. Such works determine vulnerable households to be the ones whose incomes or consumption have a certain probability, usually 50 percent, to fall below the poverty line.

This study aims to develop a shock index to classify households and determine the relative information value of shocks in identifying vulnerable households. Specifically, it seeks to classify households into vulnerability groups based on reported shocks and find the coping strategies triggered by the occurrence of shocks. It is organized in 4 sections excluding this introductory section. In section 1.2 we review relevant literature and spell out

the methodology and data used in section 1.3. We present the results and conclude in sections 1.4 and 1.5 respectively.

1.2 Literature Review

1.2.1 Shocks and households' vulnerability

The theoretical literature on vulnerability is in an early stage with numerous definitions and measures and seemingly no consensus on how to conceptualize vulnerability (Harttgen & Gunther, 2009). Pritchett, Suryahadi and Sumarto (2000) defined vulnerability as a probability or the risk that a household will experience at least one episode of poverty in the near future. A household is defined as vulnerable if it has at least a 50 percent chance of falling into poverty. According the World Bank (2000) vulnerability is the possibility of a decline in well-being resulting from insecurity or exposure to risk. The event triggering the decline is often referred to as a shock, which can affect an individual, a community, a region, or even a nation. To Chaudhuri (2003) vulnerability can broadly be understood as an ex-ante measure of well-being, reflecting not so much how well-off a household currently is, but what its future prospects are. Chaudhuri, Jalan, and Suryahadi (2002) define vulnerability, within the framework of poverty eradication, as the ex-ante risk that a household will, if currently non-poor fall below the poverty line, or if currently poor will remain in poverty. Calvo and Dercon (2005) view vulnerability as the magnitude of the threat of future poverty measured ex-ante before the veil of uncertainty has been lifted. The 'magnitude of the threat' relate to two things; the likelihood of suffering poverty in the future, and the severity of poverty in such a case. Hoddinott & Quisumbing (2003) see vulnerability as the likelihood that at a given time in the future, an individual will have a level of welfare below some benchmark. They argue that the time horizon and welfare measure are general and that one could think of vulnerability pertaining to the likelihood of being poor next year, in ten years' time, or being poor in old age. Although vulnerability assessments typically express welfare in terms of consumption, the definition of vulnerability is sufficiently general so as to encompass many dimensions of well-being.

The main cause of vulnerability is the risk that people face due to their circumstances (World Bank, 2000). The authors observe that the deeper cause is the inability to reduce or mitigate risk or cope with shocks. This cause, both draws from and feeds into the causes of other dimensions of poverty. For example, low levels of physical, natural, and financial assets

make poor people especially vulnerable to negative shocks; since those with more assets can withstand these shocks as long as they are temporary. Lack of adequate assets can set up vicious downward spiral in which actions to cope in the short term worsen deprivation in the long term. Another underlying cause of vulnerability is the inability of the state or community to develop mechanisms to reduce or mitigate the risks that poor people face. Irrigation, infrastructure, public health interventions, honest police and a fair legal system, public work schemes in times of stress, microcredit to support people go through the aftermath of an adverse shock, social networks of support and insurance, famine relief in extreme circumstances – all reduce vulnerability for poor people. Another dimension added to our understanding on shocks is their indirect effect to increase risk aversion of households which can lead to the adoption of behaviours that trap them in a state of high poverty risk, thus contributing to the persistence of and vulnerability to poverty (Gloede, Menkhoff, & Waibel, 2013).

We adopt the World Bank's definition of a shock as an adverse event that can trigger generally a decline in well-being or more specifically loss of household income, reduction in consumption and or loss of productive assets which can affect individuals, a community, a region, or an entire nation (World Bank, 2000). Shocks may be classified by the level they occur (micro, meso and macro) and by the nature of the event (natural, economic, social, political, environmental and health). Micro shocks usually referred to as idiosyncratic affect specific individuals or households. Meso (common or covariate) shocks affect groups of households or an entire community or village; with macro affecting a nation. Despite the three categorizations of shocks by Holzmann and Jørgensen (2000), in recent times the level classification of shocks has been condensed into only two; idiosyncratic and covariate.

We are therefore interested in studying how shocks experienced by households can be used to classify households into vulnerability groups using a shock index and to study the coping strategies adopted by households in the respective vulnerable groups to be identified. The shock index will be derived from principal component analysis. The score from the first principal component (usually used as a measure of size) is used to classify households with respect to vulnerability to shocks such that positive values distinguishes more vulnerable households from less vulnerable ones.

1.2.2 Impact of Shocks and Coping Strategies of households

There are various risk management strategies which can be put in place to help mitigate, reduce and cope with risk when it eventually happens. These strategies can broadly be categorized into three; preventive, mitigation and coping strategies (Holzmann and Jorgensen, 2000). Preventive strategies are the strategies introduced before the occurrence of the risk. They reduce the probability of a negative risk, increase the income of the people and also reduce the variability in income; hence increasing welfare. Such strategies include sound macroeconomic, public health, environment, education and training policies. Mitigation strategies just like preventive strategies are usually put in place prior to the occurrence of the risk to reduce the potential impact of risks. Portfolio diversification (to reduce the variability of income by relying on a variety of assets from which returns are not perfectly correlated) and insurance (through risk pooling among people whose risk are not correlated) are some ways of risk mitigation.

After the risk has occurred, individuals or households will have to devise strategies to cope with and reduce the impact of shocks on consumption and the general level of welfare; given that economic agents have preference to smooth consumption over a life time. Dercon and Krishnan (2000) argue that the ability of households to protect their consumption by relying on friends and the extended family, through village level networks or government schemes, and thus to share the risk of volatile income with others is the cross-sectional counterpart to consumption smoothing. According to the authors, if risk is fully shared through market or nonmarket institutions, household consumption should not respond to idiosyncratic shocks in income. Households however may be unable to smooth consumption when shocks occur because of inadequate assets, possible fall in the price of the assets as everyone tries to sell at the same time; incomplete financial markets for credit and or insurance; insufficient private mechanisms such as gift exchange or remittances to mitigate the income shock; and inadequate public support mechanisms such as cash or food transfers or public work schemes (Hoddinott, 2006).

Consumption smoothing after the emergence of shocks have been found to be either existent or non-existent depending on the type of shock and the area of study. Dercon and Krishnan (2000) using an extended version of a standard intertemporal optimisation model of consumption under uncertainty, with rural Ethiopian household panel data, find that idiosyncratic shocks to livestock and covariate climatic and other crop shocks have significant effect on household consumption fluctuations. All significant coefficients on

negative (positive) shock variables were found to decrease (increase) consumption. Échevin and Tejerina (2013) however argue that for urban Squatter Sal Salvador households, shocks do not significantly affect consumption. Among 21 different shocks, only lack of access to production inputs was seen to have a significant negative effect on consumption. No other shock influenced either education expenditure or labour income. They assert that households therefore succeed in facing shocks at least in the short term, by using efficient coping strategies. They therefore reject the hypothesis that consumption is significantly affected for households who have experienced shocks.

Assets have been used as a major source of coping by households; with the extent and type of asset used being different. While Fafchamps, Udry and Czukas (1998) found limited evidence that livestock inventories serve as buffer stock against large variations in crop income in Burkina Faso, Hoddinott (2006) found that in Zimbabwe for a relatively moderate drought, some households reduced their livestock holdings, with the proportion drawing down on livestock decreasing with the number of livestock held. However, Kazianga and Udry (2006) building on the earlier Burkina Faso study consider the extent to which livestock, grain storage and inter-household transfers are used to smooth consumption. They observe that households rely almost exclusively on self-insurance, specifically adjustments to grain stocks, to smooth consumption. Changes in assets therefore serve as a buffer stock, absorbing transitory changes in income.

Though households may be utilizing assets to cope with shocks, they sometimes smooth assets than consumption depending on their asset holdings. The rationale behind this behaviour is that assets held at the household level often perform several functions, as a store of wealth and a means by which income is generated, hence households selling assets in response to shocks today risks permanently lowering future consumption (Hoddinott, 2006; Barret et al., 2006; Zimmerman & Carter, 2003). Thus, when assets fall below a certain level, they no longer serve as a buffer stock and consumption begins to follow current income (Deaton, 1991). In line with this, wealthier agents will pursue conventional consumption-smoothing strategy with poorer agents going for asset smoothing (Zimmerman and Carter, 2003). Carter and Lybbert (2012) using threshold estimation techniques found that households above a certain critical asset level completely insulate their consumption from weather shocks, whereas those below the threshold do not.

The absence of efficient market-based or government provided consumption-smoothing instruments often results in the use of costly informal coping mechanisms once the adverse income shock hits, such as pulling children out of school, reducing nutritional intake, or

neglecting human capital accumulation. When this is coupled with risk aversion, households will engage in low-risk and low-yield activities (Holzmann & Jørgensen, 2000) which will in turn make them more vulnerable. A study on Kenya and Madagascar revealed that considerable exposure to risk of asset loss; due to human or livestock disease, theft or natural disasters, makes households reluctant to undertake activities that might further increase those risks (Barrett, et al., 2006). Barrett et al., demonstrate that the data from rural Kenya and Madagascar offer consistent support for the poverty trap hypothesis, with structural income and asset dynamics exhibiting multiple stable dynamic equilibria. With poverty traps at work, households who lose assets following shocks to levels below the trap threshold will be trapped in poverty if they lack access to the necessary credit to obtain additional assets. Apart from shocks affecting consumption and assets, they also affect other areas of human life such as health. Household members in Laos, experiencing a health shock did not recover their former subjective health following the shock; losing on average 0.6 points on a 5-point scale (Wagstaff & Lindelow, 2010). Health shocks causing permanent injury, illness or death were frequently cited as being responsible for households falling into poverty (Mango, Cheng'ole, Kariuki, & Ongadi, 2004).

Other findings also point out that the coping strategy adopted may depend on the nature of shocks that households experience. In Ethiopia two relatively covariate shocks, economic and natural shocks, are more likely to trigger reductions in savings and in food consumption. On the contrary relatively idiosyncratic health shocks are met by reductions in savings, asset sales and reliance on borrowing. Reductions in food consumption was notably absent in the case of health shocks. This insensitivity the authors explain should not be viewed as insurability of food consumption against health shocks but rather as an indication that a reduction in food consumption is not a viable coping response to a health shock as it does not provide cash to meet health care needs (Debebe, et al., 2013). In rural Kenya the possession of livestock, sheep and or goats, help reduce the effect of idiosyncratic shocks but appears ineffective in protecting consumption against covariate shocks (Christiaensen & Subbarao, 2005).

Access to financial services also has an impact on the type of coping strategy used. In Indonesia households respond to changes in adult health depending on their access to financial services. In response to adult health shocks, households with access to formal credit increases borrowing from banks, while those with access to only formal savings draw down on savings hence protecting productive assets. Those without access to formal banking services end up liquidating productive assets (DeLoach & Smith-Lin, 2017). In Bangladesh,

Islam and Maitra (2012) examine the role of microcredit in insuring against idiosyncratic and unanticipated health shocks. Though the primary instrument households use to cope with health shocks is the trading of livestock, households that have access to microcredit do not need to sell livestock or do not have sell as much as those that do not have access to microcredit, to insure consumption against health shocks.

Considering the relative importance of idiosyncratic and covariate shocks in contributing to household vulnerability, the results is mixed. Works such as Ligon & Schechter (2003); Harrower & Hoddinott (2005) found covariate shocks to have a greater relative impact on households than idiosyncratic shocks. Harttgen and Gunther (2009) clearly highlight the problematic nature of earlier approaches noting that though it may be difficult to evaluate the exact impact of the estimation problems, it is likely that the problems rather overestimate the impact of covariate shocks on households' consumption. Being conscious of the issues identified in earlier works, Harttgen and Gunther use multilevel modelling to determine the impact of idiosyncratic and covariate shocks on households' vulnerability. They find that idiosyncratic shocks have higher impact on vulnerability than covariate shocks. Using a more disaggregate data from a cross-sectional retrospective module on shocks in Pakistan, Heltberg and Lund (2009) identified that though many shocks result in severe hardship, idiosyncratic shocks, specifically health shocks have the greatest impact on household's vulnerability. Health shocks, in particular, lead to the most adverse consequences for children, resulting in school dropout and child labour. The recovery rate from idiosyncratic shocks is also lower than for covariate shocks, reflecting greater severity.

1.3 Methodology

Determining the extent to which shocks affect households' vulnerability to poverty can be thought of as easily estimated by considering the monetary value of lost output or income resulting from shocks affecting households. The implication will be that shocks resulting in higher loss of income or possibly consumption have a higher impact on vulnerability to poverty. Often however, income losses emerging from shocks are not readily available in datasets used for vulnerability analysis and even if available, may not have been accurately estimated. A clear reason for the latter problem is that there may be estimation errors which are likely to be encountered since the units of output lost are not traded on the market and may just be approximate values. However, it may be easy for a farmer to remember shocks

that affected him. With farming households reporting about 10 agriculture related shocks, we explore the possibility of aggregating these shocks by assigning weights to them using principal component analysis. Shocks have been found to have high correlation among themselves. Dercon and Krishnan (2000) in explaining why some of the shock variables they included in their regression model were not significant alluded to the high multicollinearity between some of the shocks. We use the possible correlation between the shock variables to build our index. This helps us to determine the relative information value of shocks on households' vulnerability and then to classify households into vulnerable groups. Subsequently we link these groups with their socio-economic status (proxied by the asset index). This helps to group vulnerable households into asset categories, ranging from asset poor to asset rich. We finally estimate a probit model to determine the differential impact of shocks on the use of various coping strategies for all the households and then for the moderate and high vulnerable groups.

1.3.1 Polychoric Principal Component Analysis

Principal component analysis (PCA) was first introduced by Pearson (1901) with Hotelling (1933) independently developing it (Jolliffe, 2002). The basic idea of PCA is to describe the variation of a set of multivariate data in terms of a set of uncorrelated variables, each of which is a particular linear combination of the original variables with maximum variance. The new variables are derived in decreasing order of importance. The first principal component for example, accounts for the highest variation in the original data; thus, the dimension along which the observations are maximally spread out. The second and subsequent components are chosen to account for as much as possible in the remaining variation subject to being uncorrelated with the previous components. The components derived may be used as an end in themselves, since they are amenable to interpretation, or more often for use as input to another analysis (Rencher, 2002).

PCA has been used in the development literature to aggregate asset ownership as an indicator of the wealth status of households. Filmer and Pritchett (2001) use twenty-one types of assets from the Demographic and Health Surveys, to create a single 'wealth' variable. Sahn and Stifel (2003) conducts robustness test on asset indices and found that the asset index reliably predicts poverty and serves as a proxy for long-term wealth with less error than data on expenditures. With respect to explaining the coefficients from the PCA on assets, if

ownership of one type of asset is highly indicative of ownership of other assets, then it receives a positive coefficient. When ownership of an asset contains almost no information about what other assets the household owns, then it receives a coefficient near zero. Higher and lower coefficients mean that ownership of that asset conveys more or less information about the other assets (Moser & Felton, 2007). In situations where the actual shock occurred, holder households may not be able to accurately determine the value of income lost due to the shock, for an extent of their vulnerability to be estimated. In situations where households report the shocks they experience but do not indicate the value of lost output or income resulting from shocks, we use PCA in this study to classify households into vulnerable groups.

PCA was initially developed for multivariate normal data or for data for which normality is a reasonable distributional approximation (Kolenikov & Angeles, 2009). Standard PCA is in principle applicable if all the variables are quantitative and continuous and the relationship between the variables is assumed to be linear. When variables are discrete, the normality assumption is violated, making standard PCA no longer appropriate. Thus, using directly the observed discrete data in standard PCA may be problematic since distributional assumptions of standard PCA are violated. Given that the variables of interest are discrete in nature, Polychoric Principal Component Analysis (PPCA) may be preferred to regular PCA because its coefficients are more accurately estimated. Kolenikov and Angeles (2009) run a Monte Carlo experiment on simulated data and find that PPCA predicts the 'true' coefficients more accurately than regular PCA. PPCA also allows for computation of the coefficients of the categories of respective variables. For example, an individual household may either experience a specific shock or not. PPCA will make it possible to estimate the coefficients of both experiencing and not experiencing a given shock.

The PPCA model is specified following Kolenikov and Angeles (2009). Suppose we have a set of p related variables, representing a given household experiencing p shocks, which can be characterized as a p dimensional random vector $x_1, x_2, \dots, x_p$. These variables can be linearly transformed into one dimensional variable, $y_i = \alpha_{i1}x_1 + \alpha_{i2}x_2 + \cdots + \alpha_{ip}x_p$ with $\alpha_{i1}, \alpha_{i2}, \dots, \alpha_{ip}$ being the weights. The first principal component of the observations is the linear combination (1.1) whose sample variance (1.2) is greatest among all such linear combinations. The variance of y_1 could be increased without limit by simply increasing the coefficients $\alpha_{11}, \alpha_{12}, \dots, \alpha_{1p}$. This implies that leaving it without any restriction will not yield a maximum for finite α_1. A normalization constraint, $\alpha_1'\alpha_1 = 1$ is imposed.

1.1 $y_1 = \alpha_{11}x_1 + \alpha_{12}x_2 + \cdots + \alpha_{1p}x_p = \alpha_1{}'x$

1.2 $var(y_1) = var(\alpha_1'x) = \alpha_1'\Sigma\alpha_1$

To find the coefficients defining the first principal component we choose the elements of the vector α_1' so as to maximize the variance of y_1 subject to the constraint $\alpha_1'\alpha_1 = 1$**.** We maximize $\alpha_1'\Sigma\alpha_1$ subject to $\alpha_1'\alpha = 1$ using the technique of Lagrange multipliers and maximize:

1.3 $\alpha_1'\Sigma\alpha_1 - \lambda(\alpha_1'\alpha_1 - 1)$

Where, λ is a Lagrange multiplier. Differentiating (1.3) with respect to α_1 yields (1.4),

1.4 $\Sigma\alpha_1 - \lambda\alpha_1 = 0,$

We can rewrite (4) as (5):

1.5 $(\Sigma - \lambda I_P)\alpha_1 = 0$

where I_P is a (p x p) identity matrix.

It therefore follows that λ is the eigenvalue of Σ and α_1 is the eigenvector of Σ. To determine which of the p eigenvectors is the maximizing value of α_1, we note the quantity to be maximized as (1.6):

1.6 $\alpha_1'\Sigma\alpha_1 = \alpha_1'\lambda\alpha_1 = \lambda\alpha_1'\alpha_1 = \lambda$

λ must as such be as large as possible. It follows that $\alpha_1$is the eigenvector corresponding to the largest eigenvalue of Σ, and $var(\alpha_1'x) = \alpha_1'\Sigma\alpha_1 = \lambda_1$, the largest eigenvalue. The other components are derived in a similar fashion, with α_k being the eigenvector of Σ associated with the *k*th largest eigenvalue. The eigenvalues of Σ are $\lambda_1, \lambda_2, \ldots, \lambda_p$, since $\alpha_k'\alpha_k = 1$, the variance of the *k*th principal component is given by λ_k. The proportion of the total variance explained by the *k*th principal component is given as:

$$\frac{\lambda_k}{\sum_{i=1}^{p}\lambda_i}$$

Where: $\sum_{i=1}^{p}\lambda_i$ is the total variance.

Everitt and Dunn (2001) argue that though the derivation of the principal components is given in terms of eigenvalues and eigenvectors of the covariance matrix, Σ, in practice it is usual to extract the components from the correlation matrix. This is because components from the correlation matrix are scale invariant than components from the Covariance matrix. Jolliffe (2002) maintains that a major drawback of PCA based on covariance matrices is the sensitivity of the components to the units of measurement used for each element of the variables of interest. When, for example, there are large differences between the variances of the elements of variables, the variables whose variances are largest will

tend to dominate the first few principal components. Thus, since correlations are scale invariant, results of analyses for different sets of random variables are more directly comparable than for analyses based on covariance matrices.

In our estimation therefore, we use the correlation matrix to extract the principal components for the shock variables. Following Kolenikov and Angeles (2009), since the shock variables used in the model are binary; the matrix from which the principal components are estimated is the tetrachoric correlation matrix and not the Pearson correlation matrix. Tetrachoric correlations are correlations between binary variables and the latent continuous variables underlying each of the variables. The coefficients are interpreted just as the Pearson correlation coefficients. The eigenproblem of the tetrachoric correlation matrix is obtained using the maximum likelihood procedure to obtain the Principal components. A high (lower) coefficient for a given shock is explained to mean that experiencing that shock conveys more (less) information about other shocks the household experiences. If the experience of a given shock has almost no information on other shocks households experience, it will have a near zero coefficient (indicating almost zero correlation with other shocks). The first principal component score of households is used as a measure of household's vulnerability to shocks. A positive value implies that those shocks increases vulnerability with a negative meaning reduction in vulnerability.

1.3.2 Probit model

Probit regression is used to investigate the impact of shocks on the use of different coping strategies. A given household may choose a specific coping strategy depending on the type of shock it experiences. In this analysis, it will be of interest to find out, given a particular shock, if a household is more likely to draw down on savings, work more, sell assets, get aid from government and other NGO's or they will lower food, health and education expenditure. The strategies households adopt when affected by shocks may have immediate or future implications on households. Responses such as taking additional jobs or increasing the number of hours one works, for example, can help to generate additional income to support the household. Support from the friends and or relatives, government, NGOs, may also help to ensure that households can at least maintain their initial level of welfare before the shock(s). Such coping strategies will not have dire consequences for households. However, sale of assets is likely to reduce the income earning abilities of households if before the

shock, households did not have adequate assets. Reducing educational expenditure by pulling children out of school can transmit poverty across generations. Thus, knowing the coping strategies households adopt when faced with shocks is essential for policies that aim at addressing poverty and vulnerability related issues.

The model we estimate is:

2.1 $$K_h = \sum_{i=1}^{I} \alpha_i S(i)_h + \sum_{l=1}^{L} \delta_l D_l + \gamma X + \varepsilon_h$$

In the above specification:

K_h is a risk coping strategy of household h; a dummy variable indicating whether a given coping strategy was used or not

D represents regional dummy variables

$S(i)_h$ is a set of observed shocks affecting agricultural holder households

X is a vector of household characteristics

Since K_h is a dummy variable, following Maddala (1992), the model will have the form:

2.2 $$P_h \equiv \Pr(k_h = 1) = Prob\left[\varepsilon_h > -\left(\sum_{i=1}^{I} \alpha_i S(i)_h + \sum_{l=1}^{L} \delta_l D_l + \gamma X\right)\right]$$

2.3 $$= 1 - F\left[-\left(\sum_{i=1}^{I} \alpha_i S(i)_h + \sum_{l=1}^{L} \delta_l D_l + \gamma X\right)\right]$$

with F being the cumulative distribution of the error term, ε

If the distribution of the error term is symmetric, then:

2.4 $$P_h = F\left[\left(\sum_{i=1}^{I} \alpha_i S(i)_h + \sum_{l=1}^{L} \delta_l D_l + \gamma X\right)\right]$$

The functional form taken by (2.4) will be dependent on the assumption made on the error term. We assume that the error term is normally distributed. When the error term is assumed to be normally distributed, a probit model is estimated. The maximum likelihood method is thus used to estimate the probit model.

1.3.3 Data

The data used for the analysis is the Ghana Africa Research in Sustainable Intensification for the Next Generation (Africa RISING) Baseline Evaluation Survey (GARBES) conducted in 2014. The survey covered maize, rice and vegetable-based farmers in three northern Ghana regions: Upper-East, Northern and Upper-West regions. The survey used multistage stratified sampling covering 10 districts from the three regions. From these districts, potential communities were chosen based on a geographic framework. At the first stage of the sampling, communities were stratified according to the development domains at the district level and 50 communities were selected. The second stage randomly selected households within each community. In particular, a constant number of 20 control households were randomly selected in 25 of the communities (control) for a total of 500 control households. With regard to the 25 intervention communities, the sampling strategy was to randomly select a constant number of 8 households not directly benefiting from any Africa Rising intervention and a constant number of 6 households interested in joining the program in 2014. Though the data was collected in 2014, the reference period for the shock module was for the last 5 years. The total number of holder households included in this study is 1282 who answered questions on the shock module, out of a total of 1284. The survey defines a farming household as a household that engages with agriculture either through livestock and/or crops production, irrespective of land ownership (i.e. whether the household owns the land or not). In addition, a household refers to one or more people, who share meals and have lived under the same dwelling for at least three months preceding the interview date.

There are 10 agriculture related shocks reported by farmer households. These are drought or flood, strong winds/storms, crop disease/pest, death or theft of livestock, large fall in sale prices of crops, large rise in price of food, large rise in agricultural input prices, severe water shortage, loss of land and immediate need for money and selling crops at lowest prices. The risk coping strategies households adopt are; relying on own-savings, unconditional help (from relatives/friends, government and NGOs/religious institutions), changing eating patterns, employed members working more, adult household members searched for jobs, migration, reduced expenditures on health and or education, obtaining credit, selling items (agricultural assets, durable assets, land/building, crop stock, sold livestock), intensifying fishing, sending children to live elsewhere, engaging in spiritual efforts (prayer, sacrifices, diviner consultations), smoking and drinking, begging, adopting other strategies or doing nothing.

