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RISK BEHAVIOUR OF WOMEN, LIVELIHOOD ACTIVITIES AND HOUSEHOLD FOOD INSECURITY: EVIDENCE FROM GHANA

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A thesis submitted to the School of Economic & Business Sciences, Faculty of Commerce, Law and Management, University of the Witwatersrand, Johannesburg, in fulfilment of the requirements for the Degree of Doctor of Philosophy in Economics.

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Dedication

To my wife, Rebecca, Nana Yaa Ayifah and my son, Fiifi Nyamekye Ayifah

Declaration

I, Emmanuel Ayifah, declare that this is my own original work, except where acknowledged in the text. It has not been submitted previously either in part or in whole to this or any other university, for any other degree or examination.

Abstract

Women's risk behaviour and how it affects their choice of livelihood activities and household food insecurity has been least explored empirically. Using experimental risk behaviour data matched with socioeconomic characteristics and food insecurity data collected from 1320 women and their households in the Yilo and Lower Manya Krobo districts of the Eastern region of Ghana, I investigated this issue by focusing on three core research questions: (1) What is the effect of religion on risk behaviour of women? (2) What is the relationship between risk behaviour and livelihood activities of women? And (3) Does risk behaviour of women matter in household food insecurity and food insecurity coping strategies? This thesis is divided into three core papers, with each paper focusing on a specific research question.

Religious doctrines may guide individual attitudes and preferences, including risk behaviour among others. The first paper examines the effect of religion on the willingness to take risk amongst 1,209 rural women. The study found that whereas religious affiliation influences the decision to engage in risk, it does not in any way influence the level of risk-taking thereafter. In particular, the study established that relative to the non-religious, religious affiliation of a woman influences her willingness to engage in risk negatively. However, there is very little difference in such willingness to engage in risk between the different religious groups (Pentecostals, Protestants, Catholics, Muslims and Traditional).

Risk attitudes are fundamental in explaining choices that individuals make in any domain that involves uncertainty around a future outcome. Based on the literature, it is apparent that no study has established a causal relationship between risk preferences and choice of livelihood for any African country, and certainly not for Ghana. Furthermore, globally, no study has focused on women specifically, and certainly not in the rural African context. Hence, the second paper investigated the relationship between risk behaviour and livelihood activities. A theoretical model is developed - this indicated that a risk averse woman would engage in a livelihood activity with very little risk such as paid employment, while a risk-seeking woman would engage in a livelihood activity involving high risk, such as farming. The model is tested empirically, and in order to deal with any potential endogeneity, instrumental variables regression was used, with religion as an instrument for risk preference to isolate the causal effect of risk behaviour of women on their choice of livelihood activity. The paper found that women who are willing to take risk are more likely to be farmers, rather than to be unemployed (have no livelihood activity). Also, risk-seeking women were indifferent between having a vocation

or being involved in petty retailing and being unemployed. In addition, risk-seeking women were less likely to be in paid employment than to be unemployed.

Despite the substantial evidence on women's role in food security, there is a paucity of studies explicitly looking at the effect of women's risk behaviour on food insecurity. Therefore, the third and last paper addressed the question whether or not risk behaviour of women matters in household food insecurity. This study contributed to filling the gap in the literature by using a panel data to examine the effect of risk behaviour on household food insecurity and coping strategies. A theoretical model is developed where risk attitudes and food insecurity are connected through precautionary savings. The model indicates that the more risk averse a woman is, the greater the level of precautionary savings, and hence, the lower the household food insecurity. The paper is twofold: the first part estimates the effect of risk behaviour of women on household food insecurity, and the second looks at the effect of risk behaviour on the coping strategies households adopt during food insecurity episodes. The study shows that risk-seeking behaviour of women increases household food insecurity. Also, risk-loving women not only have to adopt more coping strategies, but also more drastic coping strategies, all things being equal.

The results presented in this thesis have implications for policy. Policy design and implementation process needs to take cognizance of the risk behaviour of women as it may affect women's economic behaviour and policy outcomes. Additionally, the religious background of women should be taken into consideration as risk behaviour is found to be influenced by religion. Likewise, policy interventions aimed at enhancing livelihood activities of women should also take into consideration individual risk behaviour. However, livelihood enhancing policies or programmes should be context specific, because different livelihood activities are influenced by risk behaviour differently. Lastly, given that risk behaviour of women influences household food insecurity, as well as some of the strategies households adopt to cope with food insecurity episodes, policies and programmes aimed at improving access to food, should take into consideration women's risk behaviour.