1.4 Results

1.4.1 Summary Statistics

The sample size for the analysis is 1282 agricultural holder households made up of 47.9 percent from the northern region, 17.3 percent from the Upper East region and 34.8 percent from the Upper West region (Table 1.1). The total number of people in each household ranges from 1 to 40 with an average of approximately 9 people per household. We use the characteristics of the household head in this work to describe other characteristics of the household. The largest group of household heads based on their marital status is the monogamous type of marriage representing 61.3 percent and it is followed by polygamous heads taking 28 percent. Separated or divorced households have the lowest percentage of 2 percent while widow/widower headed households are 5.3 percent with single household heads being 3.4 percent. Majority of the households are headed by males making up 84.2 percent. The level of education among agricultural holder households in the three northern regions of Ghana is very low. Approximately 75 percent of household heads have no formal education. Tertiary education is 1.6 percent with primary and secondary education taking 9.9 and 13.7 percent respectively.

Agricultural holder households reported a total of 10 agriculture-related shocks with an average of approximately 2 shocks per household (Table 1.2). These shocks ranges from affecting between 2 to 62 percent of farming households. The most widely reported incidence of shock is drought or flood; it affects 62 percent of households (Table 1.2). It also has the highest degree of variability among all the shocks. Theft and or death of livestock and strong winds or storms were the second and third most common shocks with incidence rates of 30 and 29 percent respectively. The most idiosyncratic of the shocks reported is loss of land followed by large fall in sale prices of crops. Jointly these two shocks affect approximately 4 percent of the total number of households. There were 23.6 percent of households that did not experience any of these shocks.

Table 1.1: Descriptive statistics of Household Demographics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Region: Northern	1,282	0.479	0.500	0	1
Upper East	1,282	0.173	0.379	0	1
Upper West	1,282	0.348	0.476	0	1
Number of shocks	1,282	1.867	1.744	0	10
Marital Status: Monogamous	1,279	0.613	0.487	0	1
Polygamous	1,279	0.280	0.449	0	1
Separated/Divorced	1,279	0.020	0.138	0	1
Single	1,279	0.034	0.182	0	1
Widow(er)	1,279	0.053	0.224	0	1
Gender	1,282	0.842	0.364	0	1
Age	1,282	47.803	14.460	18	91
Household size	1,282	8.518	5.047	1	40
Years of education	1,282	2.108	4.298	0	19
Level of Education: None	1,282	0.748	0.434	0	1
Primary	1,282	0.099	0.299	0	1
Secondary	1,282	0.137	0.343	0	1
Tertiary	1,282	0.016	0.127	0	1

Authors compilation with data from GARBES, 2014

Table 1.2: Descriptive Statistics for Agriculture Related Shocks

Shock	Number	Mean	Std. Dev
Drought or floods	1,282	0.620	0.486
Strong winds/storms	1,282	0.285	0.451
Crop disease or pests	1,282	0.186	0.390
Livestock died or stolen	1,282	0.300	0.458
Large fall in sale prices for crops	1,282	0.021	0.144
Large rise in price of food	1,282	0.129	0.335
Large rise in agricultural input prices	1,282	0.157	0.364
Severe water shortage	1,282	0.057	0.232
Loss of land	1,282	0.019	0.136
Immediate need for money	1,282	0.094	0.292
No Shock	1,282	0.236	0.425

Source: Authors compilation with data from GARBES, 2014

1.4.2 Vulnerability to Shocks

Since households may be affected by a series of these shocks, we develop a shock index to be used as an indicator of households' vulnerability to agricultural related shocks. The first component from the polychoric principal components is then used to classify households.

From the estimation, all tetrachoric correlation coefficients for the 10 shocks were positive[1]. We report the weights from the first principal component in Table 1.3. Since the shock variables used in the PCA take a value of one when the household experiences a given shock and zero otherwise, polychoric PCA is able to report the weights for experiencing and not experiencing a shock. We note from the results that for all instances where a shock is experienced, the weight is positive and negative when it is not experienced. Using this as an indicator of vulnerability to shocks, it means that when a shock is experienced, it increases a household's vulnerability, but a household becomes less vulnerable if it does not experience shocks.

Taking the magnitude of the coefficients into account, shocks with higher scoring coefficients are more informative than those with lower scoring coefficients since they help to distinguish households from each other, than lower scoring shocks which tend to be more common among households. The weights also indicate the variables that explain more the variability in the first component. Seven of these shocks; large fall in sale prices of crops, severe water shortage, immediate need of money and selling crops at lowest prices, loss of land, large rise in agricultural input prices, large rise in price of food and crop disease or pests, largely explain the first component, with weights above 0.5. Knowing that a household experiences such high scoring shocks relative to low scoring shocks is indicative of them experiencing several other shocks and hence being more vulnerable than those that experience only lower scoring shocks[2]. The low scoring variables tend to have relatively high weights when they do not occur compared to the high scoring shocks. Thus, when they do not occur, they tend to reduce the vulnerability of households.

The first principal component[3], which combines the score of households for the various shocks, is used as the shock index for households. A Kernel density distribution of the shock index is presented in Figure 1.1. It can be observed that households' vulnerability to shocks is skewed to the right. The right skewness implies that there are households that experience series of shocks making them more vulnerable. Households that are to the extreme left of the distribution, made up of 23.6 percent, are those who experienced none of the ten shocks in the past five years and these are in the first quintile. If we assume that experiencing at least

[1] Correlation coefficients and associated p-values for the shock variables are provided in Appendix Table 1A.
[2] The argument is not that high scoring shocks on their own makes households more vulnerable but that because they are more likely to be experienced with other shocks, such households are more vulnerable.

[3] The first component explains approximately 46.2 percent of the overall variation.

one shock makes a household vulnerable, then the vulnerability rate among households for the five-year period is 76.4percent. However, among those experiencing these shocks, approximately 3.7 percent (2.7 percent of all households), indicated that none of the shocks they experienced affected either income or assets[4]. The net effect is that shocks affected the income or assets of 73.7 percent of the households under study.

Table 1.3: Agriculture Related Shock Score

Shock	Yes	No
Drought or floods	0.165	-0.270
Strong winds/storms	0.302	-0.120
Crop disease or pests	0.513	-0.118
Livestock died or stolen	0.273	-0.117
Large fall in sale prices for crops	0.730	-0.016
Large rise in price of food	0.573	-0.085
Large rise in agricultural input prices	0.604	-0.113
Severe water shortage	0.660	-0.040
Loss of land	0.612	-0.012
Immediate need for money	0.654	-0.068

Source: Authors computation with data from GARBES, 2014

A categorization of the households into three groups based on quintiles of vulnerability to shock is presented on Table 1.4. The second and third quintiles (middle 40 percent) has 40.73 percent of the total number of households with the fourth and fifth quantiles (top 40 percent) representing 35.89 percent. Regional classification points to the Upper West region having the lowest rate with respect to households at the top of the vulnerability scale; this region is less vulnerable to shocks compared to the two other regions. It has a combined rate of 5.17 percent for the top 40 percent and 49.89 percent at the bottom 20 percent. This may be good for the households since at the top, shocks affect the livelihood of relatively few households. However, if we use the experience of even a single shock as an indicator of vulnerability, it implies that about 50 percent of the households are vulnerable. Given that already the incidence of poverty in this region is 70.7 percent as reported in the Ghana Living Standards Survey round 6 report, this implies that if households do not have effective mechanisms to cope with the shocks that emerge, efforts to reduce poverty will not be able to achieve much. Between 2005/6 and 2012/2013, the incidence of poverty reduced from 89.1 percent to 70.1percent (GSS, 2014). This is an average reduction of 1.5 percent per year for

[4] The proportion of households indicating that a given shock caused a reduction in either income or assets per shock is presented on Appendix Table 2A

the 7-year period. Since most of the households are already below the poverty line even if they do not experience shocks, more effort is needed to lift them out of poverty.

The Northern and Upper East regions have over 49 percent of households at the fourth and fifth quintiles on the vulnerability scale. The Northern region has 53.1 percent of households at the top 40 percent, implying that it has the highest vulnerability rate among the three regions. It has 90.5 percent of the households in the second to the last quintile with only 8.2 percent experiencing none of the shocks. This may be an indication that poverty reduction among the three regions can be difficult. Between 2005/6 and 2012/2013 poverty incidence reduced from 55.7 percent to 50.4 percent for the northern region. This is the lowest reduction rate in 7 years among the three northern regions of Ghana. The Upper East region's vulnerability rate at the fourth and fifth quintiles is marginally lower than that of the Northern region. It has a rate of 49.6 percent. The region however experienced the highest reduction in the incidence of poverty for the period, 2005/6 – 2012/13, from 79.2 percent to 44.4percent, representing an annual reduction of approximately 5 percent (GSS, 2014). Though this was an impressive reduction the region's poverty rate is still high; twice the national average.

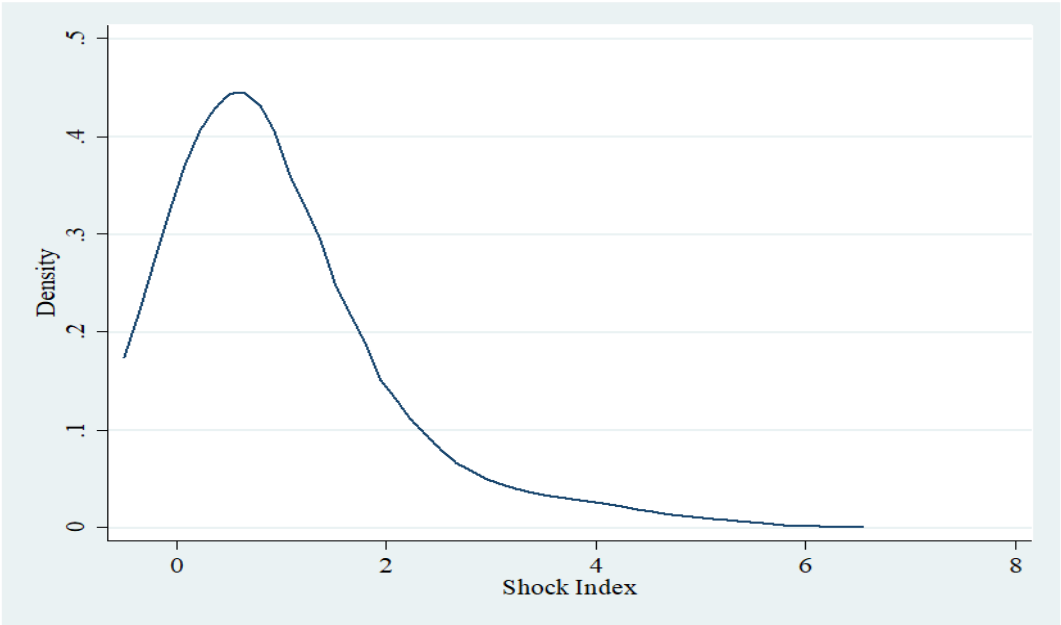

Figure 1.1: Kernel Density estimate[5] for Household Aggregate Shock Score

[5] The bandwidth for the Kernel Density estimate is 0.5

In the lowest quintile the average household size is approximately 8 but the size in the other quintiles is 9. This suggests that vulnerability to shocks marginally increases with the size of the household. The pattern seems not to be different with respect to age since the mean age for the lowest quintile is 47 years but that for the remaining quintiles is 48 years. Considering the marital status of household heads, the top two quintiles point to single household heads being less vulnerable compared to all the other groups with polygamous heads being the highest vulnerable group experiencing a series of agricultural related shocks, followed by divorced/separated heads and widow or widower headed households.

Broadly, vulnerability tends to reduce with the level of education with the only exception being those with primary education experiencing a slightly higher rate of 39.37 percent compared to the next highest of 35.56 percent for those with no education, with those having tertiary education being 33.33 percent. Taking account of gender shows that female headed households are less vulnerable than male headed households. There is a margin of 10 percent between the two groups in the first quintile. This pattern is similar to general poverty trends in Ghana; among household heads, poverty incidence for female headed households is 19.1 percent but 25.9 percent for male headed households in 2012/2013 (GSS, 2014).

To determine the wealth status of households to be associated with the three vulnerability classes, we use an asset index derived in similar manner to the shock index from various asset indicators[6]. Based on the asset index, we classify households into quintiles after which we recode into three groups[7]: bottom 40 percent, middle 40 percent and top 20 percent. Subsequently, we associate the three asset groups into the earlier vulnerability groups. For the asset poor households (bottom 40 percent), 42.36 percent are among the highest vulnerable group, while 34.38 percent of middle-income households are highly vulnerable. However, the rate for the asset rich (top 20 percent) households who are highly vulnerable is approximately 9 percent lower than the middle 40 percent of households. Among the less vulnerable and the moderate vulnerable groups however the proportion increases with the asset group. These findings suggest that vulnerability is not only limited to the poor; though there is an association between wealth status and vulnerability to shocks[8].

[6] We used 11 combinations of assets: number of rooms, number of windows, type of floor material, type of toilet, source of light, number of radios, number of television set, number of fans, number of mobile phones, number of motor cycles and number of CD player. The numbers in parenthesis are the number of households.
[7] This classification is similar to Filmer and Pritchett (2001) classification based on asset index.
[8] A Chi-square test of independence between the categories of vulnerability and wealth status is also significant at the 1 percent level. The result is provided in appendix Table 3A

Table 1.4: Classification of Households based on Shock Index

	Bottom 20 percent	Middle 40 percent	Top 40 percent
Percentage of households	23.56	40.64	35.80
Number of Shocks (Average)	0	1	4
Region:			
Northern	8.47	38.44	53.09
Upper East	12.16	38.29	49.55
Upper West	50	44.84	5.16
Household Size (Average)	8	9	9
Age in years	47	48	48
Marital Status			
Monogamy	25.13	39.8	35.08
Polygamy	20.39	41.06	38.55
Divorced/Separated	32.00	32.00	36.00
Single	20.45	47.73	31.82
Widow(er)	19.12	47.06	33.82
Education			
None	23.36	41.08	35.56
Primary	22.83	37.8	39.37
Secondary	24.57	40.57	34.86
Tertiary	28.57	38.1	33.33
Gender			
Male	21.94	41.94	36.11
Female	32.18	33.66	34.16
Asset Classes			
Bottom 40 percent (517)	21.47	36.17	42.36
Middle 40 percent (509)	22.59	43.03	34.38
Top 20 percent (256)	29.69	44.92	25.39

Source: Authors computations with data from GARBES, 2014

1.4.3 Coping Strategies

Having examined the extent to which households are vulnerable to shocks, we explore the coping strategies households use when affected by shocks. Households were to list up to three among twenty-two coping strategies they used for the most recent shocks they experienced in the past five years. These strategies are; using savings, support from others (relatives, government and NGOs/religious institutions), changing eating patterns (by relying on less preferred food, reducing the number or proportion of meals per day or skipping food for some days), employed members working more or unemployed adults looking for jobs, migration, reducing health and education expenditure, obtaining credit, selling of items (agricultural assets, durable assets, land or building, crop stock, livestock). Additional strategies are intensifying fishing, sending children to live elsewhere, spiritual efforts (prayers, sacrifices, diviner consultations), smoking, begging doing nothing or using other strategies.

The two most widely used strategies, relying on household savings and doing nothing, were used by more than 50 percent of the households when affected by shocks (Table 1.5). The strategies; sale of livestock, support from relatives, engaging in spiritual efforts, selling crop stock and other were used by between 13 to 26 percent of the households. Strategies used by 1 to 6 percent of households are job search by adult household members, changing eating patterns, selling agricultural assets, support from government, obtaining credit, support from NGOs or religious institutions, selling durable assets, migrating and fishing more. All the remaining 6 strategies were used by less than 1 percent of the households. To understand the strategies that are significantly triggered by shocks, we estimate probit regressions for the various coping strategies on shocks, household characteristics and regional dummies. We do this for all households experiencing shocks, for moderately vulnerable households and finally for highly vulnerable households.

Table 1.5: Descriptive statistics for coping strategies

Variable	Number	Mean	Std. Dev	Min	Max
Own Savings	980	0.631	0.483	0	1
Support from relatives	980	0.200	0.400	0	1
Support from government	980	0.035	0.183	0	1
Support from NGOs/religious institutions	980	0.028	0.164	0	1
Changed eating patterns	980	0.052	0.222	0	1
Additional employment	980	0.004	0.064	0	1
Job search	980	0.054	0.226	0	1
Migrated	980	0.012	0.110	0	1
Reduced health/education expenditure	980	0.006	0.078	0	1
Obtained credit	980	0.033	0.178	0	1
Sold Agric. Assets	980	0.044	0.205	0	1
Sold durable assets	980	0.024	0.155	0	1
Sold land/building	980	0.006	0.078	0	1
Sold crop stock	980	0.177	0.381	0	1
Sold livestock	980	0.252	0.434	0	1
Fish more	980	0.010	0.101	0	1
Sent child elsewhere	980	0.008	0.090	0	1
Religious activity	980	0.188	0.391	0	1
Smoking	980	0.002	0.045	0	1
Begging	980	0.009	0.095	0	1
Did nothing	980	0.580	0.494	0	1
Other	980	0.133	0.339	0	1

Authors compilation with data from GARBES, 2014

For all households, drought or flooding triggers the use of a series of strategies (Table 6[9]). The use of several strategies by households in response to drought or flood is not surprising since a higher proportion of those experiencing it rank it as the first, among the top three

[9] The full results with other controls is in Appendix Table 4A

severe shocks they experienced (Table 7). Drought when occurs, is expected to affect farming households since most of the farmers rely on rains for their agricultural activities. Overall for all farming households, only 3 percent reported to irrigate their land (IFPRI, 2015). Significant among the strategies used are drawing down on savings, receiving support from relatives, obtaining credit, selling items (agricultural assets, crop stock and livestock), engaging in spiritual efforts, using other strategies or doing nothing. Comparing farming households that experience drought or flooding to those who do not, those experiencing it are about 34percent more likely to rely on their own savings.

The emergence of strong wind or storm makes households more likely to draw down on savings, receive assistance from relatives and the government and or sell crop stock. Households seem not to have any better coping mechanism for crop disease or pest. Compared to households that do not experience this shock, those experiencing it are less likely to use the available coping strategies or they are more likely to do nothing in response to crop disease or pest. A possible explanation for the lack of any proper coping for crop disease or pest may be that because control of pest or disease require physical outlay of cash to get chemicals, with these households being less likely to use savings, it implies that either they have used the available savings for other shocks, or that they may not have enough savings to cope with this shock. Added to this they are less likely to use credit because they may not have the needed collateral to secure credit or available credit may have high interest such that the return may not justify the use of such costly credit. This may justify why households are rather more likely to do nothing when faced with crop disease or pest.

When livestock theft or death sets in, households will significantly do nothing or will begin to sell part of the remaining stock. This strategy may be adopted because if livestock are being stolen or dying, one is better off selling them and saving the revenue generated for something else. Possibly however, if this shock is not as a result of any contagious disease or frequent theft then households may not respond and hence decided to do nothing than a panic sale which may not generate enough return. Changing eating patterns and selling crop stock are used to respond to large increases in food prices. Those who engage in changing eating patterns may be the farming households who do not have enough stock to rely on or to sell to purchase preferred food while those who resort to selling their crop stock may be doing so to get additional revenue to purchase their preferred foodstuff.

Table 1. 6: Coping Strategies for shocks[10]

	Savings	Relatives	Govt	Food	Credit	Agric assets	Durable assets	Crop stock	Livestock	Religion	Did nothing	Other
Drought/Flood	0.344***	0.046**	-0.011	0.022	0.028**	0.050**	0.005	0.119***	0.192***	0.170***	0.316***	0.081***
	(0.024)	(0.023)	(0.009)	(0.014)	(0.013)	(0.019)	(0.009)	(0.024)	(0.027)	(0.027)	(0.024)	(0.020)
Strong wind/storm	0.190***	0.101***	0.038***	-0.005	0.002	0.003	-0.032**	0.049**	0.019	0.028	0.048	0.010
	(0.030)	(0.022)	(0.010)	(0.013)	(0.011)	(0.013)	(0.014)	(0.020)	(0.026)	(0.021)	(0.030)	(0.019)
Crop disease/pest	-0.147***	0.020	-0.040**	-0.027	-0.026	-0.026*	0.014	-0.037	0.018	-0.049**	0.193***	0.013
	(0.037)	(0.026)	(0.016)	(0.018)	(0.018)	(0.015)	(0.009)	(0.025)	(0.030)	(0.022)	(0.034)	(0.022)
Death/theft of livestock	0.052*	-0.026	0.013	0.014	-0.008	-0.001	0.012	-0.045**	0.116***	0.021	0.242***	0.046***
	(0.029)	(0.022)	(0.011)	(0.012)	(0.010)	(0.013)	(0.008)	(0.019)	(0.022)	(0.019)	(0.025)	(0.018)
Large fall: Sale price of crops	-0.071	-0.042				0.024		-0.009	-0.105	-0.006	-0.126	-0.010
	(0.093)	(0.065)				(0.030)		(0.054)	(0.080)	(0.048)	(0.098)	(0.057)
Large rise in food prices	0.058	0.044	-0.022	0.065***	-0.004	-0.084***	-0.018	0.066***	-0.009	0.028	-0.028	0.117***
	(0.045)	(0.028)	(0.015)	(0.015)	(0.017)	(0.027)	(0.014)	(0.025)	(0.035)	(0.026)	(0.044)	(0.025)
Large rise: Input prices	-0.059	-0.091***	-0.013	-0.047**	0.014	0.024	-0.005	0.050**	-0.044	0.050**	0.165***	-0.123***
	(0.042)	(0.033)	(0.016)	(0.021)	(0.013)	(0.017)	(0.012)	(0.025)	(0.034)	(0.023)	(0.039)	(0.030)
Severe water shortage	0.041	0.013	0.032*	0.012	-0.002	0.018	0.027**	0.001	0.075	-0.034	-0.142**	-0.023
	(0.059)	(0.041)	(0.018)	(0.024)	(0.020)	(0.022)	(0.013)	(0.036)	(0.047)	(0.036)	(0.062)	(0.036)
Loss of land	-0.025	-0.002	0.046*		0.045*			-0.031	-0.104	-0.021	0.202*	0.106**
	(0.098)	(0.079)	(0.028)		(0.025)			(0.060)	(0.082)	(0.058)	(0.111)	(0.051)
Immediate need for Money	-0.047	0.023	0.017	-0.016	0.008	-0.020	0.008	0.136***	0.093**	0.093***	-0.187***	-0.107***

Coefficients are Marginal Effects estimates with Standard errors in parentheses; *p<0.1, **p<0.05 and ***p<0.01

[10] Strategies which were not significantly triggered by the occurrence of any of the shocks are not reported in this work.

Large food price increases make holder households less likely to sell agricultural assets. Households see this shock relative to others as not so severe and hence may rely on strategies which might possibly not have dire consequences on their ability to continue their production in the future. This is confirmed by the ranking of the shock. Fifty percent of households indicated that large increase in food prices is the third most severe shock with 31 percent classifying it as the second (Table 7). Changing eating patterns and selling crop stock may therefore be used to protect households' basic agricultural asset holdings for continuous production, when there are large increases in food prices.

Large increase in input prices make households more likely to sell crop stock, engage in religious sacrifices or prayers but less likely to change eating pattern, get support from relatives or more likely to do nothing. If input prices are too high for farming households, after selling available crop stock the income generated can be used to get the essential inputs and if this is not enough, it is likely that households may rely on what is readily available. For example, if price of fertilizer increases and it is not within the reach of households, they may rather plant without fertilizers or they will only purchase what the revenue generated from crop sale can afford. Using this strategy or doing nothing therefore will mean that the output for the period will be low than otherwise making them even more vulnerable.

When there is an urgent need for money, sale of livestock and crop stock as well as engaging in sacrifices or prayers are the significant mechanisms used. Though livestock and crop stock sale will generate money for the household, resorting to sacrifices or prayers may also be adopted depending on the source of the need for money. Religious belief system is such that sacrifices and or prayers can help the household to get around some of the problems it may be facing such as ill health. There are no effective coping mechanisms for households that lose their land and or affected by severe water shortage. None of the shocks trigger an increased probability to sell durable assets. Given that generally the level of poverty in the three northern regions is high, households may be protecting their limited assets as argued by Zimmerman & Carter (2003).

To understand the combination of strategies based on the vulnerability categories, we consider the coping strategies for the middle and top 40 percent of households on the vulnerability scale. While savings is a significant strategy for the middle 40 percent of households when affected by storm or strong wind, highly vulnerable households do not significantly use savings or at best are less likely to use savings for two shocks (strong wind and increases in food prices). It is broadly not a significant strategy for the highly vulnerable

households or at best it is used less by highly vulnerable households (Table 8 and Table 9[11]). This shows that households at the top of the vulnerability scale do not have adequate savings to rely on. When the households were classified based on the asset index, 48 percent of the asset poor were in the highly vulnerable group with only 14 percent of the asset rich being highly vulnerable. Thus, highly vulnerable households are also more likely to be poor. Assets are therefore not significant coping strategies for highly vulnerable households because with their low asset levels, it will be better to use other strategies to protect their limited assets against shocks. Even for moderately vulnerable households, use of agricultural assets were not significant at 5 percent. This is a clear indication that farming households do not possess adequate assets and hence they are ready to protect the little they have not withstanding the shocks that affect their livelihoods.

Table 1.7: Severity of shocks experienced

Shock	Most Severe	Second most severe	Third most severe
Drought or floods	47.46	36.28	16.25
Strong winds/storms	16.28	43.85	39.87
Crop disease or pests	5.56	46.30	48.15
Livestock died or stolen	10.45	47.74	41.81
Large fall in sale prices for crops	0.00	66.67	33.33
Large rise in price of food	19.32	30.68	50.00
Large rise in agricultural input prices	10.43	47.83	41.74
Severe water shortage	18.18	36.36	45.45
Loss of land	30.77	38.46	30.77
Immediate need of money	28.07	26.32	45.61

Authors compilation with data from GARBES, 2014

Highly vulnerable households may even be more vulnerable because they do not seem to have access to support mechanisms to cope with shocks. Though government support and support from NGOs or religious institutions were not found to be significant coping for the two vulnerable groups when analysed separately, moderately vulnerable households were more likely to get support from relatives for strong wind or storm. However, highly vulnerable households are less likely to get support from relatives. A possibility of the less likelihood of highly vulnerable groups to receive support from relatives may be that the relatives may not be making enough for their own survival to be able to support others. Unlike moderately vulnerable households, highly vulnerable households therefore engage in religious sacrifices or prayers to respond to some of the shocks that affect them.

[11] Full results with other control variables are in Appendix tables 5A and 6A respectively for Table 8 and Table 9

Table 1.8: Coping Strategies of Middle 40 percent on Vulnerability scale

	Savings	relative	Food	Agric assets	Crop stock	Livestock	Did nothing
Drought/Flood	0.063	0.009	0.086**	0.074	0.048	0.152***	0.106*
	(0.063)	(0.044)	(0.038)	(0.049)	(0.044)	(0.057)	(0.063)
Strong wind/storm	0.139**	0.148***	-0.012	0.036	0.076**	0.013	0.065
	(0.056)	(0.040)	(0.025)	(0.026)	(0.033)	(0.052)	(0.056)
Crop disease/pest	-0.183	0.079	0.217***		0.133		0.233
	(0.239)	(0.156)	(0.072)		(0.119)		(0.236)
Death/theft of livestock	-0.056	0.022	0.043**	0.031	-0.062	0.077*	0.244***
	(0.050)	(0.042)	(0.022)	(0.028)	(0.039)	(0.044)	(0.051)
Large rise in food prices	0.305	0.076	0.193***		0.117		0.137
	(0.227)	(0.154)	(0.066)		(0.126)		(0.215)
Large rise: Input prices	-0.162						
	(0.229)						
Loss of land	-0.004						
	(0.191)						
Immediate need for Money	0.242	0.208*			0.310***	0.048	0.063
	(0.237)	(0.124)			(0.097)	(0.196)	(0.167)
N	510	511	496	409	491	502	511
Pseudo R-square	0.095	0.103	0.205	0.161	0.111	0.038	0.095

Coefficients are Marginal effects with standard errors in parentheses; *p<0.1, **p<0.05 and ***p<0.01

Table 1.9: Coping strategies of top 40 percent of households on the vulnerability scale

	Savings	Relatives	Food	Credit	Crop stock	Livestock	Religion	Did nothing
Drought/Flood	0.046	-0.087	-0.027	-0.025	0.199***	-0.052		-0.089**
	(0.064)	(0.057)	(0.029)	(0.024)	(0.074)	(0.064)		(0.037)
Strong wind/storm	0.076*	0.039	0.017	0.020	0.023	-0.037	0.036	-0.006
	(0.045)	(0.040)	(0.024)	(0.019)	(0.041)	(0.044)	(0.044)	(0.031)
Crop disease/pest	-0.240***	-0.043	-0.077***	-0.043**	-0.093**	-0.036	-0.061	-0.013
	(0.039)	(0.039)	(0.026)	(0.019)	(0.039)	(0.042)	(0.041)	(0.030)
Death/theft of livestock	-0.068	-0.133***	0.000	-0.014	-0.078**	0.117***	-0.012	-0.021
	(0.042)	(0.037)	(0.022)	(0.017)	(0.039)	(0.041)	(0.042)	(0.030)
Large fall: Sale price of crops	-0.062	-0.053			0.003	-0.093	0.006	-0.005
	(0.089)	(0.098)			(0.084)	(0.100)	(0.080)	(0.068)
Large rise in food prices	-0.010	0.011	0.060***	-0.026	0.088**	-0.041	0.050	0.106***
	(0.045)	(0.040)	(0.021)	(0.020)	(0.040)	(0.044)	(0.044)	(0.030)
Large rise: Input prices	-0.056	-0.137***	-0.054**	0.011	0.054	-0.054	0.090**	-0.105***
	(0.044)	(0.040)	(0.024)	(0.016)	(0.041)	(0.044)	(0.041)	(0.032)
Severe water shortage	-0.021	-0.043	-0.001	-0.011	-0.003	0.033	-0.035	-0.076*
	(0.062)	(0.056)	(0.032)	(0.026)	(0.055)	(0.060)	(0.059)	(0.041)
Loss of land	-0.103	0.063		0.024	-0.029	-0.059	-0.009	0.184**
	(0.108)	(0.100)		(0.037)	(0.091)	(0.109)	(0.098)	(0.074)
Immediate need for Money	-0.094*	0.027	-0.016	-0.006	0.162***	0.127**	0.138***	-0.101**
	(0.052)	(0.048)	(0.029)	(0.019)	(0.044)	(0.050)	(0.045)	(0.040)
N	459	459	407	413	459	459	393	451
Pseudo R-square	0.14	0.092	0.17	0.153	0.116	0.041	0.172	0.181

Coefficients are marginal effects; standard errors in parentheses; *p<0.1, **p<0.05 and ***p<0.01

1.5 Conclusion

The study sought to develop a shock index to classify households into vulnerable groups and determine the coping strategies adopted when there is the emergence of shocks. Within a period of five years, over 76 percent of agricultural holder households experienced at least one agricultural related shock, affecting either the income and or assets of 73 percent of the households. Using the shock index and classifying households into three groups, 35.8 percent of all households can be classified as highly vulnerable with 40.6 percent being moderately vulnerable to shocks. Households used varied strategies to cope with shocks. It was found that for highly severe shocks, households would use almost all available strategies to cope. Savings was one of the major strategies used by households for the top two severe shocks; drought and storms. Sale of crop stock and livestock were also used to support households' financial savings as coping strategies. These three strategies are broadly effective strategies which if available to all households, can help to reduce the impact of shocks on household welfare.

However, it seems that households do not have adequate savings, crop stock and livestock to cope and as such rely on support from relatives, eating less preferred food or cutting down on food consumption for some of the shocks. Support from relatives was a significant source to cope with storms for the moderately vulnerable groups and none of the shocks for the highly vulnerable groups. If relatives had enough resources to support, it wouldn't have been difficult to receive the needed support since by kinship and the reciprocity principle, families and or friends who are capable will support needy members who will also reciprocate when the need arises. Cutting down of food consumption or changing eating patterns was effective when food prices were high, crops were affected by disease or pests and during drought periods. This may be because households did not have adequate crop stock, livestock or savings to ensure that their consumption is not affected. Given that drought or flooding will affect the expected output of households, and since a large proportion of the output of households are for their own consumption, it may not be far-fetched to change eating patterns if they do not expect to harvest more and they don't have the needed funds to purchase their preferred food items and also meet other household expenditure.

There were also instances where households had to engage in religious sacrifices or prayers to cope with some shocks. Largely religious sacrifices or prayers were significantly used for two main shocks, drought or flood and immediate need for money. This was found to be associated with highly vulnerable households unlike the moderately vulnerable households. Though by nature drought or flood may occur, it is part of the religious belief system that religious interventions can help believers to get rain or prevent some unfortunate incidences

such as flooding. While farmers may want to use religious sacrifices and or prayers (as part of their worldview) to call for rains and prevent flooding, provision of dams or dug outs for irrigation purposes are necessary to help farmers undertake their activities and proper drainage systems are also important to reduce the incidence of flooding. If religious institutions, NGOs and the government, who were found not to be significant sources of support for vulnerable households, can help provide the needed dams, for example, it will be beneficial to farming households who rely heavily on rains for their activities. Also, provision of chemicals to control crop disease and pest, which is done in the cocoa sector, can be beneficial to households affected with crop disease and pest. These will ensure that households are able to produce all year round and control pests and diseases to generate more output and income which will help them to save and keep some of the crop stock for future use. If households have enough savings, crop stock and livestock, they can rely on these to prevent them from cutting down on food intake or relying on less preferred food to cope with shocks.

Farmers who lost their land, had nothing to do. Such people may wonder about looking for sharecropping opportunities or end up becoming farm labourers. Farm labourers who are paid by the day, may not be able to make enough and their opportunities may be seasonal, during planting season (depending on rains) and or harvest periods where more labour is needed. There should be some form of security to guarantee farmers access to a parcel of land on which they can farm if they are not in a position to purchase one. Community leaders can work to ensure that farmers especially those who lose their land, can have access to a dedicated land to undertake their economic activity. Thus, some special lands can be set aside in various communities for all farmers who may lose their land or are willing to farm but to don’t have land, to farm on.

References

Barrett, C. B., Marenya, P. P., Mcpeak, J., Minten, B., Murithi, F., Oluoch-Kosura, W., . . . Wangila, J. (2006). Welfare Dynamics in Rural Kenya and Madagascar. *Journal of Development Studies, 42*(2), 248-277.

Baulch, B., & Hoddinott, J. (2000). Economic Mobility and Poverty Dynamics in Developing Countries. *Journal of Development Studes, 36*(6), 1-24.

Calvo, C., & Dercon, S. (2005). Measuring Individual Vulnerability. Discussion Paper Series, No. 229, University of Oxford.

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

Chadhuri, S., Jalan, J., & Suryahadi, A. (2002). Asssessing Household Vulnerability to poverty from Cross-Sectional Data: A Methodology and Estimates from Indonesia. Discussion paper No. 0102-52. Columbia University.

Chaudhuri, S. (2003). *Assessing Vulnerability to Poverty: Concepts,Empirical Methods and Illustrative Examples.* Columbia University: Department of Economics.

Christiaensen, L. J., & Subbarao, K. (2005). Towards an Understanding of Household Vulnerability in Rural Kenya. *Journal of African Economies, 14*(4), 520-558.

Deaton, A. (1991). Savings and Liquidity Constraints. *Econometrica, 59*(5), 1221-1248.

Debebe, Z. Y., Mebratie, A., Sparrow, R., Abebaw, D., Dekker, M., Alemu, G., & Bedi, A. S. (2013). Coping with Shocks in Rural Ethiopia. *African Studies Centre Working Paper 110/2013*.

DeLoach, S. B., & Smith-Lin, M. (2017). The Rold of Savings and Credit in Coping with Idiosyncratic Household Shocks. *Journal of Development Studies*, 1-21.

Dercon, S. (2002). Income Risk, Coping Strategies and Safety Nets. UNU/WIDER Discussion Paper No. 2002/22.

Dercon, S., & Krishnan, P. (2000). Vulnerability, Seasonality and Poverty in Ethiopia. *Journal of Development Studies, 36*(6), 25-53.

Dercon, S., Hoddinott, J., & Woldehanna, T. (2005). Shocks and Consumption in 15 Ethiopian Villages, 1999 - 2004 . *Journal of African Economies*, 1-27.

Échevin, D., & Tejerina, L. (2013). Shocks and Coping Strategies in the Urban Squatter Settlements of San Salvador. *Poverty and Policy, 5*(2), 180-202.

Everitt, B. S., & Dunn, G. (2001). *Applied Multivariate Data Analysis* (2nd ed.). Sussex: John Wiley & Sons Ltd.

Fafchamps, M., Udry, C., & Czukas, K. (1998). Drought and Saving in West Africa: Are Livestock a buffer stock? *Journal of Development Economics, 55*, 273 - 305.

Filmer, D., & Pritchett, L. H. (2001). Estimating Wealth Effects without Expenditure Data or Tears:an Application to Educational Enrollments in States of India. *Demography*, 115-132.

Gertler, P., & Gruber, J. (2002). Insuring Consumption against Illness. *American Economic Association, 92*(1), 51-70.

Ghana Statistial Service. (2014). *Poverty Profile in Ghana (2005 - 2013).* Accra: Ghana Statistical Service.

Ghana Statistical Service. (2007). *Pattern and Trends of Poverty in Ghana 1991 - 2006.* Accra: Ghana Statistical Service.

Ghana Statistical Service. (2014). *Ghana Living Standards Survey Round 6 - Main Report.* Accra: Ghana Statistical Service.

Gloede, O., Menkhoff, L., & Waibel, H. (2013). Shocks, Individual Risk Attitude, and Vulnerability to Poverty among Rural Households in Thailand and Vietnam. *World Development*, 57-78.

Harrower, S., & Hoddinott, J. (2005). Consumption Smoothing in the Zone Lacustre, Mali. *Journal of African Economies, 14*(4), 489-519.

Harttgen, K., & Gunther, I. (2009). Estimating Households Vulnerability to Idiosyncratic and Covariate Shocks: A Novel Method Applied to Madagascar. *World Development, 37*(7), 1222-1234.

Heltberg, R., & Lund, N. (2009). Shocks, Coping and Outcomes for Pakistan's Poor. *The Journal of Development Studies, 45*(6), 889-910.

Hoddinot, J., & Quisumbing, A. (2003). Methods for Microeconometric Risk and Vulnerability Assessment. The World Bank, Social Protection Discussion Paper Series, No. 0324.

Hoddinott, J. (2006). Shocks and their consequences across and within households in rural Zimbabwe. *Journal of Development Studies, 42*(2), 301-321.

Holzmann, R., & Jørgensen, S. (2000). Social Risk Manangement: A new Conceptual Framework for Social Protection and beyond. *World Bank Social Protection Discussion Paper No. 0006.*

International Food Policy Research Institute (IFPRI). (2015). "Ghana Africa Research in Sustainable Intensification for the Next Generation (Africa RISING) Baseline Evaluation Survevy". http://dx.doi.org/10.7910/DVN/QUB9UT Harvard Dataverse, V1.

International Food Policy Research Institute, Monitoring and Evaluation. (2015). *Africa Rising Baseline Evaluation Survey (ARBES) Report, Ghana.* International Food Policy Research Institute, International Livestock Research Institute, International Institue of Tropical Agriculture.

Islam, A., & Maitra, P. (2012). Health Shocks and Consumption Smoothing in Rural Households: Does microcredit have a role to play? *Journal of Development Economics, 97*, 232-243.

Jolliffe, I. T. (2002). *Principal Component Analysis.* New York: Springer-Verlag.

Kazianga, H., & Udry, C. (2006). Consumption Smoothing? Livestock, Insurance and Drought in Rural Burkina Faso. *Journal of Development Economics, 79*, 413-446.

Kolenikov, S., & Angeles, G. (2009). Socioeconomic Status Measurement with Discrete Proxy Variables: Is principal component analysis a reliable answer? *Review of Income and Wealth, 55*(1), 128-165.

Ligon, E., & Schechter, L. (2003, March). Measuring Vulnerability. *The Economic Journal*(113), C95-C102.

Ligon, E., & Schechter, L. (2003). Measuring Vulnerability. *The Economic Journal, 113*(486), C95-C102.

Mango, N., Cheng'ole, J., Kariuki, G., & Ongadi, W. (2004). *Social Aspects of Dynamic Poverty Traps: Cases from, Vihiga, Baringo and Marsabit Districts, Kenya.* Nairobi.

Moser, C., & Felton, A. (2007). *The Construction of an Asset Index Measuring Asset Accumulation in Ecuador.* The Brookings Institution, Chronic Poverty Research Centre Working Paper 87, Washington DC.

Novignon, J., Nonvignon, J., Mussa, R., & Chiwaula, L. S. (2012). Health and vulnerability to poverty in Ghana: Evidence from the Ghana Living Standards Survey Round 5. *Health Economics Review, 2*(11).

Oduro, A. D. (2010). *Adverse Shocks and Social Protection in Africa: What Role for Formal and Informal Financial Institutions?* Italy: European University Institute Working Paper, RSCAS 2010/31.

Pritchett, L., Suryahadi, A., & Sumarto, S. (2000). Quantifying Vulnerability to Poverty: A Proposed Measure Applied to Indonesia. *World Bank Policy Research Working Paper 2437*.

Quaye, W. (2008). Food Security Situation in Northern Ghana, Coping Strategies and related Constraints. *African Journal of Agricultural Research, 3*(5), 334-342.

Rencher, A. C. (2002). *Methods of Multivariate Analysis* (2nd ed.). New Jersey: Wiley & Sons, Inc.

Rosenzweig, M. R., & Binswanger, H. P. (1993). Wealth, Weather Risk and the Composition and Profitability of Agricultural Investments. *The Economic Journal, 109*(416), 56-78.

Sahn, D. E., & Stifel, D. (2003). Exploring Alternative Measures of Welfare in the Absence of Expenditure Data. *Review of Income and Wealth, 49*(4), 463-489.

Todaro, M. P., & Smith, S. C. (2012). *Economic Development* (11th ed.). Boston: Pearson Education Inc.

Wagstaff, A., & Lindelow, M. (2010). *Are Health Shocks Different? Evidence from a Multi-Shock Survey in Laos.* The World Bank, Policy Research Working Paper, WPS5335.

World Bank. (2000). *World Development Report 2000/2001: Attacking Poverty.* New York: Oxford University Press.

World Bank. (2000). *World Development Report: Attacking Poverty.* New York: Oxford University Press.

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

Appendix

Table 1A: Tetrachoric Correlation between shocks

	Drought/ floods	Strong winds/ storms	Crop disease/ pests	Livestock died/ stolen	Large fall: sale price of crops	Large rise: price of food	Large rise: input prices	Severe water shortage	Loss of land	Immediate need for money
Drought/floods	1									
Strong winds/ storms	0.318 0.000	1								
Crop disease/ pests	0.318 0.000	0.420 0.000	1							
Livestock died/ stolen	0.341 0.000	0.203 0.000	0.431 0.000	1						
Large fall: sale prices of crops	0.291 0.015	0.293 0.004	0.561 0.000	0.349 0.000	1					
Large rise: price of food	0.297 0.000	0.414 0.000	0.544 0.000	0.273 0.000	0.418 0.000	1				
Large rise: input prices	0.594 0.000	0.353 0.000	0.575 0.000	0.379 0.000	0.472 0.000	0.617 0.000	1			
Severe water shortage	0.164 0.034	0.259 0.000	0.437 0.000	0.270 0.000	0.411 0.001	0.543 0.000	0.511 0.000	1		
Loss of land	0.201 0.092	0.274 0.010	0.365 0.000	0.085 0.500	0.128 0.403	0.340 0.002	0.451 0.000	0.443 0.000	1	
Immediate needs of money	0.459 0.000	0.291 0.000	0.475 0.000	0.256 0.000	0.460 0.000	0.530 0.000	0.667 0.000	0.636 0.000	0.418 0.000	1

Rho and P-values indicated on the table

Table 2A: Percentage of households with shocks reducing income or assets

	Number	**Income loss**	**Asset loss**	**Both**	**Neither**
Drought or floods	769	46.94	6.26	38.72	8.00
Strong winds/storms	301	11.33	47.33	39.67	2.00
Crop disease or pests	162	41.98	11.11	33.95	13.00
Livestock died or stolen	287	16.03	33.45	43.55	7.00
Large fall in sale prices for crops	9	66.67	11.11	22.22	0.00
Large rise in price of food	88	48.86	7.95	18.18	25.00
Large rise in agricultural input prices	115	43.48	4.35	31.3	21.00
Severe water shortage	44	15.91	6.82	38.64	39.00
Loss of land	13	0.00	46.15	53.85	0.00
Immediate need for money	57	21.43	32.14	41.07	5.00

Table 3A: Chi-square test of independence between vulnerability and Socioeconomic status

		Asset categories			
		1	2	3	Total
Categories of vulnerability to shocks	1	108	127	67	302
		8.42	9.91	5.23	23.56
	2	190	214	117	521
		14.82	16.69	9.13	40.64
	3	218	169	72	459
		17	13.18	5.62	35.8
	Total	516	510	256	1,282
		40.25	39.78	19.97	100

Pearson chi2(4) = 17.5449 Pr = 0.002

Table 4A: Coping Strategies of households when there is the emergence of shocks

	Savings	Relatives	Govt	Food	Credit	Agric assets	Durable assets	Crop stock	Livestock	Religion	Did nothing	Other
Drought/Flood	0.344***	0.046**	-0.011	0.022	0.028**	0.050**	0.005	0.119***	0.192***	0.170***	0.316***	0.081***
	(0.024)	(0.023)	(0.009)	(0.014)	(0.013)	(0.019)	(0.009)	(0.024)	(0.027)	(0.027)	(0.024)	(0.020)
Strong wind/storm	0.190***	0.101***	0.038***	-0.005	0.002	0.003	-0.032**	0.049**	0.019	0.028	0.048	0.010
	(0.030)	(0.022)	(0.010)	(0.013)	(0.011)	(0.013)	(0.014)	(0.020)	(0.026)	(0.021)	(0.030)	(0.019)
Crop disease/pest	-0.147***	0.020	-0.040**	-0.027	-0.026	-0.026*	0.014	-0.037	0.018	-0.049**	0.193***	0.013
	(0.037)	(0.026)	(0.016)	(0.018)	(0.018)	(0.015)	(0.009)	(0.025)	(0.030)	(0.022)	(0.034)	(0.022)
Death/theft of livestock	0.052*	-0.026	0.013	0.014	-0.008	-0.001	0.012	-0.045**	0.116***	0.021	0.242***	0.046***
	(0.029)	(0.022)	(0.011)	(0.012)	(0.010)	(0.013)	(0.008)	(0.019)	(0.022)	(0.019)	(0.025)	(0.018)
Large fall: Sale price of crops	-0.071	-0.042				0.024		-0.009	-0.105	-0.006	-0.126	-0.010
	(0.093)	(0.065)				(0.030)		(0.054)	(0.080)	(0.048)	(0.098)	(0.057)
Large rise in food prices	0.058	0.044	-0.022	0.065***	-0.004	-0.084***	-0.018	0.066***	-0.009	0.028	-0.028	0.117***
	(0.045)	(0.028)	(0.015)	(0.015)	(0.017)	(0.027)	(0.014)	(0.025)	(0.035)	(0.026)	(0.044)	(0.025)
Large rise: Input prices	-0.059	-0.091***	-0.013	-0.047**	0.014	0.024	-0.005	0.050**	-0.044	0.050**	0.165***	-0.123***
	(0.042)	(0.033)	(0.016)	(0.021)	(0.013)	(0.017)	(0.012)	(0.025)	(0.034)	(0.023)	(0.039)	(0.030)
Severe water shortage	0.041	0.013	0.032*	0.012	-0.002	0.018	0.027**	0.001	0.075	-0.034	-0.142**	-0.023
	(0.059)	(0.041)	(0.018)	(0.024)	(0.020)	(0.022)	(0.013)	(0.036)	(0.047)	(0.036)	(0.062)	(0.036)
Loss of land	-0.025	-0.002	0.046*		0.045*			-0.031	-0.104	-0.021	0.202*	0.106**
	(0.098)	(0.079)	(0.028)		(0.025)			(0.060)	(0.082)	(0.058)	(0.111)	(0.051)
Immediate need for Money	-0.047	0.023	0.017	-0.016	0.008	-0.020	0.008	0.136***	0.093**	0.093***	-0.187***	-0.107***
	(0.051)	(0.035)	(0.015)	(0.022)	(0.018)	(0.023)	(0.012)	(0.028)	(0.039)	(0.029)	(0.054)	(0.038)
Gender	-0.027	0.017	-0.018	0.029*	-0.003	0.018	0.004	0.017	0.003	0.052*	-0.034	0.040*
	(0.039)	(0.029)	(0.014)	(0.016)	(0.014)	(0.012)	(0.010)	(0.028)	(0.033)	(0.030)	(0.036)	(0.022)
Age	0.001	0.001	-0.000	-0.001	0.000	-0.001*	0.000*	-0.001	-0.000	-0.000	0.001	0.000
	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Household size	0.004	-0.001	0.002**	-0.000	0.001	0.002	0.001	0.003*	-0.000	0.001	-0.002	0.002
	(0.003)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
Education (Years)	0.002	0.003	0.001	0.001	-0.000	-0.002	-0.001	-0.001	0.001	-0.005**	0.001	-0.001
	(0.003)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
Monogamy	0.135**	-0.060	-0.012	-0.033	-0.002	-0.098*	0.009	-0.009	0.056	-0.063	0.037	-0.108*
	(0.058)	(0.055)	(0.020)	(0.046)	(0.022)	(0.054)	(0.015)	(0.045)	(0.045)	(0.054)	(0.057)	(0.059)
Polygamy	0.112*	-0.105*	-0.023	-0.042	-0.016	-0.089	-0.002	0.037	0.053	-0.004	0.027	-0.132**
	(0.064)	(0.058)	(0.022)	(0.048)	(0.023)	(0.056)	(0.016)	(0.050)	(0.050)	(0.057)	(0.063)	(0.061)
Divorced	0.125	-0.036			0.014			-0.034	0.014	-0.063	-0.067	-0.137
	(0.106)	(0.093)			(0.050)			(0.070)	(0.080)	(0.077)	(0.097)	(0.083)
Single	0.105	-0.118	0.000	0.010		-0.101		-0.045	-0.017	0.033	0.075	-0.008
	(0.093)	(0.073)	(0.034)	(0.067)		(0.064)		(0.059)	(0.067)	(0.086)	(0.089)	(0.087)
North	0.014	0.166***	0.008	0.051***	-0.001	0.054***	0.031***	0.061***	-0.032	0.094***	-0.103***	0.047**
	(0.034)	(0.023)	(0.009)	(0.013)	(0.011)	(0.011)	(0.008)	(0.022)	(0.028)	(0.023)	(0.030)	(0.020)
Upper East	0.279***	0.057**	0.076***	0.028**	0.021		0.004	0.061**	0.055	-0.067***	-0.035	0.015
	(0.040)	(0.026)	(0.015)	(0.014)	(0.018)		(0.005)	(0.030)	(0.038)	(0.023)	(0.039)	(0.025)
N	1279	1279	1228	1205	1210	1016	1164	1279	1279	1279	1279	1279
pseudo R-sq	0.196	0.124	0.296	0.15	0.073	0.189	0.216	0.197	0.103	0.249	0.232	0.123

Marginal effects; standard errors in parentheses; (d) for discrete change of dummy variable from 0 to 1; *p<0.1, **p<0.05 and ***p<0.01

Table 5A: Coping Strategies for middle 40percent of households on the Vulnerability Scale

	savings	**relative**	**food**	**Agric assets**	**crop stock**	**Livestock**	**did nothing**	**Other**
Drought/Flood	0.063	0.009	0.086**	0.074	0.048	0.152***	0.106*	0.182***
	(0.063)	(0.044)	(0.038)	(0.049)	(0.044)	(0.057)	(0.063)	(0.052)
Strong wind/storm	0.139**	0.148***	-0.012	0.036	0.076**	0.013	0.065	0.063
	(0.056)	(0.040)	(0.025)	(0.026)	(0.033)	(0.052)	(0.056)	(0.040)
Crop disease/pest	-0.183	0.079	0.217***		0.133		0.233	0.291*
	(0.239)	(0.156)	(0.072)		(0.119)		(0.236)	(0.152)
Death/theft of livestock	-0.056	0.022	0.043**	0.031	-0.062	0.077*	0.244***	0.132***
	(0.050)	(0.042)	(0.022)	(0.028)	(0.039)	(0.044)	(0.051)	(0.035)
Large rise in food prices	0.305	0.076	0.193***		0.117		0.137	0.386***
	(0.227)	(0.154)	(0.066)		(0.126)		(0.215)	(0.131)
Large rise: Input prices	-0.162							
	(0.229)							
Loss of land	-0.004							
	(0.191)							
Immediate need for Money	0.242	0.208*			0.310***	0.048	0.063	
	(0.237)	(0.124)			(0.097)	(0.196)	(0.167)	
Gender	-0.156**	-0.016	0.042	0.012	-0.008	-0.022	0.005	0.023
	(0.066)	(0.054)	(0.028)	(0.029)	(0.046)	(0.067)	(0.071)	(0.050)
Age	0.002	0.001	-0.002*	-0.001	-0.000	-0.002	-0.000	-0.001
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Household size	0.003	-0.001	-0.004	0.001	0.003	-0.000	-0.004	0.001
	(0.005)	(0.004)	(0.002)	(0.002)	(0.003)	(0.004)	(0.005)	(0.003)
Education (Years)	0.008	0.006	0.001	-0.003	0.001	0.002	-0.009*	-0.000
	(0.005)	(0.004)	(0.002)	(0.003)	(0.003)	(0.005)	(0.005)	(0.004)
Monogamy	0.278***	-0.017	-0.100	-0.017	0.021	0.061	-0.032	-0.091
	(0.099)	(0.078)	(0.110)	(0.057)	(0.049)	(0.077)	(0.097)	(0.091)
Polygamy	0.255**	-0.037	-0.077	-0.026	0.073	0.072	-0.067	-0.087
	(0.108)	(0.085)	(0.114)	(0.061)	(0.059)	(0.089)	(0.110)	(0.097)
Divorced		0.043			0.022	0.061	-0.306*	-0.083
		(0.155)			(0.095)	(0.163)	(0.160)	(0.152)
Single	0.140	-0.110	-0.073	0.031		-0.012	-0.040	-0.045
	(0.151)	(0.098)	(0.123)	(0.112)		(0.115)	(0.148)	(0.132)
North	-0.114**	0.147***	0.066***	0.089***	0.038	-0.125***	-0.244***	0.029
	(0.050)	(0.038)	(0.021)	(0.020)	(0.032)	(0.044)	(0.050)	(0.035)
Upper East	0.200***	-0.030	0.021	0.000	0.020	-0.016	-0.277***	0.008
	(0.055)	(0.037)	(0.024)	(.)	(0.043)	(0.064)	(0.065)	(0.046)
N	510	511	496	409	491	502	511	504
Pseudo R-square	0.095	0.103	0.205	0.161	0.111	0.038	0.095	0.067

Marginal effects; standard errors in parentheses; *p<0.1, **p<0.05 and ***p<0.01

Table 6A: Coping strategies used by top 40percent of households on the vulnerability scale

	Savings	**Relatives**	**Food**	**Credit**	**Crop stock**	**Livestock**	**Religion**	**Did nothing**	**other**
Drought/Flood	0.046	-0.087	-0.027	-0.025	0.199***	-0.052		-0.089**	0.205***
	(0.064)	(0.057)	(0.029)	(0.024)	(0.074)	(0.064)		(0.037)	(0.057)
Strong wind/storm	0.076*	0.039	0.017	0.020	0.023	-0.037	0.036	-0.006	-0.055
	(0.045)	(0.040)	(0.024)	(0.019)	(0.041)	(0.044)	(0.044)	(0.031)	(0.042)
Crop disease/pest	-0.240***	-0.043	-0.077***	-0.043**	-0.093**	-0.036	-0.061	-0.013	0.148***
	(0.039)	(0.039)	(0.026)	(0.019)	(0.039)	(0.042)	(0.041)	(0.030)	(0.040)
Death/theft of livestock	-0.068	-0.133***	0.000	-0.014	-0.078**	0.117***	-0.012	-0.021	0.110***
	(0.042)	(0.037)	(0.022)	(0.017)	(0.039)	(0.041)	(0.042)	(0.030)	(0.040)
Large fall: Sale price of crops	-0.062	-0.053			0.003	-0.093	0.006	-0.005	-0.088
	(0.089)	(0.098)			(0.084)	(0.100)	(0.080)	(0.068)	(0.084)
Large rise in food prices	-0.010	0.011	0.060***	-0.026	0.088**	-0.041	0.050	0.106***	-0.083**
	(0.045)	(0.040)	(0.021)	(0.020)	(0.040)	(0.044)	(0.044)	(0.030)	(0.042)
Large rise: Input prices	-0.056	-0.137***	-0.054**	0.011	0.054	-0.054	0.090**	-0.105***	0.174***
	(0.044)	(0.040)	(0.024)	(0.016)	(0.041)	(0.044)	(0.041)	(0.032)	(0.042)
Severe water shortage	-0.021	-0.043	-0.001	-0.011	-0.003	0.033	-0.035	-0.076*	-0.133**
	(0.062)	(0.056)	(0.032)	(0.026)	(0.055)	(0.060)	(0.059)	(0.041)	(0.055)
Loss of land	-0.103	0.063		0.024	-0.029	-0.059	-0.009	0.184**	0.057
	(0.108)	(0.100)		(0.037)	(0.091)	(0.109)	(0.098)	(0.074)	(0.103)
Immediate need for Money	-0.094*	0.027	-0.016	-0.006	0.162***	0.127**	0.138***	-0.101**	-0.193***
	(0.052)	(0.048)	(0.029)	(0.019)	(0.044)	(0.050)	(0.045)	(0.040)	(0.047)
Gender	0.044	0.075	0.037	0.006	0.032	0.046	0.186***	0.074**	-0.124**
	(0.071)	(0.055)	(0.029)	(0.021)	(0.065)	(0.062)	(0.057)	(0.033)	(0.061)
Age	-0.003**	0.001	0.001	0.001	-0.002	-0.000	-0.001	0.001	0.003**
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)
Household size	0.007*	-0.004	0.002	0.002	0.006	-0.001	0.003	0.002	-0.005
	(0.004)	(0.004)	(0.002)	(0.002)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)
Education (Years)	-0.005	-0.000	0.003	0.002	-0.003	0.002	-0.005	-0.003	0.012**
	(0.005)	(0.005)	(0.002)	(0.002)	(0.005)	(0.005)	(0.005)	(0.004)	(0.005)
Monogamy	0.028	-0.220*	0.011	0.012	-0.050	0.050	-0.119	-0.219*	0.126
	(0.113)	(0.122)	(0.050)	(0.035)	(0.109)	(0.099)	(0.129)	(0.113)	(0.108)
Polygamy	-0.006	-0.307**	-0.018	-0.019	0.019	0.036	-0.018	-0.261**	0.160
	(0.120)	(0.127)	(0.051)	(0.032)	(0.120)	(0.107)	(0.137)	(0.117)	(0.116)
Divorced	-0.087	-0.154			-0.093	-0.016	-0.021		0.126
	(0.216)	(0.197)			(0.174)	(0.166)	(0.197)		(0.194)
Single	0.026	-0.278*	0.105		-0.016	-0.120	0.102	0.038	0.135
	(0.189)	(0.163)	(0.120)		(0.164)	(0.130)	(0.214)	(0.182)	(0.160)
North	-0.001	0.198***	-0.019	-0.086	0.044	0.020	0.152*	-0.005	-0.211**
	(0.104)	(0.050)	(0.071)	(0.080)	(0.088)	(0.092)	(0.083)	(0.083)	(0.083)
Upper East	0.254**	0.137**	-0.030	-0.117	0.039	0.094	-0.098	-0.047	-0.066
	(0.111)	(0.061)	(0.072)	(0.079)	(0.099)	(0.105)	(0.084)	(0.091)	(0.092)
N	459	459	407	413	459	459	393	451	459
Pseudo R-square	0.14	0.092	0.17	0.153	0.116	0.041	0.172	0.181	0.165

Marginal effects; standard errors in parentheses; *p<0.1, **p<0.05 and ***p<0.01

Chapter 2

The Joint Choice for Savings, Insurance and Credit among Household Members in Ghana: An Individual Level Analysis Beyond the Household Head

2.1 Introduction

The daily lives of individuals and households are affected by risks which have likely consequences welfare. Though risks are unavoidable, measures can be adopted to mitigate or cope with their effects. Investment in various assets, real or financial, can serve as risk mitigation strategies to help reduce the likely impact of shocks on welfare. Earlier works in developing countries have found households using various forms of asset stocks including livestock, crop stocks and productive assets to smooth consumption (Udry, 1995; Hoddinott, 2006; Kazianga & Udry, 2006). The use of real assets, especially the productive ones, have however been found not to be efficient coping strategy when their use can lead to irreversible asset losses (Baulch & Hoddinott, 2000). Real assets are also highly illiquid and may not be effective mechanism for covariate shocks. In addition, they are subject to the lemons problem (Guiso & Sodini, 2013). The services financial institutions provide, including savings, insurance and consumer credit yield direct benefits to individuals in coping with risk (Gersovitz, 1988). However, there is the non-participation of individuals in the utilization of some of the financial products, especially the risky ones as well as debts and insurance (Guiso & Sodini, 2013). This has been labelled as the participation puzzle. Various reasons have been given; including high transaction costs, beliefs about future returns, mistrust of financial institutions, lack of awareness and unfair insurance pricing (Besley, 1995 and Guiso & Sodini, 2013).

There has been the emergence of new financial products in developing countries aimed at increasing access to financial services and the mobilization of financial resources to propel economic growth and reduce poverty. One of the new products aimed at increasing access to financial services, in developing countries, is mobile money. Mobile Money is an electronic cash stored on a mobile phone, using the Subscriber Identification Module (SIM), through the collaborative effort of Mobile Phone networks and some financial institutions. According to the Bank of Ghana (2017), in Ghana mobile money is used to transfer value from one person to another, pay for goods and services, micro-credit, savings and micro-insurance. On quarterly basis, interest is paid on balances in the individual's mobile money wallet due to its

store of value function. By the end of 2016, total float balance and interest paid to holders of mobile money accounts were 1.26billion and 24.8million Ghana cedis respectively (Bank of Ghana, 2017). The total number of registered mobile money agents offering services to customers were about 79,747 but the number of branches to banks were 1491 as of the end of 2016 (Bank of Ghana, 2017). Mobile money therefore is one of the means being utilized to reduce supply side constraints and cost of financial services to the unbanked and low-income households, usually located in rural areas.

Due to the importance of financial services in the life of individuals and the role they play in any given economy, several studies have examined the determinants of the choice for financial products. Most of the studies on developing countries, however, do not usually include preferences – risk and time preferences, in their analyses. Preferences are important elements in the decision-making process. Theory predicts that differences in risk and time preferences can explain issues such as the choice of occupation, purchase of insurance contract, self-insurance, stock holdings among others. Apart from the non-inclusion of preferences, such studies also tend to focus on household heads as the unit of analysis. Households in developing countries, however, are made up of several individuals and an aggregate overview, represented by the head, may not necessarily be reflective of the individual situation. Deaton and Paxson (2000) recognise that households in developing countries are multigenerational and the age-saving profile for households may be different from the age-saving profiles of individuals that make up households. Different members of houesholds may have varied preferences and expectations resulting in different propensities to save (Browning and Lusardi, 1996; Rozensweig, 2001). These evidence indicate that individual level analysis may be preferred to household level analysis. It is important to study individual decisions in the utilization of financial products, since increased participation of individuals on the financial market will help increase the availability of financial resources for investment and economic growth, which is generally low in developing countries. We therefore provide, to the best of our knowledge, the first comparative study of household members in terms of their choice for savings, insurance and credit.

Another issue which has not been widely considered in the literature is the joint utilization of the three products. The notion that savings, credit and insurance are interrelated has long been recognized. Gersovitz (1988) makes the point that to understand savings behaviour, the sources of uncertainty and the options available to the decision maker are important. He notes that the availability of insurance, borrowing and the role of the extended family can influence choices about savings in developing countries. Besley (1995) adds to

this observation by arguing that while savings and credit transfer resources across time and insurance across states, they relate to one another in most developing countries largely due to the presence of incomplete markets.

A known exception among studies on the utilization of financial services in developing countries is Giesbert, Steiner and Bendig (2011)[12]. They examine the low uptake of micro life insurance in Ghana and how households' utilization of other financial products may be related to uptake using data from two towns in the Central region of Ghana in the year, 2007. They find suggestive evidence of a mutually reinforcing relationship between microinsurance and other financial services. They however, report no significant relationship between risk preferences and savings or credit except micro life insurance. Contrary to expectations, however, the risk averse were less likely to use microinsurance. This was attributed to the possibility that households may consider microinsurance as risky. The authors acknowledge in their study that external validity may not be fully given; the data used was from only two towns in one of the ten regions[13] and also the chosen insruance product was not the only product available. Though we acknowledge that their study has provided some useful insight, at least at the local level, there is the need for further analysis using a nationally representative data, that also goes beyond the head of the household.

Using a nationally representative data we estimate a trivariate probit model to account for possible joint choices and to examine: the comparative financial product choice of household members (the head, spouse, child/grandchild and others) and the role risk and time preferences play in individuals' choice of financial products especially savings. This study is an attempt to contribute to the literature on household finance in developing countries. A new evidence from the study is that there are important differences in the choice for financial products when household heads, usually used as the unit of analysis, are compared to other household members. We also find that the choice for savings, insurance and credit are positively related. Taking account of preferences, differences in risk preferences are important in the savings decision though its contribution to the demand for credit and insurance is not significantly different from zero. Above all, mobile money – an innovation in the financial sector, is found to predict the choice for savings and insurance.

In the next section, we review relevant literature with emphasis on savings and its determinants. We then spell out the trivariate probit model and describe the data and

[12] Though their unit of analysis is also the head of the household
[13] The number of regions as of the time of their study was 10 but has currently been increased to 16 regions.

variables in section 3.3 with section 3.4 focusing on the results and discussion. Conclusion of the study is done in section 3.5.

2.2 Literature Review

There are two main theories on consumption and savings: the life cycle and permanent income hypotheses. Per the life-cycle hypothesis of Modigliani and Brumberg (1954), at relatively younger age, individuals will accumulate savings and draw it down at retirement, in an attempt to smooth consumption using lifetime income. Provision for retirement therefore is one of the important reasons for savings. The life cycle hypothesis also notes the proportionality between increases in income and consumption (Deaton, 2005). Despite the proportionality argument in the life-cycle theory, Keynes had already argued that though on the average consumption varies with income, the rate of variation was not as much as the change in income. The permanent income hypothesis by Friedman (1957) posits that transitory changes in income has a negligible effect on consumption since households are freely able to save and borrow to smooth consumption. Thus, transitory changes in income will affect savings.

To improve on the lifecycle/permanent income models in explaining savings behaviour, other factors have explicitly been included in the basic model. According to Rosenzweig (2001), the simple lifecycle models of savings do not appear to explain long-term savings in developing countries. It has been argued that the lifecycle hypothesis does not adequately account for uncertainty, the bequest motive and the presence of children in the household. Deaton (2005), however indicates that though the lifecycle theory did recognize the importance of such issues, it was possible to advance the theory without them (Deaton, 2005). Alternative models have been developed to account for these issues. Carroll (1997) developed the "buffer-stock" version of the lifecycle/permanent income hypothesis. He observed that from the Federal Reserve Board's 1983 Survey of consumer finances, 43percent indicated that the most important reason for saving was for emergency with 15percent saying it was to prepare for retirement.

The proposition made by Carroll (1997) is that consumers engage in buffer stock savings behaviour when they face important income uncertainty, are prudent (have a precautionary savings motive) and impatient (in that were future income known with certainty, they would choose to consume more than their current income). Buffer-stock savers

have a target wealth-to-permanent-income ratio such that, if wealth is below the target, precautionary saving motive dominates impatience leading to more savings but when wealth goes beyond the target, impatience will dominate prudence, and the consumer will dissave. From Carroll's work, uncertain future earnings will make sufficiently prudent individuals never to borrow given even the slightest chance that they will not earn enough to repay their debts. Such people will keep their consumption within their income even if they expect earnings to increase over time. Deaton (2005) makes it clear that this result is theoretically similar to situations where there are liquidity constraints.

Another argument which has been put forward as an important rationale behind savings is the bequest motive. Contrary to what the simple lifecycle hypothesis would suggest, saved resources are not completely depleted since individuals do not only maximize their own lifetime utility but also that of their descendants (Kotlikoff and Summers, 1981; Dynan, Skinner and Zeldes, 2004). Deaton (2018) observes that in developing economies where the old live with their children, there is no need for the accumulation and decumulation of marketable assets as it is the case in developed economies. Rosenzweig (2001) extends the argument further by noting that in low income countries where children are seen as a form of old-age support, investments in children are a form of long-term savings. The presence of children therefore will postpone financial savings for retirement, in favour of investment in human capital.

Empirical evidence has confirmed the importance of life cycle factors in the savings decision. Age has been used as the principal lifecycle determinant with its square added to account for possible nonlinearities and these have largely been found to be significant determinants of savings (Beckmann, Hake and Urvova, 2013). There are however some few works which find no significant effect of age on savings. Such works include Abdelkhalek, Arestoff, de Freitas and Mage (2010) who studied household savings in Morocco. Household size can contribute either positively or negatively to savings. Apart from the non-income earners of the household leading to a reduction in the probability of savings, Beckmann, Hake and Urvova (2013) use household size to capture the effect of economies of scale such that large households are expected to have higher savings when there are more adults. Empirical evidence points to the following: smaller households are more likely to save; lower dependency ratio increases the likelihood of savings (Attanasio and Székely, 2000; Yuh and Hanna, 2010). The negative effect of household size on savings has been found in some instances to be significant for urban households than for rural households (Abdelkhalek, Arestoff, de Freitas, & Mage, 2010). They contend that the non-significance of household

size on the savings of rural households imply that in these areas, an additional household member does not change household living and working conditions. Increasing household size in adult members can serve as a source of insurance. Rosenzweig and Stark (1989) study on India show that in riskier settings, households are more extended with more daughters-in-law, because marital ties enhance ex-post protection against income shocks through cross-village transfers.

It is not in doubt that the level of income and education of individuals will affect the savings decision. Browning and Lusardi (1996) adduce evidence that most savings are by rich households with Dynan, Skinner and Zeldes (2004) finding a positive relationship between saving rates and current income as well as a strong positive correlation between savings rate and permanent income, proxied by variables including education. Education may thus be used to account for individuals' earnings potentials. Another factor that has been used to explian the demand for financial services is financial literacy. Results from such works show a positive relationship between financial literacy and the choice of financial products (Abdelkhalek, Arestoff, de Freitas, & Mage, 2010; Baidoo, Boateng, & Amponsah, 2018).

There seemed to be mixed results in empirical works that tried to determine the significance of precautionary savings from income risks, through employment choice. Earlier works found almost no evidence (Guiso, Jappelli, & Terlizese, 1992; Dynan, 1993) with more recent works finding significant evidence (Carroll & Samwick, 1998; Ceritoğlu, 2013). Fuchs-Schündeln and Schündeln (2005) show that one of the possible reasons for the earlier findings is self-selection bias when risk aversion is not controlled for. In the first instance, the argument is that, more risk averse individuals will save more. The propensity to save, on the other hand, is also expected to be high at relatively higher levels of income for those in riskier jobs than otherwise. When individuals self-select into jobs, then those who are less risk averse will choose high risk jobs with the more risk averse choosing low risk jobs. Thus, on the one hand, the more risk averse should save more while their self-selection into low risk jobs means they should save less. Self-selection therefore generates a bias which can lead to underestimating the importance of precautionary savings if risk aversion is not controlled for (Fuchs-Schündeln & Schündeln, 2005). Another aspect of precautionary savings is through liquidity constraints and Lee and Sawada (2010) find substantial evidence of precautionary savings in Pakistan. They put forward the view that precautionary savings motive appears stronger when households face liquidity constraints. It emerges that there are varied reasons for precautionary savings either because of income uncertainty, liquidity constraints, illness, accidents, natural disasters and the likes.

Empirical studies on savings behaviour also control for other demographic variables including marital status, gender and location. The married and single male-headed households have been found to be more likely to save than female headed households (Yuh & Hanna, 2010). The location of the individual is generally used to control for aggregate risk, which cannot be avoided by the individual because it cannot be insured. Lee and Sawada (2010) uses district dummy to capture aggregate risk. Locational variables can also be indicative of the availability and or ease of access to financial services.

2.3 Methodology

To determine the effect of preferences and individual membership status in the household on the choice of savings, insurance and credit, we use a multivariate probit model. The multivariate probit model is an extension of the bivariate probit model which allows for more than two equations with correlated disturbances. It does not only help in the joint determination of two or more binary variables with correlated error terms but also serves as a framework for modelling endogenous binary variables or even treatment effect (Greene, 2012).

We use the binary version of the financial products because the available data does not include the monetary values for all the three choices. Individuals responded to questions on whether they save or have an account, have insurance products and or are utilizing a loan facility. Adopting Greene (2012) specification of a multivariate probit model, we specify a trivariate probit model as:

$$y_1^* = \mathbf{x_1'}\boldsymbol{\beta_1} + \varepsilon_1\,, \qquad y_1 = 1 \text{ if } y_1^* > 0, \qquad 0 \text{ otherwise,}$$
$$y_2^* = \mathbf{x_2'}\boldsymbol{\beta_2} + \varepsilon_2\,, \qquad y_2 = 1 \text{ if } y_2^* > 0, \qquad 0 \text{ otherwise,}$$
$$y_3^* = \mathbf{x_3'}\boldsymbol{\beta_3} + \varepsilon_3\,, \qquad y_3 = 1 \text{ if } y_3^* > 0, \qquad 0 \text{ otherwise,}$$

$$\begin{pmatrix}\varepsilon_1\\ \varepsilon_2\\ \varepsilon_3\end{pmatrix}\Bigg|\mathbf{x}_1,\mathbf{x}_2,\mathbf{x}_3 \sim N\left[\begin{pmatrix}0\\0\\0\end{pmatrix},\begin{pmatrix}1 & \rho_{12} & \rho_{13}\\ \rho_{12} & 1 & \rho_{23}\\ \rho_{13} & \rho_{23} & 1\end{pmatrix}\right].$$

$y_1,\ y_2\ and\ y_3$ are the three different choice of financial products; savings, insurance and credit.

$\varepsilon_1, \varepsilon_2 and\ \varepsilon_3$ are the error terms which are trivariate normally distributed, each with mean 0, variance of 1 and correlations of ρ_{jm}. The correlation between the variables are captured by the conditional tetrachoric correlation of the error terms (Greene, 2012). The vector X is the matrix of explanatory variables.

The joint probability of the observed choices $[y_{i1}, y_{i2}, y_{i3}]$, $i = 1, \dots, n$ forming the basis for the log likelihood function are the trivariate normal probabilities:

$$L_i = \Phi_3(q_{i1}\mathbf{x}'_{i1}\boldsymbol{\beta}_1, q_{i2}\mathbf{x}'_{i2}\boldsymbol{\beta}_2, q_{i3}\mathbf{x}'_{i3}\boldsymbol{\beta}_3, \boldsymbol{R}^*)$$

$q_{im} = 2y_{im} - 1, \qquad m = 1, \dots, 3,$
when $y_{im} = 1$, $q_{im} = 1$ and when $y_{im} = 0$, $q_{im} = -1$
$\boldsymbol{R}^*_{jm} = q_{ij}q_{im}\rho_{jm}, \quad j = 1, \dots, 3$

$$\boldsymbol{R}^*_{11} = \boldsymbol{R}^*_{22} = \boldsymbol{R}^*_{33} = 1$$
$$\boldsymbol{R}^*_{12} = \boldsymbol{R}^*_{21} = q_{i1}q_{i2}\rho_{12}$$
$$\boldsymbol{R}^*_{13} = \boldsymbol{R}^*_{31} = q_{i1}q_{i3}\rho_{13}$$
$$\boldsymbol{R}^*_{23} = \boldsymbol{R}^*_{32} = q_{i2}q_{i3}\rho_{23}$$

Φ_3 is the trivariate normal cumulative density function.

The correct analogy for the multivariate probit model is the seemingly unrelated model and not the linear simultaneous equations model, there is no requirement that different variables appear in different equations or some variables be excluded from some equations Greene (2012). We thus use the same set of regressors as determinants for the joint determination of the three products.

The model we estimate therefore can be specified as:

$$Y_{1ih} = \beta_0 + \beta_1 R_{ih} + \beta_2 T_{ih} + \beta_3 S_{ih} + \beta_4 C_{ih} + \beta_5 M_{ih} + \beta_6 A_{ih} + \beta_7 Z_{1ih} + \cdots + \beta_n Z_{nih} + \varepsilon_{1ih}$$

$$Y_{2ih} = \beta_0 + \beta_1 R_{ih} + \beta_2 T_{ih} + \beta_3 S_{ih} + \beta_4 C_{ih} + \beta_5 M_{ih} + \beta_6 A_{ih} + \beta_7 Z_{1ih} + \cdots + \beta_n Z_{nih} + \varepsilon_{2ih}$$

$$Y_{3ih} = \beta_0 + \beta_1 R_{ih} + \beta_2 T_{ih} + \beta_3 S_{ih} + \beta_4 C_{ih} + \beta_5 M_{ih} + \beta_6 A_{ih} + \beta_7 Z_{1ih} + \cdots + \beta_n Z_{nih} + \varepsilon_{3ih}$$

Where ih represent individual i in household h, Y_1 is for whether an individual save or not, Y_2 for insurance choice and Y_3 is a dummy for credit or loans. R shows risk preference, T for time preference, S shows the individual is the spouse of the head of the household, C as a child/grandchild of the head, M for any other member of the household with A indicating the age of the individual. The $Z_1 \ldots Z_n$ are for other control variables in the model. These are ownership of mobile phones, gender, education, employment type, marital status, number of dependents (household members below age 18), household income, a rural/urban dummy and regional dummies. The model is estimated using maximum likelihood.

2.3.1 Description of Data and Variables

The Data we use for the study is the Ghana Living Standards Survey Round 7 (GLSS7), which was collected over a 12-month period by the Ghana Statistical Service between 2016 and 2017. This is a nationally representative data collected using a two-stage stratified sampling design. The first stage selected 1,000 enumeration areas as the Primary Sampling Unit (PSU). These were allocated into the 10 regions of the country using probability proportional to population size. The Enumeration Areas were also divided into urban and rural localities of residence. A complete listing of households in the selected Primary Sampling Units was undertaken to form the secondary sampling units. At the second stage, 15 households from each PSU were selected systematically. The total sample size was therefore 15,000 households. Available data, however, is for 14,009 households with about 58,844 individual members. The data also includes final sampling weights adjusted for nonresponse.

At the individual level, the risk and time preference questions were administered to all household members aged 12 years and above. Not all members of the household answered these questions by themselves. We therefore limit our analysis to a subpopulation made up of individuals who self-answered the risk and time preference questions and are at least 18 years. With respect to time preference, individuals were to answer three questions each with two options. Respondents were to indicate their preference by imagining that they have a choice between the two options. For question 1, the options are to either receive 16 Ghana Cedis immediately or to receive 32 Ghana Cedis in 1 month. The options for the second question, are: to receive 16 Ghana cedis today or 40 Ghana Cedis in 1 month. The last

question has the same first option as the two previous questions with the alternative option being to receive 24 Ghana cedis in 1 month. Based on the responses to these questions, we classify individuals as indicated on Table 2.1.

We use a time preference dummy by condensing these classifications into two groups – patient (moderately patient and patient) and impatient. An individual is considered impatient if he chooses the option "… immediately" to all the questions. In this instance, the discount rate is above 1.5. He is patient if he chooses "1 month" for all the three questions; this has a discount rate less than 0.5. There are two groups we classify as moderately patient; those with discount rates between 0.5 and 1.5. Any other choice combination is inconsistent, if the associated discount rates are inconsistent. Those in the inconsistent group are excluded from the analysis. Thus, approximately 48.2 percent of respondents are patient with 48.5percent being impatient.

The responses to two lottery-type questions are used to categorize individuals into two risk preference[14] groups; low risk (risk averse) and some risk (not risk averse). Respondents were asked to imagine two scenarios and indicate their preference from the two options. The options for the first question (Q1) are: to receive 4 Ghana Cedis for sure or the interviewer flips a 1 Cedi coin where the respondent gets 12 cedis with a shell on the coin showing up or otherwise receive 1 Ghana cedi. The subsequent question (Q2) has the same first option as Q1 with the second option still being determined by the toss of a coin. The respondent will receive 16 cedis if a shell shows up or 1 cedi alternatively.

Table 2.1: Time Preference Classification for Individuals

Scenario	Q1	Q2	Q3	Discount Rate	Time Preference	Percentage
1	16	16	16	r > 1.5	Impatient	48.48
2	16	40	16	1< r < 1.5	Moderately patient	3.08
3	32	40	24	r < 0.5	Patient	39.04
4	16	16	24	r > 1.5 & r < 0.5	Inconsistent	0.81
5	16	40	24	1<r<1.5 & r <0.5	Inconsistent	1.42
6	32	16	16	0.5<r<1 & r>1.5	Inconsistent	0.72
7	32	16	24	0.5<r & r>1.5	Inconsistent	0.39
8	32	40	16	0.5<r<1.5	Moderately Patient	6.07
Total					**24,658**	**100.00**

Source: Authors, with data from GLSS7

The classification from the responses are on Table 2.2. If a person chooses the sure bet in response to all the two questions, he is risk-averse, but when he chooses the bet in both

[14] There is another question on investment preference, but we chose to use the lottery type question, following the standard approach in the literature.

questions, he is considered as high risk. However, if in the first question, he chooses the sure bet but chooses the lottery in the second question, then he is moderately risk averse. The reasoning is that he needs a higher expected value (EV) more than 6.5 to take the bet and when the expected value increased to 8.5, he was induced to take the bet. Any individual taking the bet at a lower expected value but not taking it at a higher value is considered to be inconsistent.

Savings can be with commercial banks, investment banks, rural/community banks, savings and loans schemes, credit unions, Susu scheme, mobile money or any other institution. Those who are classified as saving in this study are either having a bank account or contributing to a savings and loan scheme. Within the subpopulation of interest, the percentage that saves is 46 but among the groups, savings is high for heads of households but low among other members. Insurance as a dependent variable is based on the question whether the individual has an insurance policy. Though we do not distinguish between the type of insurance the individual holds, most of the policies are in health insurance[15]. About 94percent of those who said they had insurance were in health insurance. From the descriptive statistics, approximately 23percent have an insurance cover and it is highest among spouses and children (Table 2.3). Credit utilization is defined as all those who applied for a loan and were not rejected as well as those who said they have too much credit at hand. Credit seems not to be a preferred option for individuals since the proportion who had some credit facility was 7percent.

Table 2.2: Risk Preference Classification

Scenario	Q1	EV1	Q2	EV2	Risk Preference	Percentage
1	4	4	4	4	No risk	76.03
2	4	4	1,16	8.5	Moderate	2.22
3	1,12	6.5	4	4	Inconsistent	1.67
4	1,12	6.5	1,16	8.5	High	20.07
Total					**24,628**	**100.00**

Source: Authors, with data from GLSS7

Since most of the studies on savings behaviour use the household head as a representative agent of the household, we include the relation of an individual to the head in our analysis to determine if there are significant differences in behaviour in terms of savings, insurance and credit utilization. Heads of households make up 53percent with 24percent as

[15] Individuals below age 18 and above 70 years as well as pregnant women do not pay premiums. Social Security and National Insurance Trust (SSNIT) contributors are also exempted from paying directly but deductions are made by SSNIT (Wang, Otoo, & Dsane-Selby, 2017).

spouses while 16percent are children (children/grandchildren). Among heads of households 36percent are females but for spouses, females make up approximately 98percent. On the average, household heads are 5years older than spouses. The youngest group are children with average age of 24years. On the whole females make up more than half of the sample. The mean age of the subpopulation is 40 years with the oldest person being 99 years. Age is used as an explanatory variable to capture life cycle effects in the dependent variables. With life cycle effects, we expect a hump shape between age and savings but given possible bequest motive, we don't expect the probability to save to drop to very low levels after retirement. For credit, we also expect an inverted u-shape with age and given the bequest motive, individuals are expected to have very low propensities to borrow later in life. We should see an increasing utilization of insurance with age since one's stock of health is expected to deteriorate with age (Grossman, 1972).

We control for other demographics and household level variables. The income variable used in the estimation is the log of household income and falls between 2.4 and 16.6 with an overall mean of 8.2. Current income is expected to have a positive effect on savings (Friedman, 1957), credit and insurance choice. Because the income variable is at the household level, we add employment status and educational dummies at the individual level to capture the effect of earnings and earning potentials. Lacking individual level income data, Hillesland (2019) uses employment status and education. Education and income are known to be highly correlated (Browning & Lusardi, 1996) and savings have been found to be too little among those without college education (Bernheim & Scholz, 1993).

Those with a minimum qualification of Basic Education Certificate/Middle School Leaving Certificate (BECE/MSLC) form the largest education class of 37percent largely made up of heads and spouses. Those possessing Secondary Education are 16 percent. The remaining 12percent falls within vocational/technical/teacher training and tertiary education. Children of household heads have higher levels of education than all the other groups. On employment, the self-employed (Agric and Non-Agric) is the largest group taking 42percent, followed by paid employees of 17percent. Self-employment is high among both heads and spouses.

There are 16percent of individuals not in the labour force (inactive), with the unemployed taking 11percent of the pie. A larger section of children and other household members are either inactive, in other types of employment (contributory family workers, apprentices or casual workers) or are unemployed.

Table 2.3: Descriptive Statistics of Variables

Variable	All	Head	Spouse	Child/ Grandchild	Other Member
Relationship to head		53.13	24.00	16.07	6.80
Savings	45.95	56.13	38.88	32.09	23.58
Insurance	23.4	23.1	24.43	24.05	20.56
Credit	6.55	8.63	6.89	1.11	1.72
Risk Averse	78.08	77.44	81.81	75.2	76.59
Patient	49.47	49.59	50.72	48.54	46.22
Female	55.22	36.04	97.95	49.87	66.99
Income	8.21	8.09	8.23	8.45	8.50
	(0.023)	(0.021)	(0.032)	(0.039)	(0.063)
Age	39.88	45.15	38.90	23.78	40.16
	(0.129)	(0.181)	(0.20)	(0.13)	(0.696)
No. of Dependents	2.1	1.65	2.72	2.3	2.4
	(0.025)	(0.019)	(0.038)	(0.039)	(0.065)
Marital Status: Married	57.17	57.46		8.764	18.12
Separated/Divorced	7.99	12.92		4.134	6.711
Widowed	8.39	12.55		0.5919	23.96
Never Married	26.46	17.07		86.51	51.21
Education: None	35.17	34.51	49.76	12.44	42.54
BECE/MSL	36.56	39.46	35.68	31.15	29.75
Secondary	15.96	12.18	7.365	40.16	18.65
Voc./Tech./Training	5.188	5.663	3.706	6.239	4.217
Tertiary	7.128	8.194	3.486	10.01	4.835
Employment: Employee	17.02	22.96	8.562	13.24	9.346
Self-emp (Non-Agric)	23.70	25.78	34.76	7.426	6.941
Self-emp (Agric)	18.66	26.82	12.76	5.076	7.822
Unemployed	10.85	7.448	12.07	17.93	16.41
Other	13.71	6.287	20.84	25.08	19.72
Inactive	16.06	10.7	11.01	31.25	39.76
Region: Western	9.85	10.06	10.24	8.494	10.08
Central	8.70	8.43	7.831	11.47	7.288
Greater	18.42	17.9	18.01	19.67	21.04
Volta	7.79	7.424	7.605	8.208	10.37
Eastern	11.68	12.33	10.49	12.51	8.879
Ashanti	19.96	22.98	17.14	17.13	12.93
Brong Ahafo	9.50	9.38	9.795	9.833	8.636
Northern	7.73	6.395	11.14	6.176	9.815
Upper East	3.76	2.998	4.682	3.813	6.323
Upper West	2.60	2.104	3.064	2.694	4.644
Rural Area	46.1	44.89	50.01	44.07	46.58
Mobile Phone	77.35	83.19	69.56	77.52	58.86
Subpopulation: Min	23,285	11703	5987	3745	1850
Subpopulation: Max	24,713	12402	6343	3980	1988

Values in parentheses are linearized standard errors for the subpopulation in question. Apart from the first three and the last two variables, all other variables are in percentages.

Source: Authors, with data from GLSS 7

The percentage of the married (legal and consensual) is about 57 and those who have never married constitute approximately 26percent and the remaining 16percent are either divorced/separated or widowed. Individuals in rural areas are 46 percent with the rest being in urban areas. Regionally, Ashanti, Greater Accra and the Eastern regions have the largest

number of individuals. About 77percent own mobile phones. We include ownership of mobile phones and locational factors (regional and rural dummies) to control for possible supply side factors.

2.4 Results and Discussion

From the estimation, there is a significant positive correlation between the three products: savings, insurance and credit. The products can thus be seen as complementary. Households that save are also more likely to use credit. This can be explained by the fact that with no savings, individuals have a lower chance of assessing credit and may not even apply for it, given that they may require some form of security and savings can serve as "cash collateral" for some institutions. With the multiplicity of shocks individuals face and limited formal insurance to insure other important shocks, such as income shocks, individuals complement the available insurance products, largely health insurance, with savings. We present and discuss the results under four subsections: life cycle effect and bequest motive, Risk Preferences, Other factors and comparing household members.

2.4.1 Life Cycle Effect and Bequest Motive

There are life cycle effects in terms of savings and credit utilization as age and its square are significant for these two products (Table 2.4). To see how the probability for the three products vary over the life cycle, we plot their average adjusted predictions at representative values of age between 20 and 80 years. It is evident from Figure 2.1 that the probability to save reaches a maximum at age 60, the retirement age but reduces to about 45percent by age 80. Thus, though the life cycle effect is operative, we cannot also discount the bequest motive since, even at age 80, the probability to save is still high and above that at age 20. This observation is in line with Deaton's argument that the older generation, in developing countries, need not dispose of their assets like it is done in developed countries, because they live with their children.

Credit utilization is very low and seems therefore not to be a preferred choice for individual household members. When asked about why they did not apply for a loan, 69percent said there was no need for it (Table A 2.1). The second major reason given by 19percent was high interest rate. The highest probability to utilize credit is less than 10percent and that is when the individual is at age 50. By age 80, there is a 3percent chance of taking a loan (Figure 2.1). Insurance uptake is low but higher than credit utilization.

Among those without insurance, 45percent said it's because they cannot afford it (Table A 2.2). Another 27percent claim they do not see it necessary with 20percent declaring that they do not know what insurance is or how it works. Insurance uptake however increases with age as expected (Figure 2.1). This can possibly be because health insurance is free after age 70. The increasing demand for insurance at older ages, possibly as a result of health insurance being free can help individuals conserve household resources. Insurance therefore will put less pressure on the household in terms of the financial outlays for already insured shocks.

2.4.2 Risk Preferences

Risk preference significantly determines savings, pointing to the precautionary motive for saving, in contrast to Giesbert, Steiner, & Bendig (2011) who found that among household heads, self-assessed risk preference is not a significant determinant for savings. This evidence of precautionary motive for savings is in line with other works such as Lee and Sawada (2010) and (Guiso & Paiella, 2005). If all other variables in the model are at their observed values by varying only risk preference the probability for the risk averse to save, is 46.7percent (Table 2.4). This translates into an average partial effect of 3.3percent above that of the non-risk averse. Though risk preference significantly determines savings, time preference is not a significant determinant; a possible indication that precautionary motive is more important than impatience in the decision to save. As argued by Carroll (1997), individuals have a wealth-to-income ratio such that when current wealth is below it, precautionary motive will dominate impatience, generating more savings from individuals.

For both credit and insurance, however, risk aversion does not significantly determine the probability of using them. This agrees with Giesbert, Steiner, & Bendig (2011) finding on the relationship between willingness to take risk and insurance[16]. There is thus an indicative evidence that precautionary measures are largely undertaken through savings possibly because available insurance products are not suitable to insure other important risks individuals face, such as income uncertainty or unemployment risk. As has been stated previously, individuals hold largely health insurance and will thus need to self-insure other risks they face; this they do through savings. An examination of the effect of risk aversion on

[16] Though the authors found a positive relationship between willingness to take risk and micro life insurance, they add a note that a robustness check with all available insurance products including the National Health Insurance shows an insignificant negative relationship between the willingness to take risk and insurance. Our results in this light agrees with their results.

savings show that though the average marginal effect was about 3.3percent, it changes over the life cycle (See Figure 2.2).

2.4.3 Other Factors

Education and employment differences are two important factors that contribute more to savings, insurance and credit utilization. For savings, the average adjusted predicted probability of savings for those with basic education qualification is 45.2percent with and associated average partial effect of 12percent compared to those with no qualification. Completing secondary school yields a partial effect is 21.1percent. The average partial effect of tertiary education is more than twice the difference between those with no qualification and secondary education. Results on the effect of the nature of employment show that compared to the inactive (reference category), all other groups are more likely to save but employees having the highest marginal effect to save (Table 2.4).

Significant differences are found between employees (both public and private sector) and the inactive in the decision to insure. The design of the health insurance scheme makes it much easier for paid employees who contribute to Social Security to hold health insurance than all the other categories of employment. Health insurance premium for SSNIT contributors are not paid directly but deducted as part of the SSNIT contributions before employees receive their salaries. What more, other insurance service providers may market their services more to those in the formal sector than otherwise since it is easier to reach these groups. It is therefore not surprising to see those employees with the highest probability of saving also having the highest probability of taking insurance. Employment status also significantly determine credit utilization. The self-employed have the highest partial effect to use credit compared to all other groups, followed by paid employees (Table 2.4).

Gender differences indicate that males save a little more than females, but females have a higher probability to insure than males. The higher demand for insurance by females than males, may be a reflection of the design of Ghana's health insurance, as it tends to favour females especially pregnant women (Wang, Otoo, & Dsane-Selby, 2017). Once they enrol onto it, it will be much easier for them to renew in subsequent years since they have enjoyed the service and know the importance of it. Taking account of marital status, those who have never married consistently have lower probabilities to save, insure and utilize credit compared to those who are married (the reference group).

Table 2.4: Estimates from Trivariate Probit Model for the Joint Choice of Savings, Insurance and Credit

	savings			Insurance			Credit		
	Coef.	**AAP**	**AME**	**Coef.**	**AAP**	**AME**	**Coef.**	**AAP**	**AME**
Patient	0.035	0.465***	0.01	0.025	0.238***	0.007	-0.052	0.063***	-0.006
	(0.027)	(0.005)	(0.008)	(0.026)	(0.005)	(0.008)	(0.036)	(0.003)	(0.004)
Risk Averse	0.113***	0.467***	0.033***	0.000	0.234***	0.0001	0.009	0.066***	0.001
	(0.032)	(0.004)	(0.009)	(0.031)	(0.004)	(0.009)	(0.046)	(0.002)	(0.005)
Relationship to head: Spouse	-0.245***	0.435***	-0.073***	0.075*	0.249***	0.022*	-0.176***	0.056***	-0.021***
	(0.042)	(0.010)	(0.013)	(0.040)	(0.009)	(0.012)	(0.063)	(0.005)	(0.007)
Child/Grandchild	-0.495***	0.363***	-0.145***	0.058	0.244***	0.017	-0.477***	0.031***	-0.046***
	(0.055)	(0.013)	(0.0157)	(0.055)	(0.014)	(0.016)	(0.097)	(0.006)	(0.007)
Others	-0.456***	0.374***	-0.134***	-0.051	0.213***	-0.014	-0.504***	0.029***	-0.048***
	(0.071)	(0.019)	(0.021)	(0.060)	(0.015)	(0.016)	(0.099)	(0.006)	(0.007)
Age	0.033***		0.003***	-0.003		0.0016***	0.058***		0.001***
	(0.005)		(0.0004)	(0.005)		(0.0004)	(0.008)		(0.0002)
Age Square ($*10^2$)	-0.029***			0.010**			-0.057***		
	(0.0055)			(0.000)			(0.0081)		
Female	-0.064*	0.452***	-0.019*	0.160***	0.255***	0.046***	0.082	0.070***	0.009
	(0.035)	(0.006)	(0.010)	(0.034)	(0.006)	(0.009)	(0.057)	(0.004)	(0.006)
Education: BECE/MSLC	0.384***	0.452***	0.120***	0.108***	0.225***	0.029***	0.061	0.063***	0.007
	(0.034)	(0.007)	(0.011)	(0.032)	(0.006)	(0.009)	(0.045)	(0.003)	(0.005)
Secondary	0.669***	0.543***	0.211***	0.221***	0.258***	0.063***	0.083	0.066***	0.009
	(0.046)	(0.011)	(0.015)	(0.046)	(0.011)	(0.013)	(0.066)	(0.006)	(0.007)
Voc./Tech/Training	1.106***	0.677***	0.344***	0.248***	0.267***	0.071***	0.389***	0.109***	0.052***
	(0.071)	(0.019)	(0.021)	(0.061)	(0.017)	(0.018)	(0.086)	(0.013)	(0.014)
Tertiary	1.742***	0.832***	0.500***	0.631***	0.397***	0.202***	0.396***	0.110***	0.054***
	(0.077)	(0.014)	(0.017)	(0.060)	(0.018)	(0.021)	(0.079)	(0.012)	(0.012)
Employment: Employee	0.942***	0.606***	0.292***	0.176***	0.276***	0.053***	0.375***	0.063***	0.033***
	(0.054)	(0.011)	(0.017)	(0.052)	(0.010)	(0.015)	(0.087)	(0.005)	(0.007)
Self-employed (Non-Agric)	0.764***	0.550***	0.236***	0.074	0.245***	0.021	0.607***	0.094***	0.064***
	(0.050)	(0.009)	(0.015)	(0.046)	(0.008)	(0.013)	(0.079)	(0.005)	(0.007)
Self-employed (Agric)	0.377***	0.427***	0.113***	-0.053	0.209***	-0.015	0.418***	0.068***	0.038***
	(0.054)	(0.010)	(0.016)	(0.050)	(0.009)	(0.014)	(0.077)	(0.004)	(0.006)
Unemployed	0.161***	0.361***	0.047***	-0.009	0.221***	-0.003	0.171*	0.043***	0.013**
	(0.053)	(0.011)	(0.015)	(0.052)	(0.011)	(0.015)	(0.087)	(0.005)	(0.006)
Other	0.322***	0.410***	0.096***	-0.022	0.217***	-0.006	0.226**	0.047***	0.017**
	(0.053)	(0.011)	(0.016)	(0.051)	(0.010)	(0.014)	(0.090)	(0.006)	(0.007)
Marital Status: Separated/Divorced	-0.106*	0.442***	-0.031*	-0.024	0.229***	-0.007	0.200**	0.093***	0.027**
	(0.056)	(0.015)	(0.016)	(0.054)	(0.014)	(0.015)	(0.079)	(0.011)	(0.012)
Widowed	-0.157***	0.428***	-0.045***	-0.049	0.222***	-0.014	0.006	0.067***	0.0007

	savings			Insurance			Credit		
	Coef.	**AAP**	**AME**	**Coef.**	**AAP**	**AME**	**Coef.**	**AAP**	**AME**
	(0.056)	(0.015)	(0.016)	(0.056)	(0.014)	(0.016)	(0.078)	(0.008)	(0.009)
Never Married	-0.092*	0.446***	-0.027*	-0.001	0.236***	-0.0003	-0.228***	0.043***	-0.023***
	(0.051)	(0.011)	(0.015)	(0.050)	(0.011)	(0.015)	(0.067)	(0.005)	(0.006)
Income	0.036***		0.011***	0.026**		0.008**	0.047***		0.005***
	(0.009)		(0.003)	(0.010)		(0.003)	(0.012)		(0.001)
Number of Dependents	0.005		0.001	0.021**		0.006**	0.013		0.001
	(0.007)		(0.002)	(0.009)		(0.003)	(0.009)		(0.001)
Region: Central	0.235***	0.517***	0.070***	0.344***	0.271***	0.097***	0.173**	0.102***	0.025***
	(0.058)	(0.010)	(0.017)	(0.058)	(0.010)	(0.016)	(0.068)	(0.006)	(0.01)
Greater	0.177***	0.499***	0.052***	-0.215***	0.126***	-0.048***	-0.377***	0.038***	-0.039***
	(0.061)	(0.012)	(0.018)	(0.062)	(0.007)	(0.014)	(0.082)	(0.004)	(0.01)
Volta	-0.056	0.431***	-0.016	0.607***	0.361***	0.187***	-0.053	0.070***	-0.007
	(0.058)	(0.010)	(0.017)	(0.058)	(0.011)	(0.016)	(0.071)	(0.006)	(0.009)
Eastern	0.016	0.452***	0.005	0.627***	0.368***	0.194***	-0.164**	0.058***	-0.02**
	(0.057)	(0.010)	(0.017)	(0.060)	(0.013)	(0.018)	(0.070)	(0.005)	(0.009)
Ashanti	0.016	0.452***	0.005	0.172***	0.219***	0.046***	-0.197**	0.054***	-0.023**
	(0.057)	(0.010)	(0.017)	(0.056)	(0.008)	(0.014)	(0.077)	(0.005)	(0.009)
Brong	0.001	0.447***	0.0004	0.379***	0.283***	0.109***	-0.211***	0.053***	-0.024***
	(0.058)	(0.010)	(0.017)	(0.058)	(0.010)	(0.016)	(0.075)	(0.005)	(0.009)
Northern	-0.349***	0.348***	-0.099***	-0.171***	0.135***	-0.039***	0.243***	0.114***	0.037***
	(0.059)	(0.010)	(0.017)	(0.063)	(0.008)	(0.015)	(0.068)	(0.008)	(0.010)
Upper East	0.376***	0.558***	0.111***	0.538***	0.336***	0.162***	0.225***	0.111***	0.034***
	(0.058)	(0.010)	(0.017)	(0.057)	(0.011)	(0.016)	(0.070)	(0.008)	(0.01)
Upper West	-0.076	0.425***	-0.022	0.478***	0.315***	0.142***	0.065	0.086***	0.009
	(0.061)	(0.012)	(0.018)	(0.056)	(0.011)	(0.016)	(0.075)	(0.008)	(0.010)
Rural	-0.121***	0.441***	-0.035***	-0.124***	0.215***	-0.036***	0.141***	0.074***	0.016***
	(0.030)	(0.006)	(0.009)	(0.029)	(0.005)	(0.008)	(0.041)	(0.003)	(0.005)
Mobile Phone	0.663***	0.499***	0.197***	0.192***	0.246***	0.053***	0.029	0.066***	0.003
	(0.036)	(0.004)	(0.010)	(0.034)	(0.004)	(0.009)	(0.047)	(0.002)	(0.005)
Cons	-2.446***			-1.692***			-3.616***		
	(0.160)			(0.160)			(0.217)		
Correlation	$\rho 21$	0.203***		$\rho 31$	0.331***		$\rho 32$	0.097***	
		(0.018)			(0.024)			(0.023)	
N	23,258			F-stat	115.08		Prob>F	0.0000	

Linearized Standard Errors in Parenthesis; * p<0.1; ** p<0.05; *** p<0.0; ρij are the respective tetrachoric correlations. AAPs is Average Adjusted Predictions and AMEs is Average Marginal/Partial Effects. Coef. is the coefficient from the trivariate probit model

Ownership of mobile phones, an indicative factor for access to financial services, has a significant effect on the choice for savings and insurance. Regional dummies are also important in the three choices, especially in the decision to insure. While people in rural areas have lower partial effect to save and insure relative to urban areas, they have a higher partial effect to utilize credit (Table 2.4).

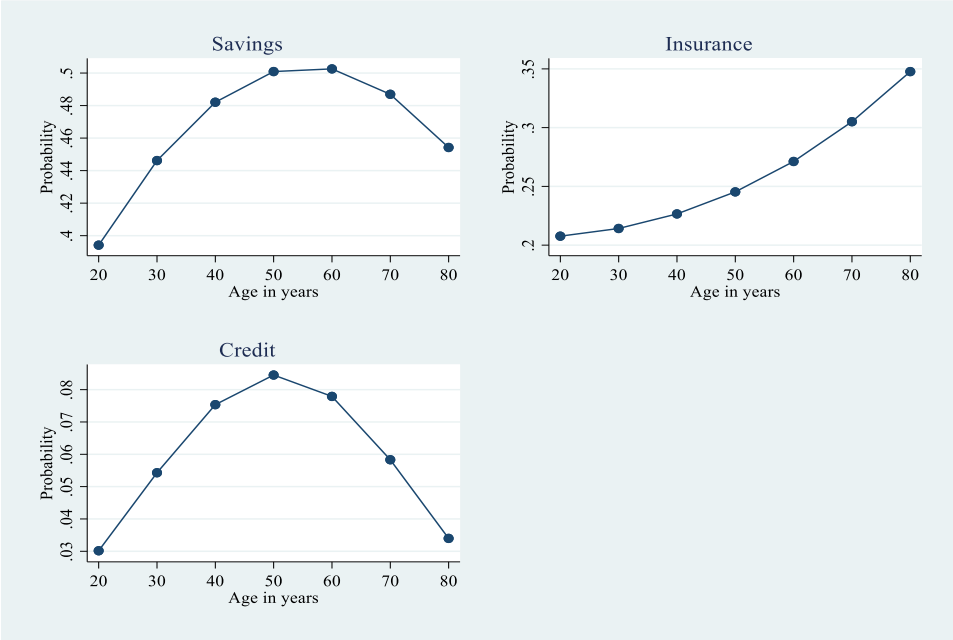

Figure 2.1 Probability to Save, Insure and Utilize Credit over the Life Cycle of Individuals
Source: Authors, with data from GLSS7

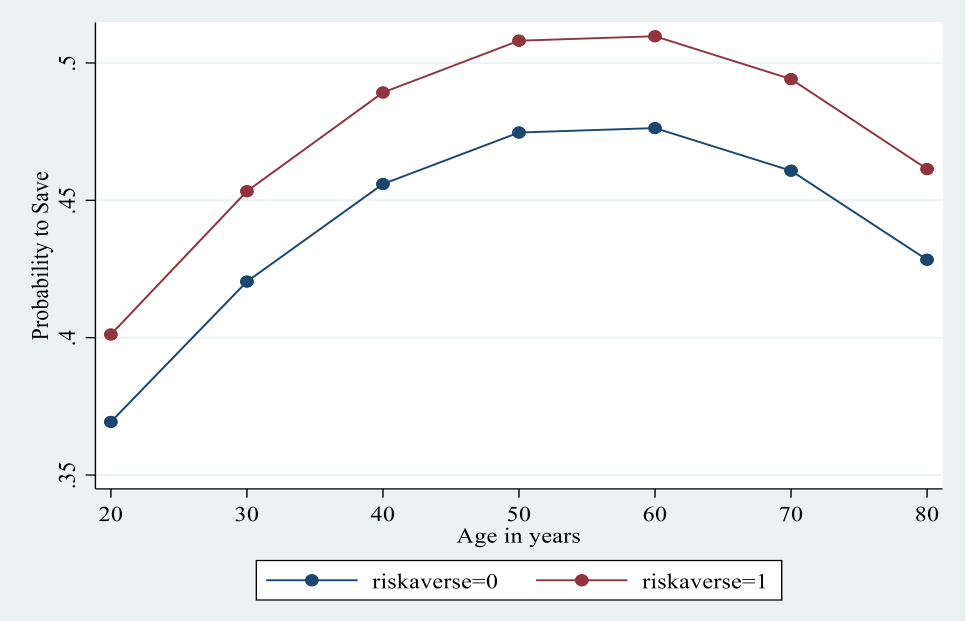

Figure 2.2: Risk Preference and Savings Over the Life Cycle.
The two lines are the Average Adjusted Predicted Probability to save. The difference between the two lines shows the average marginal effect at representative values of age
Source: Authors, with data from GLSS7

2.4.4 Comparing Household Members

A comparative analysis of the categories of household members show that heads have the highest probability to save and utilize credit, followed by spouses (Table 2.4). Heads of households have the ultimate responsibility for the members and are expected to provide for the major needs with spouses, if any, supporting in this role. Knowing their responsibilities, heads and spouses will keep more savings and when necessary, apply for credit to meet the needs of the family. For insurance, the only significant difference is found between the head of the household and the spouse; spouses have the highest probability to hold insurance. The higher likelihood for heads and males to save than spouses and females, suggests the existence of wealth gaps. Since there are more spouses who are females and more heads who are males, there will be gender wealth gaps. In her resolve to explain gender wealth gap in Ghana, Hillesland (2019) notes that a large part of the gap was not explained in the model. She suggests that the unexplained part could be attributed to savings and consumption differences.

We examine how risk preferences affect the savings decision of household members, by estimating three separate trivariate probit models for heads, spouses and then combine the other groups[17] (child/grandchild and others). The decision to combine them is based on their probabilities not being widely different (Table 2.4). Risk preference affects the savings decision of heads and spouses but not that of other household members (Table 2.5). It contributes marginally more to spousal savings decision than heads indicating that spouses are likely to face higher insecurity than heads of households which engenders them to keep more precautionary savings. Other members of the household may rely on heads and spouses for precautionary measures, since risk preference does not influence their savings decision.

[17] Though we jointly estimate savings, insurance and credit models for the three groups of household members, we only produce that for savings because risk preference we found, significantly influences on the saving decision.

Table 2.5: Average Marginal Effects of Savings for Household Members

	Head	Spouse	Others
Patient	0.019*	0.007	-0.008
	(0.010)	(0.016)	(0.016)
Risk Averse	0.037***	0.053***	0.004
	(0.013)	(0.020)	(0.017)
Age	0.001**	0.003***	0.009***
	(0.000)	(0.001)	(0.002)
Female	-0.051***	-0.026	0.029*
	(0.014)	(0.072)	(0.015)
Education: BECE/MSLC	0.134***	0.136***	0.048**
	(0.015)	(0.020)	(0.021)
Secondary	0.248***	0.203***	0.127***
	(0.022)	(0.036)	(0.024)
Voc./Tech/Training	0.320***	0.436***	0.286***
	(0.027)	(0.047)	(0.043)
Tertiary	0.474***	0.539***	0.473***
	(0.020)	(0.042)	(0.041)
Employment: Employee	0.254***	0.326***	0.258***
	(0.025)	(0.042)	(0.030)
Self-employed (Non-Agric)	0.218***	0.264***	0.198***
	(0.022)	(0.027)	(0.035)
Self-employed (Agric)	0.079***	0.178***	0.166***
	(0.021)	(0.032)	(0.059)
Unemployed	0.039	0.048*	0.040*
	(0.027)	(0.029)	(0.022)
Others	0.054*	0.135***	0.067***
	(0.030)	(0.031)	(0.020)
Marital Status: Separated/Divorced	-0.002		-0.103***
	(0.019)		(0.035)
Widowed	-0.026		-0.035
	(0.020)		(0.045)
Never Married	-0.025		-0.016
	(0.019)		(0.026)
Income	0.011***	0.005	0.020***
	(0.004)	(0.005)	(0.005)
Number of Dependents	0.008**	-0.003	0.000
	(0.003)	(0.004)	(0.004)
Region: Central	0.032	0.041	0.191***
	(0.021)	(0.036)	(0.034)
Greater	0.043*	0.058	0.090***
	(0.023)	(0.038)	(0.033)
Volta	-0.037*	-0.063*	0.077**
	(0.021)	(0.036)	(0.035)
Eastern	0.006	-0.031	0.059
	(0.022)	(0.037)	(0.039)
Ashanti	0.000	-0.009	0.036
	(0.021)	(0.036)	(0.035)
Brong	0.009	-0.045	0.039
	(0.021)	(0.037)	(0.033)
Northern	-0.159***	-0.082**	-0.013
	(0.022)	(0.034)	(0.035)
Upper East	0.067***	0.123***	0.192***
	(0.022)	(0.035)	(0.035)
Upper West	-0.066***	0.014	0.021
	(0.023)	(0.035)	(0.034)
Rural	-0.043***	-0.047**	-0.006
	(0.012)	(0.019)	(0.016)
Has Mobile Phone	0.250***	0.141***	0.165***
	(0.017)	(0.019)	(0.019)
N	11693	5975	5590
F	63.38	31.07	27.038

Source: Authors, with data from GLSS7. Linearized Standard Errors in Parenthesis; * p<0.1; ** p<0.05; *** p<0.01

2.5 Conclusion

In this study, we examined the joint choice for savings, insurance and credit among household members, taking account of time and risk preferences using a trivariate probit model. We compared the choices of other household members to that of the head of the household, unlike previous studies that tend to focus on the household head. We found that the three products complement each other. Among them, savings has the highest probability of being used with credit having the lowest. Household heads had the highest chance of saving followed by the spouses with other members having lower probabilities of saving. Insurance usage is high among spouses than heads of households and increases with age. Credit utilization among other members of the household is very low. Though credit choice is high for household heads than their spouses, the difference is marginal. These results suggest the existence of life cycle effects as well as the bequest motive since in later years of life, the probability to save or insure is high but that to borrow is low. The joint effect of these three at older ages imply a conservation of household resources with no desire to leave debt for descendants.

Another issue we were interested in investigating is how preferences influence the choices individuals make in terms of the three products. We found that risk preferences significantly determine the decision to save; pointing to the precautionary saving motive. What more, though risk preference was significant in determining savings, time preference was not significant and point to the importance of precautionary motive over impatience in the savings decision. Separate regressions for household heads, spouses and other household members show that precautionary savings is significantly used by household heads and their spouses but driven more by spouses. In addition, we found risk preference to affect savings but not insurance utilization and this suggests a limited scope of the available insurance products for other important risks individuals face, making them self-insure through savings.

There are other important variables that determine the decision to save, insure and utilize credit. These include ownership of a mobile phones, household income, employment status, location, gender and marital status. Though we examined these, our focus was more on preferences and individuals' relationship with the head of the household, since these have not been examined to a greater extent in the literature, especially within an African context. Emerging from the results, it can be said that studies that examine only the behaviour of household heads do not expose observed dynamics in the saving, insurance and credit

utilization decisions especially when households in developing countries are made up of different generations of individuals.

For policy purposes, efforts to improve on savings, insurance and credit utilization can first be made by household heads. Household heads should be encouraged to pull along other members of the household especially in the choice of savings and insurance. Financial institutions may also target other members of the household in their marketing campaigns. Meeting heads of households alone may not be enough to engender increased utilization of these products. To increase participation in the insurance markets, insurance products should be well explained by marketing executives. Policies aimed at making mobile phones easily accessible to individuals at cheaper costs, can also enhance utilization of financial services.

References

Abdelkhalek, T., Arestoff, F., de Freitas, N. E., & Mage, S. (2010). A Microeconometric Analysis of Household Savings Determinants in Morocco. *African Review of Money Finance and Banking*, 7-27.

Attanasio, O. P., & Székely, M. (2000). *Household Saving in Developing Countries - Inequality, Demographics and All That: How Different are Lating America and South East Asia?* Inter-American Development Bank.

Baidoo, S. T., Boateng, E., & Amponsah, M. (2018). Understanding the Determinants of Savings in Ghana: Does Financial Literacy Matter? *Journal of International Development, 30*, 886-903.

Bank of Ghana. (2017). *Impact of Mobile Money on the Payment System in Ghana: An Econometric Analysis.* Accra: Bank of Ghana.

Baulch, B., & Hoddinott, J. (2000). Economic Mobility and Poverty Dynamics in Developing Countries. *Journal of Development Studes, 36*(6), 1-24.

Beckmann, E., Hake, M., & Urvova, J. (2013). Determinants of households' savings in Central, Eastern and Southeastern Europe. *Focus on European Economic Integration, 3*(13), 8-29.

Bernheim, B. D., & Scholz, J. K. (1993). Private Savings and Public Policy. *Tax Policy and the Economy, 7*, 73-110.

Besley, T. (1995). Savings, Credit and Insurance. In J. Behrman, & T. N. Srinivasan (Eds.), *Handbook of Development Economics* (Vol. III, pp. 2123 - 2207). Elsevier Science B.V.

Browning, M., & Lusardi, A. (1996). Household Saving: Micro Theories and Micro Facts. *Journal of Economic Literature, 34*(4), 1797 - 1855.

Carroll, C. D. (1997). Buffer-Stock Saving and the Life Cycle/Permanent Income Hypothesis. *The Quarterly Journal of Economics*, 1 - 55.

Carroll, C. D., & Samwick, A. A. (1998). How Important is Precautionary Saving? *The Review of Economics and Statistics, 80*(3), 410-419.

Ceritoğlu, E. (2013). The Impact of Labour Income Risk on Household Saving Decisions in Turkey. *Review of Economics of the Household*, 109-129. doi:10.1007/s11150-011-9137-2

Deaton, A. (2005). Franco Modigliani and the Life-Cycle Theory of Consumption. *BNL Quarterly Review, 58*(233-234), 91 - 107.

Deaton, A. (2018). *The Analysis of Household Surveys: A Microeconometric Approach to Development Policy. Reissue Edition with a New Preface.* Washington, DC: World

Bank. doi:10.1596/978-1-4648-1331-3. License: Creative Commons Attribution CC BY 3.0 IGO

Deaton, A., & Paxson, C. (2000). Growth and Saving Among Individuals and Households. *The Review of Economics and Statistics, 82*(2), 212 - 225.

Dynan, K. E. (1993). How Prudent are Consumers? *Journal of Pollitical Economy, 101*(6), 1104-1113.

Dynan, K. E., Skinner, J., & Zeldes, S. P. (2004). Do the Rich Save More? *Journal of Political Economy, 112*(2), 397-444.

Friedman, M. (1957). The Permanent Income Hypothesis. In M. Friedman, *A Theory of the Consumption Function* (pp. 20 - 37). New Jersey: Princeton University Press.

Fuchs-Schündeln, N., & Schündeln, M. (2005). Precautionary Savings and Self-Selection: Evidence from the German Reunification "Experiment". *The Quarterly Journal of Economics, 120*(3), 1085 - 1120.

Gersovitz, M. (1988). Saving and development. *Handbook of Development Economics, 1*, 381 - 424.

Ghana Statistical Service. (2018). *Ghana Living Standards Survey Round 7 (GLSS7): Poverty Trends in Ghana 2005 - 2017.* Accra.

Giesbert, L., Steiner, S., & Bendig, M. (2011). Participation in Micro Life Insurance and the Use of other Financial Services in Ghana. *The Journal of Risk and Insurance, 78*(1), 7-35. doi:10.1111/j.1539-6975.2010.01405.x

Greene, W. H. (2012). *Econometric Analysis.* New York: Prentice Hall.

Grossman, M. (1972). On the Concept of Health Capital and the Demand for Health. *Journal of Political Economy*, 223 - 255.

Guiso, L., & Paiella, M. (2005). The Role of Risk Aversion in Predicting Individual Behavior. *Working Paper, No. 546*. Bank of Italy.

Guiso, L., & Sodini, P. (2013). Household Finance: An Emerging Field. In *Handbook of the Economics of Finance* (Vol. 2, pp. 1397 - 1532). Elsevier.

Guiso, L., Jappelli, T., & Terlizese, D. (1992). Earnings Uncertainty and Precautionary Saving. *Journal of Monetary Economics, 30*(2), 307 - 337. doi:doi.org/10.1016/0304-3932(92)90064-9

Hillesland, M. (2019). Investigating the Gender Wealth Gap in Ghana. *Oxford Development Studies, 47*(1), 63-78. doi:10.1080/13600818.2018.1498473

Kotlikoff, L. J., & Summers, L. H. (1981). The Role of Intergenerational Transfers in Aggregate Capital Accumulation. *Journal of Political Economy, 89*(4), 706 - 732.

Lee, J.-J., & Sawada, Y. (2010). Precautionary Saving Under Liquidity Constraints: Evidence from Rural Pakistan. *Journal of Development Economics, 91*, 77-86.

Modigliani, F., & Brumberg, R. (1954). Utility Analysis and the Consumption Function: An Interpretation of Cross-Sectional Data. In F. Modigliani, *The Collected Papers of Franco Modigliani* (Vol. 6, pp. 3-45). Cambridge, Massachusetts: The MIT Press. 2005.

Wang, H., Otoo, N., & Dsane-Selby, L. (2017). *Ghana National Health Insurance Scheme: Improving Financial Sustainability Based on Expenditure Review*. World Bank Studies. Washington, DC: World Bank. doi:10.1596/978-1-4648-1117-3. License: Creative Commons Attribution CC BY 3.0 IGO

Williams, R. (2012). Using the Margins Command to Estimate and Interpret Adjusted Predictions and Marginal Effects. *The Stata Journal, 12*(2), 308-331.

Yuh, Y., & Hanna, S. D. (2010). Which Households Think They Save? *Journal of Consumer Affairs*, *44*(1), 70 - 97.

Appendix

Table A 2.1: Reasons why Individuals do not apply for loans

Why didn't you apply for a loan	Percentage
No need	69.08
Interest rate too high	19.44
Demand for Collateral	4.243
Already has too much debt	1.532
Cannot obtain amount needed	3.69
Other	2.02
Total	**100**

Source: Authors, with data from GLSS7

Table A 2.2: Reasons Why Individuals do not hold Insurance Policy

Why don't you have Insurance policy?	Percentage
Do not see it necessary	26.81
Cannot afford it	45.12
Insurance companies are deceptive	3.07
Inadequate compensation	1.41
Don't know what insurance is or how it works	20.19
Procedure for claims take too long	2.54
Other	0.87
Total	**100**

Source: Authors, with data from GLSS7

Chapter 3
Trust in the Family, Risk and Time Preferences

3.1 Introduction

Preferences have been identified as important elements in the decision-making process, which affect the behaviour of economic agents. Differences in preferences among individuals can explain issues such as occupational choice, purchase of insurance contract, self-insurance, stock holdings, savings and investment among others. Within countries and subnational regions, Falk et al. (2018) show that preferences are linked to individual savings decisions and self-employment in addition to the decision to smoke as well as higher educational attainments. Among the old in the United States of America, Barsky, Juster, Kimball, & Shapiro (1997), find evidence of risk tolerance having predictive power over decisions on smoking, drinking, buying insurance, immigration, self-employment, and stock holding. Goldbach & Schlüter (2018) produce statistical evidence showing that migrants from Coastal Ghana and Indonesia are more risk tolerant than non-migrants. Risk preferences have in addition been found to affect farmers adoption of improved agricultural technologies and crop diversification strategies in developing countries (Asravor, 2018; Liu, 2013). Time preference is also argued to be important in theories of savings and investment, economic growth, addiction, among others (Becker & Mulligan, 1997).

Most of the earlier research in economics focused attention on other institutions but the family in explaining socioeconomic outcomes such as innovation, wealth and growth (Alesina & Giuliano, 2014). There is, however, emerging literature examining the relationship between the family environment and how it influences individual preferences. Since socialization of the individual begins at home, parents have been found to play an important role by transmitting their preferences to their offspring (Hryshko, Luengo-Prado, & Sørensen, 2011; Kennison, Wood, Byrd-Craven, & Downing, 2016; Brown & van der Pol, 2015). Hryshko et al. (2011) found that the probability of being risk averse is significantly impacted by parental variables, especially the level of education. The authors argue that the correlation between parental schooling and risk aversion of children may reflect a combination of children learning from their parents, parents investing more in the upbringing of their children or parental aspirations for their children. They find children of parents who are ambitious on their behalf to be less risk averse. Studying young adults, Kennison et al.

(2016), observe that risk taking can be predicted from childhood interaction with parents. They found negative mother interaction, for example, to be a predictor of men's financial risk taking.

The importance of other aspects of the social and family structure in explaining preferences are still being explored. The degree of individualism as proposed by Hofstede (2001) and family ties (Alesina & Giuliano, 2014) have been used in the literature. Coleman, (1988) argues that family ties though can strengthen the support received by young generations from the old, it can at the same time stifle innovation and new ideas. Weber (1904) as cited in Alesina & Giuliano (2014), contend that strong family values do not allow for the development of individual forms of entrepreneurship, which are fundamental to the formation of capitalistic societies. According to Todd as cited in Alesina & Giuliano (2014) the inability to rely on the family for income and housing for example, can generate a more entrepreneurial spirit of self-reliance as well as greater motivation to work. We introduce an important aspect of the family, trust in the family, to determine how it influences the simultaneous determination of risk and time preferences of individuals. Our estimation results show that though trust in the family has a positive relationship with patience, it has a negative relationship with risk tolerance suggesting a higher level of collectivism as against individualism among family members.

After reviewing relevant literature on trust, risk and time preferences in section 3.2, we specify the estimation technique and describe the data used in the analysis in section 3.3. We proceed in section 3.4 with the presentation and discussion of results and provide a conclusion in section 3.5.

3.2 Literature Review

3.2.1 Trust and Preferences

There have been several definitions of trust. Noting the varied definitions of trust and taking account of the essential elements, Nickel & Vaesen (2012) define trust as *"a disposition willingly to rely on another person or entity to perform actions that benefit or protect oneself or one's interest in a given domain"*. Trust is broadly categorized into two; generalized (social) trust and particularized trust. Within-group trust, for example trust in family and friends, is termed particularized trust while trust in strangers defines generalized trust. Linking risk preferences to generalized trust, the proposition has been that greater risk

aversion leads to less trust. Results however on the empirical relationship is mixed. While some have found no relationship between trust and risk preferences (Eckel & Wilson, 2004; Sheremeta & Shields, 2013) others find a significant relationship between the two (Albanese, de Blasio, & Sestito, 2017; Fehr, 2009). Extending the relationship between generalized trust and risk preferences, Albanese, de Blasio, & Sestito (2017) further find a significant negative relationship between generalized trust and impatience.

Trust in the family is different from trusting behaviour in trust games, which has become topical, in recent times, in the economics literature. Unlike the trust games where social trust is more about uncertainty, trust in the family may be based on experience. Bubolz (2001) observes that trust is one of the fundamental needs of human beings. She argues further that building trust is part of the attachment process that begins in infancy as parents or other primary caregivers meet the needs of children, such that when their needs are not met, a sense of mistrust develops. Since parent–child and sibling relationships are important in providing economic aid, help with tasks, personal and health care, and companionship to older adults (Bubolz, 2001), not so good relationships, dampens trust generating a more individualistic approach to issues which may then increase one's willingness to find alternative means of achieving economic goals. In this sense, low trust can proxy for high individualism. Individualism measures the extent to which it is believed that individuals are supposed to take care of themselves as opposed to being strongly integrated and loyal to a cohesive group (Gorodnichenko & Roland, 2011a). Individualism, it is argued, is linked to overconfidence and optimism which have been found to positively affect financial risk taking (Breuer, Riesener, & Salzmann, 2014). Low trust in the family therefore is expected to increase risk taking.

However, trust in the family can also generate insurance for its members. It has been theorized that small networks with members who trust or care for each other and can punish non-cooperating members can have high levels of insurance (Ambrus, Möbius, & Szeidl, 2014; Foster & Rosenzweig, 2001; Genicot & Ray, 2003) which can help members undertake riskier but more profitable investment (Obstfeld, 1994). If trust in the family is indicative of family insurance, then risk tolerance should increase with in-family trust. Nonetheless, if trust in the family is more indicative of collectivism as against individualism, those who trust the family less should be more risk tolerant. Thus, the relationship between in-family trust and risk tolerance may be uncertain but we expect a positive relationship between trust in the family and patience in line with Albanese et al. (2017).

3.2.2 Elicitation of Preferences: Real versus hypothetical Rewards

Individual preferences have been elicited broadly from lab experiments or through survey questionnaires (Guiso & Sodini, 2013) using either real or hypothetical rewards. Other researchers have inferred preferences from actual choices of individuals in risky assets, insurance or consumption smoothing models (Booij & van Praag, 2009). Given the limited number of subjects that can be studied at any point in time and the cost implication when lab experiments with real monetary payments are used but the ability of surveys to cover more participants over a given period of time at no extra cost, survey measures of risk and time preferences are emerging as the most widely used method of eliciting individual preferences.

Concerns have been raised about the use of hypothetical as against real rewards in eliciting preferences. The argument is that hypothetical reward systems, usually implemented through survey questions without real monetary incentives, unlike those with real rewards, may not be motivative enough for participants to give thoughtful answers and hence some have questioned whether such preferences are reflective of actual behaviour. Most studies comparing the two, broadly, do not find systematically clear differences both for risk and time preferences emerging from the two elicitation methods. Vieider et al. (2015) examine risk preferences and their components using both controlled experiment and survey questions for 2939 subjects in 30 countries. They note that measures of risk preferences are correlated irrespective of the measurement methods used or even the decision contexts. The authors maintain that it is indicative of the existence of one underlying risk preference which influences attitudes. What more, they find that survey measured risk preferences are correlated with incentivized lottery choices within and between most countries. Using a field experiment where participants answer a general risk question and also make choices in a real-stakes lottery experiment, Dohmen et al. (2011) find that risk preferences obtained through answers from general risk questions are a reliable predictor of actual risky behaviour. They claim that even a simple, qualitative survey measure can generate a meaningful measure of risk attitude, which maps into actual choices in lotteries with real monetary consequences.

There are also results which point to elicitation of time preferences using non-monetary incentives to be as good as those with real incentives. Johnson & Bickel (2002) compared real and hypothetical rewards and find no systematic difference in time preference from responses to real and hypothetical choices leading them to suggest that hypothetical rewards may often serve as a valid proxy for real rewards. This same conclusion has been reached earlier by Kirby & Maraković (1995). To test the predictability of survey measure of

patience, Vischer et al. (2013) uses the German Socioeconomic Panel (SOEP) data which also has information on a representative sub-sample of the respondents on incentive compatible intertemporal choice experiment. By relating the survey measure of patience to the available experimental measure of patience, the authors find that responses to the survey questions on patience significantly predicts the choice experiment.

3.2.3 Determinants of Risk Preferences

Research examining the determinants of risk preferences, acknowledging the possible endogeneity of some of the explanatory variables, have tried to use potentially exogenous variables especially demographic characteristics. The most common of such variables are gender, age and cognitive ability in addition to height and parental education. There are still other works that include endogenous variables such as income and education as determinants. Most of the works have been done outside the African continent with the exception of a few. We thus review both works within and outside Africa.

Results emerging from risk preference studies on gender point to either a significant relationship or no evidence of gender differences. Tanaka, Camerer, & Nguyen (2010) using household data from Vietnam find no evidence of differences in risk preferences between men and women. Schubert, Brown, Gysler, & Brachinger (1999) through the experimental method from abstract gambling and also a financially motivated insurance and investment environment among undergraduates in two tertiary institutions in Switzerland, do not find any significant evidence of females being less risk prone compared to males in risky financial choices. In most of the studies however, females have been found to be less risk tolerant than males. Analysis of data on undergraduate students from two tertiary institutions in USA by Eckel & Grossman (2002) show that women are more risk averse than men when they were given a gamble to choose from. By extending this experiment and asking both sexes to guess the gamble choice of other participants, each sex group overestimated the risk aversion of the other, especially that of women. Other works finding women to be more risk averse than men include Barnea, Cronqvist, & Siegel (2010); Barsky, Juster, Kimball, & Shapiro (1997); Bucciol, Miniaci, & Pastorello (2017); Donkers, Melenberg, & Van Soest (2001); Hryshko et al. (2011); Renneboog & Spaenjers (2012) among others.

Results on countries in Africa also follow the general pattern where only a few works find no relationship. For South Africa, panel Tobit regression with experimental data

collected from subsistence farmers, show the insignificance of gender as a determinant of risk aversion (Brick & Visser, 2015). Using experimental data on 262 farm households in Kebele, Ethiopia, Yesuf & Bluffstone (2009) also do not find enough evidence to reject a no relationship between gender of heads of households. However, among Cocoa farmers in Cote D'Ivoire, Kouame & Komenan (2012) find male heads to be more risk tolerant than female heads. The results is also not different for rural Uganda through a field experiment by Tanaka & Munro (2014). On the global front, using data for students from 30 countries, Vieider et al. (2015) find female students to be more risk averse than males. Falk et al. (2018) also show that risk preferences is highly related to gender, with females being more risk averse than males, for about 95percent of the countries. Niederle (2015) in a meta-analysis suggests that the observed mixed effect of gender could reflect small samples.

Another important demographic characteristic used is age. The emerging trend shows that risk aversion increases with age or has hump shape relationship with age. Results from the US Survey of Consumer Finances (SCF) indicates that risk aversion increases with age (Bucciol et al., 2017). Donkers, Melenberg, & Van Soest (2001) using the first wave of the CentER Savings Survey (CSS) for the Netherlands produce evidence that older people have a more negative attitude toward risk. But Barsky, Juster, Kimball, & Shapiro (1997) testing for mean difference in risk tolerance by various demographic characteristics including age, using the Health and Retirement Study on United States of America, show the relationship between risk tolerance and age to be U shaped. While evidence from African countries such as Burkina Faso, Cote D'Ivoire, Ethiopia show that risk tolerance significantly decreases with age (Kouame & Komenan, 2012; Sepahvand & Shahbazian, 2017; Yesuf & Bluffstone, 2009) age is not an important determinant of risk aversion for subsistence farmers in South Africa (Brick & Visser, 2015) and rural Uganda (Tanaka & Munro, 2014). Globally, risk tolerance has been found to decrease with age irrespective of the regional classification of countries (Falk et al., 2018).

The role played by cognitive ability in affecting preference for risk has also been examined. Benjamin, Brown, and Shapiro (2013) study on high school students in Chile through a lab experiment produce evidence showing that cognitively able individuals, especially in maths, tend to be less risk averse. Dohmen, Falk, Huffman, & Sunde (2010) also report a negative relationship between risk aversion and cognitive ability in Germany, which is not different from the results obtained by Burks, Carpenter, Goette, & Rustichini (2009) through lab experiment for 1000 driver trainees in Midwest U.S. For several countries in the world, Falk et al. (2018) adduce evidence to show that lower cognitive ability is associated

with higher risk aversion. Andersson, Holm, Tyran, & Wengström (2016) note that the observed relationship between risk preferences and cognitive ability may be hard to identify, and spurious, because cognitive ability is related to noisy decision making. They argue further that this only suggests the need for the use of balanced experimental elicitation designs but not that linking cognitive ability and risk preferences is useless. A closely related factor to the measure of cognitive ability is the educational level of the decision maker's father which yields a positive relationship with risk tolerance. Using the German Socio-Economic Panel survey questions about willingness to take risks in general, Dohmen et al. (2011) find that the higher a father's education, the more risk an individual is willing to take. For Burkina Faso, Sepahvand & Shahbazian (2017) find individuals with literate fathers to prefer more risk but Yesuf & Bluffstone (2009) do not find enough evidence to reject a no relationship between literacy and risk preferences in Ethiopia.

Other factors that have been used to explain risk taking is height, religion, household size, number of dependents, marital status and location. Dohmen et al. (2011) find risk taking to be increasing with height. Barsky et al. (1997) produce evidence indicating significant differential risk tolerance with respect to religion such that risk tolerance reduces according the following order; Jews, Catholics, Protestants and Others. Children-to-adult ratio has a positive relationship (Yesuf & Bluffstone, 2009). Tanaka & Munro (2014) find evidence of variations in risk preferences based on regional differences (agro-climatic zones), with farmers in less favourable regions in rural Uganda being more risk averse. The heterogeneity in risk preferences based on zones, they argue, indicates the need for regional differences in policies aimed at engendering more investments. Akay, Martinsson, Medhin, & Trautmann (2012) using Tobit regression with experimental data collected on small scale farmers in the northern highlands of Ethiopia at the household level through real monetary incentives, found risk aversion to significantly increase with household size but marital status of household heads were insignificant. Using the same data on South Africa, but a different measure of risk aversion and by running an Ordinary Least Squares regression, Jumare, Visser, & Brick (2018) found that among households heads, the size of the household is negatively related to risk aversion.

3.2.4 Determinants of Time Preferences

Theories explaining the rate of discounting over time, has argued for either an increasing impatience over the life cycle or patience formation with time. Trostel & Taylor (2001)

offering a rational basis for the higher discounting of the future than the present, postulate that people discount the future because expected marginal utility from consumption declines and is comparable to the eventual fall of physical and mental abilities. They further argue that as the ability to enjoy consumption decreases, in line with human abilities that fall with age, discounting should increase with age. Becker & Mulligan (1997) though recognizing the increasing impatience over time, maintain that resources are expended by individuals in an attempt to partially or fully offset the over-discounting. Schooling for example is one of the means which Becker & Mulligan (1997) put forward to be a means of reducing impatience. They reason that schooling focuses attention on the future and may help to reduce the remoteness of the future thereby helping to reduce impatience. Other factors which have been theorized to be related to patience includes income and development. Fisher 1930 as cited in Becker & Mulligan (1997) claims that poverty heavily affects a man's expected life by increasing the want for immediate income more than for future income. Fisher explains the effect of poverty on impatience to be partly rational due to the ability to supply present needs to be able to cope for the future and partly irrational as it blinds a person to the needs of the future.

Empirical works investigating the determinants of time preference have not found a consistent relationship between patience and age. Vischer et al. (2013) using German data in an attempt to validate survey measures of impatience with incentive-compatible rate of time preference, controls for gender, age, height and IQ test scores. Among these four, it was only age that significantly affects the rate of return chosen by individuals. They adduce evidence showing that people become more patient at middle age but in early and later years of life there is high impatience. Falk et al. (2018) using hypothetical reward system, find an inverted u-shape relationship between patience and age for OECD countries but a strictly declining one for other countries in the data set. Tanaka et al. (2010) however find a positive relationship between patience and age with Vietnamese data. For the Netherlands, Kapteyn & Teppa (2003) using the 2002 CentER panel, find impatience to increase with age.

Results on the relationship between time preferences and gender are mixed especially at the country level with global data showing that gender is important in time preference determination. Country specific works by Harrison, Lau, & Williams (2002) for Denmark, Kirby & Maraković (1995) using 22 Psychology students from Williams College, USA, Tanaka et al. (2010) for Vietnam, Kapteyn & Teppa (2003) for the Netherlands among others point to no gender differences in time preference. Gender however has been found to be an important variant of patience at the country level by Coller & Williams (1999) through lab

experiment conducted at the University of South Carolina on 35 undergraduate and graduate students, Kirby & Maraković (1996) for 528 undergraduate students of Williams College, Donkers & van Soest (1999) for the Netherlands among others find that females are more patient than males. Falk et al. (2018) show with global data that females are more patient than males but explains further that when the relationship is estimated for individual countries, the significance of gender exists for only 32percent of the countries.

The relationship between cognitive ability and time preference has also been examined for some countries. Though Vischer et al. (2013) do not find any significant effect of IQ test scores on time preference, Dohmen, Falk, Huffman, & Sunde, (2010) show that there is a systematically positive relationship between cognitive ability and patience using a representative sample of 1000 individuals from Germany, just as Falk et al. (2018) find for several other countries. Another related variable is education which has been found to lead to lower discount rate, for example in Denmark (Harrison et al., 2002) though for the Netherlands, education does not have a relevant effect on discount rate (Kapteyn & Teppa, 2003).

Emerging from an instrumental variable estimation with data from Vietnam, household and mean village income positively relate with patience (Tanaka et al., 2010). Tanaka & Munro (2014) find regional differences to affect time preferences with farmers in less favourable agro-climatic regions (zones) being impatient compared to those in more favourable regions. Weber's (1930) argument of a Protestant ethic is postulated to make protestants more patient. The effect of household income on discount rate is significant at the 5% level and suggests that patience rises with income (Kapteyn & Teppa, 2003).

3.3 Methodology

We use a bivariate probit model to examine the determinants of the two preferences, as several studies indicate that risk and time preferences are related. Results show a negative relationship between risk aversion and patience (Anderhub, Güth, Gneezy, & Sonsino, 2001; Andersen, Harrison, Lau, & Rutström, 2008; Vischer et al., 2013). Falk et al. (2018) though finding a positive correlation between patience and the willingness to take risk for other regions, the indicated that for Sub-Saharan Africa, risk-seeking and impatience are high. Andreoni & Sprenger, 2012; Booij & van Praag (2009) claim that the study of time

preference for example is problematic if studied in isolation from risk because though the present is known with certainty, the future is distinctively risky.

In this study, the risk and time preference variables are binary in nature and given the observed correlation between the two, we estimate a bivariate probit model. In a bivariate probit model, the correlation between the binary variables is captured by the conditional tetrachoric correlation of the error terms (Greene, 2012). The bivariate probit model can be specified, following (Greene, 2012) , as:

$$y_1^* = \mathbf{x_1'}\boldsymbol{\beta_1} + \varepsilon_1 , \qquad y_1 = 1 \text{ if } y_1^* > 0, \qquad 0 \text{ otherwise,}$$
$$y_2^* = \mathbf{x_2'}\boldsymbol{\beta_2} + \varepsilon_2 , \qquad y_2 = 1 \text{ if } y_2^* > 0, \qquad 0 \text{ otherwise,}$$

$$\begin{pmatrix}\varepsilon_1 \\ \varepsilon_2\end{pmatrix}\Big|\mathbf{x}_1, \mathbf{x}_2 \sim N\left[\begin{pmatrix}0 \\ 0\end{pmatrix}, \begin{pmatrix}1 & \rho \\ \rho & 1\end{pmatrix}\right]$$

y_1 and y_2 represent time and risk preferences respectively.

ε_1 *and* ε_2 are the error terms which are bivariate normally distributed, each with mean 0, variance of 1 and correlation, ρ. This correlation is a conditional tetrachoric correlation. The vector **x** is the matrix of explanatory variables.

The joint probability of the observed choices $[y_{i1}, y_{i2}]$, $i = 1, \ldots, n$ forming the basis for the log likelihood function are the bivariate normal probabilities. The bivariate normal cumulative density function (cdf) is:

$$\text{Prob}(X_1 < x_1, X_2 < x_2) = \int_{-\infty}^{x_2}\int_{-\infty}^{x_1} \phi(z_1, z_2, \rho)\, dz_1 dz_2 = \Phi_2(x_1, x_2, \rho)$$

While the density function is:

$$\phi_2(x_1, x_2, \rho) = \frac{e^{-\left(x_1^2 + x_1^2 - 2\rho x_1, x_2\right)/2(1-\rho^2)}}{2\pi(1-\rho^2)^{\frac{1}{2}}}$$

Let $q_{i1} = 2y_{i1} - 1, \quad q_{i2} = 2y_{i2} - 1$ such that when $y_{ij} = 1$, $q_{ij} = 1$ and when $y_{ij} = 0$, $q_{ij} = -1$ for $j = 1, 2$.

Also let:

$z_{i1} = \mathbf{x}'_{i1}\boldsymbol{\beta}_1,\ z_{i2} = \mathbf{x}'_{i2}\boldsymbol{\beta}_2,\ w_{i1} = q_{i1}z_{i1}, w_{i2} = q_{i2}z_{i1}$ and $\rho_{i^*} = q_{i1}q_{i2}\rho$

Apart from the use of the subscript 2 in Φ_2 and ϕ_2 to denote the bivariate normal distribution, in other cases, it refers to variables in the second equation.

The probabilities entering the likelihood function are:

$$\text{Prob}(Y_1 = y_{i1}, Y_2 = y_2|\mathbf{x_1}, \mathbf{x_2}) = \Phi_2(w_{i1}, w_{i1}, \rho_{i^*})$$

The resulting log likelihood to be estimated is:

$$\ln L = \sum_{i=1}^{n} ln\, \Phi_2(w_{i1}, w_{i1}, \rho_{i^*})$$

The model we estimate therefore can be specified as:

$$Y_{1i} = \alpha_0 + \alpha_1 ftrust_i + \alpha_2 Z_{1i} + \cdots + \beta\alpha_n Z_{ni} + \varepsilon_{1i}$$

$$Y_{2i} = \beta_0 + \beta_1 ftrust_i + \beta_2 Z_{1ih} + \cdots + \beta_n Z_{nih} + \varepsilon_{2ih}$$

Where i represents individual i, Y_1 shows whether the individual is patient or impatient, Y_2 is a dummy indicating either being risk tolerant or risk averse and $ftrust$ is a dummy for trust in the family. Potentially exogenous variables in the model, contained in $Z_1 \ldots Z_n$, are also controlled for. Such variables include age, gender, religious affiliation, height, father's education and rural-urban dummy. The same set of regressors are used in both the risk and time preference equations, since the correct analogy for the multivariate probit model is the seemingly unrelated model which does not require the addition or exclusion of some variables from one of the equations for identification (Greene, 2012). The model is estimated using maximum likelihood.

3.3.1 Data and Description of Variables

The Data we use for the study is the Ghana Living Standards Survey Round 7 (GLSS7), a nationally representative data, collected over a 12-month period by the Ghana Statistical Service between 2016 and 2017. A two-stage stratified sampling design was used, by first

selecting 1,000 enumeration areas as the Primary Sampling Unit in the 10 regions of Ghana proportional to their respective population. The Enumeration Areas were also divided into urban and rural localities of residence. The secondary sampling units were obtained by listing all households in the selected Primary Sampling Units, after which 15 households from each PSU were selected systematically. Available data is on 14,009 households and the individual members of such households, with adjusted final sampling weights for nonresponse. Questions on preferences were administered to all household members aged 12 years and above while for those on trust, a member of each household was randomly selected to respond. We thus focus on individuals who were randomly selected to answer the trust questions and also self-answered the risk and time preference questions.

We use responses given by individuals on three questions to build a time preference dummy. These questions were hypothetical, with respondents being asked to choose among two options each time for the three questions. For question one, a respondent was to choose between receiving 16 Ghana Cedis immediately or 32 Ghana Cedis in 1 month. The first options for questions two and three are the same as question one. The second-choice options are 40 Ghana Cedis in 1 month and 24 Ghana cedis in 1 month for questions two and three respectively. We computed associated discount rates from these three questions and classify individuals based on all the three responses. A person is classified as impatient if the discount rate is above 1.5 but patient if the discount rate is below 1.5. All others with discount rates above 1.5 in a given question but lower than 1.5 for any of the remaining questions are considered as inconsistent and hence, excluded from the analysis. Table 3.1 gives more details.

Two lottery-type questions are used to categorize household members as either risk tolerant or risk averse. Each member was asked to imagine two scenarios and indicate preference from the two options. The options for the first question (Q1) are: to receive 4 Ghana Cedis for sure or the interviewer flips a 1 Cedi coin where the respondent gets 12 cedis with a shell on the coin showing up or otherwise receive 1 Ghana cedi. The subsequent question (Q2) has the same first option as Q1 with the second option still being determined by the toss of a coin. The respondent will receive 16 cedis if a shell shows up or 1 cedi alternatively. If a person chooses the sure bet in response to all the two questions, he is risk averse but when he chooses the bet in both questions, he is considered as risk tolerant. However, if in the first question, he chooses the sure bet but chooses the lottery in the second question, then he is moderately risk averse. The reasoning is that he needs a higher expected value (EV) more than 6.5 to take the bet and when the expected value increased to 8.5, he

was induced to take the bet. Any individual taking the bet at a lower expected value but not taking it at a higher value is considered to be inconsistent.

Table 3.1: Time Preference Classification for Individuals

Scenario	Q1	Q2	Q3	Discount Rate	Time Preference	Percentage
1	16	16	16	r > 1.5	Impatient	47.46
2	16	40	16	1< r < 1.5	Moderately patient	3.06
3	32	40	24	r < 0.5	Patient	40.57
4	16	16	24	r > 1.5 & r < 0.5	Inconsistent	0.58
5	16	40	24	1<r<1.5 & r <0.5	Inconsistent	1.67
6	32	16	16	0.5<r<1 & r>1.5	Inconsistent	0.75
7	32	16	24	0.5<r & r>1.5	Inconsistent	0.42
8	32	40	16	0.5<r<1.5	Moderately Patient	5.50
Total					**13,682**	**100.00**

Source: Authors, with data from GLSS7

The classification into risk tolerant and risk averse from the responses to the lottery type questions are on Table 3.2 . If a person chooses the sure bet in response to all the two questions, he is risk-averse, but when he chooses the bet in both questions, he is considered as risk tolerant. However, if in the first question, he chooses the sure bet but chooses the lottery in the second question, then he is moderately risk tolerant. The reasoning is that he needs a higher expected value (EV) more than 6.5 to take the bet and when the expected value increased to 8.5, he was induced to take the bet. Any individual taking the bet at a lower expected value but not taking it at a higher value is considered to be inconsistent; this group shall be excluded from the estimation. We however generate two groups from this classification into not risk tolerant and risk tolerant (comprising of moderate risk tolerance and risk tolerance).

Table 3.2: Risk Preference Classification

Scenario	Q1	EV1	Q2	EV2	Risk Preference	Percentage
1	4	4	4	4	Not risk tolerant	75.62
2	4	4	1,16	8.5	Moderately risk tolerant	1.86
3	1,12	6.5	4	4	Inconsistent	1.62
4	1,12	6.5	1,16	8.5	Risk tolerant	20.09
Total					**13,663**	**100.00**

Source: Authors, with data from GLSS7

The question on trust was administered to a randomly selected person in each household. Selected members were asked how much they trust different groups of people,

one of which was the family. It was explained in the questionnaire that, sometimes people do not trust others because of litigation on family land, cheating, distribution of money, extra marital activities, irresponsibility, etc. Respondents were then asked if they trust people in their family, including the extended family. We interpret this to mean that trust in the family, in this instance, will be high if there is no litigation on family land among family members, where the family has a land; if members of the family are not cheated by other members for example in the distribution of the family's economic resources, which will make such family members more reliable. If the individual has been unfairly cheated in terms of economic resources, for example, he is expected to trust the family less because in this instance trusting the family involves some cost. We link trust in the family with individuals' appetite for risk or patience. Given that low trust may lead to a sense of individualism which has been linked to overconfidence, people with low trust will be more optimistic about success from risky ventures, making them more risk tolerant. The contrary view however is that if trust in the family, generates family insurance, then those who trust the family should be more risk tolerant. What more, if one thinks the family is a reliable source of support, he or she is expected to be more patient. Trust therefore is expected to increase patience but can reduce or increase risk tolerance.

Respondents were to rank their trust in the family as; not at all, sometimes, most of the time and all the time. From this, we create a dummy variable with value zero if an individual does not trust the family at all and 1 otherwise. Approximately 89percent of individuals trust their families at least somewhat (Table 3.3). We control for other characteristics of respondents such as age, gender, height, religious affiliation, location and father's education, are controlled for in our estimation. The average age for respondents is 42 years with a height of about 1.6 meters (Table 3.3). There are more females; making up approximately 53percent of the respondents. About 91percent of fathers of subjects do not have a minimum of secondary education (secondary or senior high). With respect to religion, Christians form the largest group, among which there are 18percent Protestants with Catholics, Charismatic/Pentecostals and other Christians being 59percent. There is almost 45percent of the respondents located in rural areas of the country. Classified into binary variables, the percentage that is patient is 51 while those who are risk tolerant are 22percent with as high as 89percent trusting at least somewhat in the family.

Table 3.3: Summary Statistics of Variables

	Mean	Std. Error	Min	Max
Patient	51.11	0.661	0	1
Risk Tolerant	21.83	0.529	0	1
Trusts the Family	89.11	0.367	0	1
Age (years)	41.55	0.203	14	99
Height (cm)	160.34	0.265	11	235
Female	53.45	0.663	0	1
Father's Education	8.62	0.374	0	1
Rural	44.53	0.613	0	1
No Religion or other	5.15	0.269	0	1
Christian – Other	59.07	0.583	0	1
Christian – Protestant	17.76	0.460	0	1
Islam	15.13	0.412	0	1
Traditional	2.90	0.123	0	1

Source: Authors, with data from GLSS7
Standard Errors are linearized standard errors for the subpopulation.

3.4 Results and Discussion

The bivariate probit estimation results show that as found in previous literature (Anderhub et al., 2001; Andersen et al., 2008; Falk et al., 2018; Vischer et al., 2013), there is a significant positive correlation between patience and risk tolerance. The conditional tetrachoric correlation from the estimation is 0.38 and it is statistically different from zero at the 1percent level of significance. Our main variable of interest, trust in the family is a significant determinant of both risk and time preferences. Individuals who at least somewhat trust the family are more patient than those who do not trust the family at all. On risk preference however, it is individuals who do not trust the family that are more likely to take risky bets, than those who trust the family. Lack of trust in the family is likely to generate a form of individualism, argued to be related with overconfidence and over-optimism found to positively influence financial risk taking (Breuer et al., 2014).

Within a bivariate probit system, a researcher may be interested in the joint marginal probabilities. From Table 3.4, individuals who trust their families are about 7.4percent more likely to be patient and risk averse but 2.4percent less likely to be patient and risk tolerant or 3.4percent less likely to be impatient and risk tolerant compared to those who do not trust the family. The average predicted probability for those who trust their families to be patient and

risk averse is 36.3percent which is about twice that to be patient and risk tolerant or about 6 times that of being impatient and risk tolerant. The overall effect of trust in the family, is that though it makes individuals more patient, such people also become risk averse.

Age is found to be negatively related with both patience and risk tolerance. The observed negative relationship has been found in several studies including Falk et al. (2018); Kapteyn & Teppa (2003) for time preference and Bucciol et al. (2017); Donkers et al. (2001); Kouame & Komenan (2012); Sepahvand & Shahbazian (2017); Yesuf & Bluffstone (2009) for risk preference. Reasons given for the higher discounting with age include the argument by Trostel & Taylor (2001) that the ability to enjoy consumption decreases, in line with human abilities, with age; thus making older people prefer the present to the future. We present the probability of being patient or risk tolerant over age of respondents on Figure 3.1. It is evident from the figure that the older people are more impatient and risk averse than being patient and risk tolerant while younger ones are more patient and risk tolerant.

Females are more risk averse compared to males but there is no systematic difference in gender when it comes to time preference. The insignificance of gender in time preference determination has also been reported by Harrison et al. (2002); Kapteyn & Teppa (2003); Kirby & Maraković (1995); Tanaka et al. (2010). Concerning risk tolerance Kouame & Komenan (2012);Tanaka & Munro (2014); Vieider et al. (2015); Falk et al. (2018) show that females have a lower penchant for risk. The regression output point to females being more likely to be patient and risk averse but less likely to be patient and risk tolerant or impatient and risk tolerant. The average adjusted prediction of a female being patient and risk averse is 36.7percent which is about 2.5percent above that of males. The average predicted probability for a female to be patient and risk tolerant is 13.9percent with associated marginal effect of 3.8percent below that of a male.

Parental education, with emphasis on the father's education has a positive effect on risk tolerance and patience though insignificant for the later. It has been argued in the literature that parents may transmit their preferences to their offspring and their level of education may have an influence (Hryshko et al., 2011). The suggestive explanation is that parents with higher education may invest more in the upbringing of their children. In employment estimations, parental education has also been used to proxy for ability. People with educated parents are assumed to have higher abilities, which can be linked to cognitive ability. Cognitive ability has been found by previous works to be positively associated with risk tolerance (Benjamin, Brown, & Shapiro, 2013; Burks et al., 2009; Dohmen et al., 2010; Falk et al., 2018).

Table 3.4: Bivariate Probit results showing the Coefficients, Adjusted Predictions and Marginal Effects

	Patient	Risk Tolerant	AAP (1,1)	ME (1,1)	AAP (1,0)	ME (1,0)	AAP (0,1)	ME (0,1)
Trusts Family	0.1238***	-0.1907***	0.1535***	-0.0242**	0.3630***	0.0735***	0.0582***	-0.0341***
	(0.0476)	(0.0514)	(0.0049)	(0.0111)	(0.0069)	(0.0159)	(0.0029)	(0.0080)
Age	-0.0028***	-0.0072***		-0.0016***		0.0004		-0.0005***
	(0.0010)	(0.0012)		(0.0002)		(0.0003)		(0.0001)
Female	-0.0316	-0.1910***	0.1385***	-0.0379***	0.3668***	0.0253**	0.0536***	-0.0177***
	(0.0341)	(0.0372)	(0.0057)	(0.0079)	(0.0082)	(0.0116)	(0.0032)	(0.0044)
Father's Education	0.0143	0.1893***	0.1904***	0.0376**	0.3260***	-0.0319	0.0805***	0.0204**
	(0.0615)	(0.0640)	(0.0148)	(0.0153)	(0.0189)	(0.0198)	(0.0087)	(0.0087)
Height	-0.0009	-0.0007		-0.0002		-0.0001		-0.0000
	(0.0008)	(0.0008)		(0.0002)		(0.0003)		(0.0001)
Christian – Other	0.0803	-0.1485*	0.1594***	-0.0207	0.3548***	0.0526**	0.0627***	-0.0252**
	(0.0779)	(0.0823)	(0.0058)	(0.0193)	(0.0082)	(0.0239)	(0.0035)	(0.0115)
Christian - Protestant	0.1054	-0.1751**	0.1564***	-0.0237	0.3678***	0.0656**	0.0580***	-0.0299**
	(0.0840)	(0.0893)	(0.0090)	(0.0204)	(0.0146)	(0.0268)	(0.0053)	(0.0122)
Islam	0.0356	-0.2877***	0.1315***	-0.0486**	0.3650***	0.0627**	0.0520***	-0.0359***
	(0.0860)	(0.0916)	(0.0093)	(0.0207)	(0.0146)	(0.0267)	(0.0050)	(0.0120)
Traditional	0.0369	-0.0806	0.1685***	-0.0116	0.3285***	0.0263	0.0740***	-0.0138
	(0.0941)	(0.1001)	(0.0150)	(0.0231)	(0.0201)	(0.0295)	(0.0088)	(0.0137)
Rural	0.0143	-0.0666*	0.1499***	-0.0111	0.3644***	0.0168	0.0575***	-0.0081*
	(0.0337)	(0.0364)	(0.0056)	(0.0077)	(0.0085)	(0.0115)	(0.0034)	(0.0042)
Constant	0.1074	0.0645						
	(0.1623)	(0.1705)						
Correlation	0.3823***							
	(0.0202)							
Observations	10,352							

Source: Authors, with data from GLSS7

Linearized Standard Errors in Parenthesis; * p<0.1; ** p<0.05; *** p<0.0; correlation is the conditional tetrachoric correlation between patience and risk tolerance. AAPs is Average Adjusted Predictions and MEs is Average Marginal Effect. The values in parenthesis attached to AAPs and MEs show combinations of patience and risk tolerance; (1,0) for example shows patient and risk averse combination. Coefficients from the bivariate probit model are listed under the respective dependent variables.

Protestants are less risk tolerant than other Christians (Catholics, Charismatic/Pentecostals) or those who belong to no religion. Barsky et al. (1997) in a related study found Protestants to be less risk tolerant compared to Catholics. Though all those who are religious are more likely to be patient, this is not significantly different from zero. Nevertheless, for joint marginal effects, Protestants, Muslims and other Christians in that order are more likely to patient and risk averse when compared with those with no religion. Risk aversion is also location specific with those in rural areas being less risk tolerant than those in urban areas. From the marginal effects, rural dwellers compared to urban residents

are less likely to be impatient and risk tolerant. The associated average predicted probability is 5.8percent which is about 0.81percent below that of individuals in urban locations. Tanaka & Munro (2014) found that in Uganda, those in less favourable areas are more risk averse. Since rural dwellers are largely engaged in agriculture, which is highly risky and uncertain due to high reliance on rainfall coupled with limited access to credit and insurance, they may care more about maximization of survival than of income (Todaro & Smith, 2015). If they must choose between survival with lower risk, and higher income with increased risk, they will choose survival. This may explain the high risk-aversion among rural inhabitants.

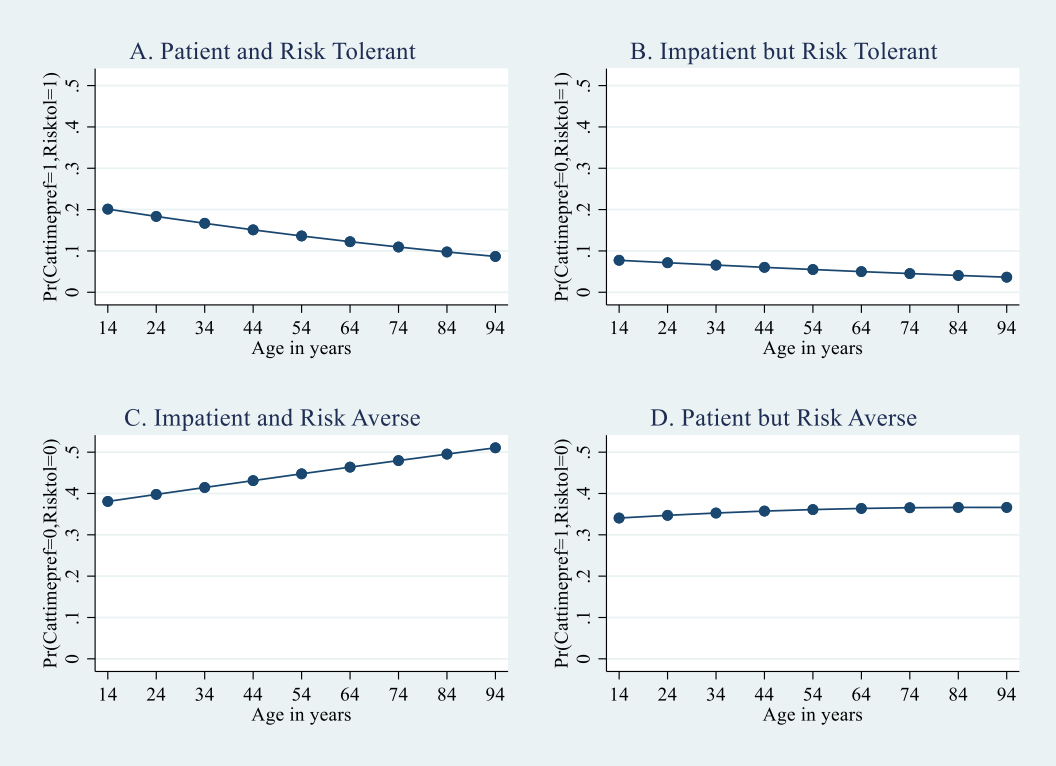

Figure 3.1: Average Adjusted Predictions over the life cycle

3.5 Conclusion

Previous studies have examined the determinants of either risk preference or time preference but independently with only a few considering their joint determination. There is however evidence that these two preferences are correlated. What more, the family environment is increasingly becoming relevant for the study of preferences with parental variables considered as a means of transmission of preferences. In this study, we investigated the determinants of risk and time preferences, simultaneously, and added an additional family

related variable, trust in the family, as a possible predictive factor. To the best of our knowledge, this is the first study that finds the effect of trust in the family on preferences, though other researchers have examined the effect of individualism on risk tolerance.

Our estimation from a bivariate probit model, confirms the positive relationship between patience and risk tolerance as found by previous studies. On the determinants of preferences, the results indicate that trust in the family has a positive relationship with patience but a negative relationship with risk tolerance. Essentially therefore, though trust is beneficial in building the patience of individuals, a higher level of trust in the family may reduce individual initiative and the spirit of self-reliance, making them less risk tolerant compared to those who do not trust the family. The finding that family trust reduces risk tolerance may be an indication of the high support people who trust the family anticipate, which may reduce the desire to be self-reliant. As Todd argued, the inability to rely on the family for income and housing, for example, can generate a more entrepreneurial spirit of self-reliance and a greater motivation to work. Another related variable that influences preferences is the level of education of the father. Put together these two results indicate that the family environment has an important influence on individual preferences. The policy of free education up to senior high, in Ghana, for all children of school going age can increase risk tolerance, not only of the students but in the long term, that of their children. There is also the need for open discussion at the family level on the relevance of self-reliance which can generate an enterprising spirit, likely to engender increasing desire to bear more risk. What more, given high trust in the family, family insurance networks can be strengthened. These we believe can increase risk tolerance as members who will continue to trust their families.

Other factors such as age, gender, religion and location are also important variants of preferences. In line with previous literature, patience and risk tolerance falls with age; females and rural dwellers are more risk averse than males and urban residents respectively. Policies to influence investments and entrepreneurship which involves risk taking, should be varied depending on location, gender and even age.

References

Akay, A., Martinsson, P., Medhin, H., & Trautmann, S. T. (2012). Attitudes toward uncertainty among the poor: An experiment in rural Ethiopia. *Theory and Decision*, *73*(3), 453–464. https://doi.org/10.1007/s11238-011-9250-y

Alesina, A., & Giuliano, P. (2014). Family Ties. In *Handbook of Economic Growth* (Vol. 2). https://doi.org/10.1016/B978-0-444-53538-2.00004-6

Ambrus, B. A., Möbius, M., & Szeidl, A. (2014). Consumption Risk-Sharing in Social Networks. *The American Economic Association*, *104*(1), 149–182.

Anderhub, V., Güth, W., Gneezy, U., & Sonsino, D. (2001). On the interaction of risk and time preferences: An experimental study. *German Economic Review*, *2*(3), 239–253. https://doi.org/10.1111/1468-0475.00036

Andersen, S., Harrison, G. W., Lau, M. I., & Rutström, E. E. (2008). Eliciting Risk and Time Preferences. *Econometrica*, *76*(3), 583–618. https://doi.org/10.1111/j.1468-0262.2008.00848.x

Andersson, O., Holm, H. J., Tyran, J. R., & Wengström, E. (2016). Risk Aversion Relates To Cognitive Ability: Preferences or Noise? *Journal of the European Economic Association*, *14*(5), 1129–1154. https://doi.org/10.1111/jeea.12179

Andreoni, B. J., & Sprenger, C. (2012). Risk Preferences Are Not Time Preferences Author (s): James Andreoni and Charles Sprenger Source : The American Economic Review , Vol . 102 , No . 7 (DECEMBER 2012), pp . 3357-3376 Published by : American Economic Associa. *The American Economic Review*, *102*(7), 3357–3376.

Asravor, R. K. (2018). *Farmers ' risk preference and the adoption of risk management strategies in Northern Ghana*. *0568*. https://doi.org/https://doi.org/10.1080/09640568.2018.1452724

Barnea, A., Cronqvist, H., & Siegel, S. (2010). Nature or nurture: What determines investor behavior? *Journal of Financial Economics*, *98*(3), 583–604. https://doi.org/10.1016/j.jfineco.2010.08.001

Barsky, R. B., Juster, F. T., Kimball, M. S., & Shapiro, M. D. (1997). Preference Parameters and Behavioral Heterogeneity: An Experimental Approach in the Health and Retirement Study. *The Quarterly Journal of Economics*, *112*(2), 537–579. https://doi.org/10.1162/003355397555280

Becker, G. S., & Mulligan, C. B. (1997). The Endogenous Determination of Time Preference. *The Quarterly Journal of Economics*, *112*(3), 729–758. https://doi.org/10.1162/003355397555334

Benjamin, D. J., Brown, S. A., & Shapiro, J. M. (2013). WHO is "behavioral"? Cognitive ability and anomalous preferences. *Journal of the European Economic Association*, *11*(6), 1231–1255. https://doi.org/10.1111/jeea.12055

Booij, A. S., & van Praag, B. M. S. (2009). A simultaneous approach to the estimation of risk aversion and the subjective time discount rate. *Journal of Economic Behavior & Organization*, *70*(1–2), 374–388. https://doi.org/10.1016/j.jebo.2009.01.005

Breuer, W., Riesener, M., & Salzmann, A. J. (2014). Risk aversion vs. individualism: what

drives risk taking in household finance? *European Journal of Finance*, *20*(5), 446–462. https://doi.org/10.1080/1351847X.2012.714792

Brick, K., & Visser, M. (2015). Risk preferences, technology adoption and insurance uptake: A framed experiment. *Journal of Economic Behavior and Organization*, *118*, 383–396. https://doi.org/10.1016/j.jebo.2015.02.010

Brick, K., Visser, M., & Burns, J. (2012). Risk aversion: Experimental evidence from South African fishing communities. *American Journal of Agricultural Economics*, *94*(1), 133–152. https://doi.org/10.1093/ajae/aar120

Brown, H., & van der Pol, M. (2015). Intergenerational transfer of time and risk preferences. *Journal of Economic Psychology*, *49*, 187–204. https://doi.org/10.1016/j.joep.2015.06.003

Bubolz, M. M. (2001). Family as source, user, and builder of social capital. *The Journal of Socio-Economics*, *30*(2), 129–131. https://doi.org/10.1016/s1053-5357(00)00091-3

Bucciol, A., Miniaci, R., & Pastorello, S. (2017). Return expectations and risk aversion heterogeneity in household portfolios. *Journal of Empirical Finance*, *40*, 201–219. https://doi.org/10.1016/j.jempfin.2016.08.002

Burks, S. V., Carpenter, J. P., Goette, L., & Rustichini, A. (2009). Cognitive skills affect economic preferences, strategic behavior, and job attachment. *Proceedings of the National Academy of Sciences of the United States of America*, *106*(19), 7745–7750. https://doi.org/10.1073/pnas.0812360106

Coleman, J. S. (1988). Social Capital in the Creation of Human Capital. *American Journal of Sociology*, *94*(Supplement), S95–S120.

Coller, M., & Williams, M. B. (1999). Eliciting individual discount rates. *Experimental Economics*, *2*(2), 107–127. https://doi.org/10.1007/BF01673482

Dohmen, T., Falk, A., Huffman, D., & Sunde, U. (2010). Are risk aversion and impatience related to cognitive ability? *American Economic Review*, *100*(3), 1238–1260. https://doi.org/10.1257/aer.100.3.1238

Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., & Wagner, G. G. (2011). Individual risk attitudes: Measurement, determinants, and behavioral consequences. *Journal of the European Economic Association*, *9*(3), 522–550. https://doi.org/10.1111/j.1542-4774.2011.01015.x

Donkers, B., Melenberg, B., & Van Soest, A. (2001). Estimating Risk Attitudes using Lotteries: A Large Sample Approach. *Journal of Risk and Uncertainty*, *22*(2), 165–195. https://doi.org/10.1023/A:1011109625844

Donkers, B., & van Soest, A. (1999). Subjective measures of household preferences and financial decisions. *Journal of Economic Psychology*, *20*(6), 613–642. https://doi.org/10.1016/S0167-4870(99)00027-6

Eckel, C. C., & Grossman, P. J. (2002). Sex differences and statistical stereotyping in attitudes toward financial risk. *Evolution and Human Behavior*, *23*(4), 281–295. https://doi.org/10.1016/S1090-5138(02)00097-1

Falk, A., Becker, A., Dohmen, T., Enke, B., Huffman, D., & Sunde, U. (2018). Global Evidence on Economic Preferences. *Quarterly Journal of Economics*, *133*(4), 1645–1692. https://doi.org/10.1093/qje/qjy013.Advance

Foster, A. D., & Rosenzweig, M. R. (2001). Imperfect commitment, altruism, and the family: Evidence from transfer behavior in low-income rural areas. *Review of Economics and Statistics*, *83*(3), 389–407. https://doi.org/10.1162/00346530152480054

Genicot, G., & Ray, D. (2003). Group formation in risk-sharing arrangements. *Review of Economic Studies*, *70*(1), 87–113. https://doi.org/10.1111/1467-937X.00238

Goldbach, C., & Schlüter, A. (2018). Risk aversion, time preferences, and out-migration. Experimental evidence from Ghana and Indonesia. *Journal of Economic Behavior and Organization*, *150*, 132–148. https://doi.org/10.1016/j.jebo.2018.04.013

Gorodnichenko, Y., & Roland, G. (2011). Which Dimensions of Culture Matter for Long-Run Growth? *American Economic Review*, *101*(3), 492–498. https://doi.org/10.1257/aer.101.3.492

Greene, W. H. (2012). *Econometric Analysis* (7th ed.). New Jersey: Pearson Education.

Guiso, L., & Sodini, P. (2013). Household Finance: An Emerging Field. In *Handbook of the Economics of Finance* (Vol. 2). https://doi.org/10.1016/B978-0-44-459406-8.00021-4

Harrison, G. W., Lau, M. I., & Williams, M. B. (2002). Estimating Individual Discount Rates in Denmark: A Field Experiment. *American Economic Review*, *92*(5), 1606–1617. https://doi.org/10.1257/000282802762024674

Hryshko, D., Luengo-Prado, M. J., & Sørensen, B. E. (2011). Childhood determinants of risk aversion: The long shadow of compulsory education. *Quantitative Economics*, *2*(1), 37–72. https://doi.org/10.3982/qe2

Johnson, M. W., & Bickel, W. K. (2002). Within-subject comparison of real and hypothetical money rewards in delay discounting. *Journal of the Experimental Analysis of Behavior*, *77*(2), 129–146. https://doi.org/10.1901/jeab.2002.77-129

Jumare, H., Visser, M., & Brick, K. (2018). Risk preferences and the poverty trap: A look at farm technology uptake among smallholder farmers in the Matzikama Municipality. In *Agricultural Adaptation to Climate Change in Africa: Food Security in a Changing Environment* (pp. 169–198). https://doi.org/10.4324/9781315149776

Kapteyn, A., & Teppa, F. (2003). Hypothetical Intertemporal Consumption Choices. *The Economic Journal*, *113*(486), C140–C152. https://doi.org/10.1111/1468-0297.00111

Kennison, S. M., Wood, E. E., Byrd-Craven, J., & Downing, M. L. (2016). Financial and ethical risk-taking by young adults: A role for family dynamics during childhood. *Cogent Economics and Finance*, *4*(1). https://doi.org/10.1080/23322039.2016.1232225

Kirby, K. N., & Maraković, N. N. (1995). Modeling Myopic Decisions: Evidence for Hyperbolic Delay-Discounting within Subjects and Amounts. *Organizational Behavior and Human Decision Processes*, *64*(1), 22–30. https://doi.org/10.1006/obhd.1995.1086

Kirby, K. N., & Maraković, N. N. (1996). Delay-discounting probabilistic rewards: Rates decrease as amounts increase. *Psychonomic Bulletin and Review*, *3*(1), 100–104.

https://doi.org/10.3758/BF03210748

Kouame, E. B. H., & Komenan, A. N. (2012). Risk preferences and demand for insurance under price uncertainty: An experimental approach for cocoa farmers in Côte d'Ivoire. *ILO Microinsurance Innovation Facility Research Paper*, (13), 1–30.

Liu, E. M. (2013). Time to change what to sow: Risk preferences and technology adoption decisions of cotton farmers in China. *Review of Economics and Statistics*, *95*(4), 1386–1403. https://doi.org/10.1162/REST_a_00295

Niederle, M. (2015). Gender. In J. H. Kagel & A. E. Roth (Eds.), *Handbook of Experimental Economics* (Vol. 2, pp. 481–562).

Obstfeld, M. (1994). Evaluating risky consumption paths: The role of intertemporal substitutability. *European Economic Review*, *38*(7), 1471–1486. https://doi.org/10.1016/0014-2921(94)90020-5

Renneboog, L., & Spaenjers, C. (2012). Religion, economic attitudes, and household finance. *Oxford Economic Papers*, *64*(1), 103–127. https://doi.org/10.1093/oep/gpr025

Schubert, R., Brown, M., Gysler, M., & Brachinger, H. W. (1999). Financial Decision-Making: Are Women Really More Risk Averse? *American Economic Review*, *89*(2), 381–385. https://doi.org/10.1257/aer.89.2.381

Sepahvand, M. H., & Shahbazian, R. (2017). *Individual's Risk Attitudes in Sub-Saharan Africa: Determinants and Reliability of Self-Reported Risk in Burkina Faso* (No. 2017:11).

Tanaka, T., Camerer, C. F., & Nguyen, Q. (2010). Risk and Time Preferences: Linking Experimental and Household Survey Data from Vietnam. *American Economic Review*, *100*(1), 557–571. https://doi.org/10.1257/aer.100.1.557

Tanaka, Y., & Munro, A. (2014). Regional variation in risk and time preferences: Evidence from a large-scale field experiment in rural uganda. *Journal of African Economies*, *23*(1), 151–187. https://doi.org/10.1093/jae/ejt020

Todaro, M. P., & Smith, S. C. (2015). *Economic Development* (12th ed.). New Jersey: Pearson Education.

Trostel, P. A., & Taylor, G. A. (2001). A Theory of Time Preference. *Economic Inquiry*, *39*(3), 379–395. https://doi.org/10.1093/ei/39.3.379

Vieider, F. M., Lefebvre, M., Bouchouicha, R., Chmura, T., Hakimov, R., Krawczyk, M., & Martinsson, P. (2015). Common components of risk and uncertainty attitudes across contexts and domains: Evidence from 30 countries. *Journal of the European Economic Association*, *13*(3), 421–452. https://doi.org/10.1111/jeea.12102

Vischer, T., Dohmen, T., Falk, A., Huffman, D., Schupp, J., Sunde, U., & Wagner, G. G. (2013). Validating an ultra-short survey measure of patience. *Economics Letters*, *120*(2), 142–145. https://doi.org/10.1016/j.econlet.2013.04.007

Yesuf, M., & Bluffstone, R. A. (2009). Poverty, risk aversion, and path dependence in low-income countries: Experimental evidence from Ethiopia. *American Journal of Agricultural Economics*, *91*(4), 1022–1037. https://doi.org/10.1111/j.1467-

8276.2009.01307.x