Key words: Women, Risk Behaviour, Religion, Livelihood Activities, Food Insecurity, Hunger, Coping Strategies, Ghana

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CHAPTER ONE

Introduction

1.1 Background

Economic theory postulates that choice made under uncertainty such as occupation/livelihood activities, education, insurance purchase, marriage and asset ownership are largely influenced by individual risk behaviour. These choices inadvertently go a long way to affect certain outcomes, including health, wealth, and food security among others. Chavas (2004) notes that it is difficult to consider any situation where risk does not play a role. Also, Cox and Harrison (2008) argue that it is important for policy makers to know what influences individual risk behaviour in order to judge the certainty equivalence of the effect of policies on individuals effectively. Thus, there is a need to understand what factors influence risk attitudes. It is important to note that religious doctrines may guide individual attitudes and preferences, including risk behaviour among others. Individuals may internalize the doctrines of their respective religion leading them to behave in a particular way. Thus, risk behaviour may differ based on religious affiliation. Risk attitudes can vary from very unwilling to take risk (risk averse) to very willing to take risk (risk-seeking), and these may shape individual decisions and/or choices.

Understanding individual attitudes toward risk is intimately linked to the goal of understanding and predicting economic behaviour (Dohmen et al. 2011; Bhandari and Kundu 2014). Risk behaviour affects many different aspects of people's livelihoods, including whether people are able to maintain assets and endowments, how these assets are transformed into incomes, and how the incomes are translated into broader development outcomes (Kouamé and Komenan 2012). A high degree of risk averse behaviour may cause individuals to engage in less risky livelihood activities, which very often results in low-returns (Dercon and Krishnan 2000; Lybbert et al. 2011). This implies that risk behaviour of household members, including women, is likely to affect their livelihood activities and for that matter their contribution to household income, which also goes a long way to affect household food security. Bass (2009) notes that maternal income effects on food security can be significantly larger than paternal income effects, while livelihood activity is an important determinant of household food security, because it enables a household to build or replenish its assets.

One key characteristic of risk-loving individuals is their short time horizon (Anderhub et al. 2001; Chetty and Looney 2006; Andersen et al. 2008, Anderson and Stafford 2009, Ferecatu and Onculer, 2016), which to a greater extent affects their ability to smooth consumption and hence, influence their

household food security status. Reducing food insecurity and hunger has been high on the agenda of almost every country, because of its attendant negative effect on individuals, households and the nation at large. The Sustainable Development Goals (SDGs) has placed food insecurity high on the global development agenda; food insecurity is thus seen as a developmental concern globally. Various policies and programmes have been implemented by governments and development organizations to ensure a food secure society. Also, at the household level, individual members work tirelessly to provide adequate and nutritious food to feed their household. Empirical literature (Kunze and Drafor 2003; Fonjong 2004 ; Geheb et al. 2008; World Bank et al. 2009 ; Brown 2015) have documented the contribution of women in this regard. For instance, Fonjong (2004) notes that women are indispensable in the drive towards food security owing to the role they play as food producers, income earners, and home managers. Geheb et al. (2008) stress that societal and cultural norms impose on women the role of ensuring there is adequate food among household members. Also, women play an important role in achieving food availability, food access and food utilization in the household (Ibnouf 2009; Kotze 2003) and are more likely to spend their income on household food needs relative to men (World Bank et al. 2009; Bass 2009).

To the extent that women play a crucial role in ensuring household food security, and the fact that women's attitude to risk influences their choices and outcomes, it makes sense that the risk behaviour of women may likely influence livelihood activities, as well as household food insecurity. It is worth noting however that, understanding how risk behaviour of women affects their choice of livelihood activities and household food insecurity is an area that has been least explored empirically. An extensive literature search revealed a dearth of evidence in the development economics literature on the effect of risk behaviour on household food insecurity and coping strategies. The current study therefore endeavours to fill these gaps in the literature by seeking answers to the following questions:

a. Does risk behaviour vary across women and does their religious affiliation play any role?
b. What is the relationship between risk behaviour and livelihood activities of women?
c. Does the risk behaviour of women matter in household food insecurity and coping strategies?

1.2 Objectives

The aim of this study is to ascertain to what extent the risk behaviour of Ghanaian women affects their livelihood activities and household food insecurity. Specific objectives include:

1. To assess individual risk behaviour and to evaluate the effect of religion on risk behaviour.

2. To assess the relationship between risk behaviour and livelihood activities of women.
3. To estimate the effect of risk behaviour on household food insecurity and coping strategies.

Ghana represent an interesting case in terms of analysing religion and risk seeking attitude of women and how women's risk seeking behaviour affects their livelihood activities and household food insecurity. Generally, Ghanaians are very religious: the global Gallup International Religiosity Index[1] show a religiosity index of 95 percent in 2009 for Ghana (Gallup 2009). Other studies have also established that Ghanaians identify themselves more by their religious affiliation (Langer 2010; International Religious Freedom Report 2015; Mc Cauley 2016). Also, according to the Ghana Statistical Service Labour Force Report (2015) females constitute the bulk of the Ghanaian population and about 64.7 percent of females in the working age group are employed (71.4 percent for males). In terms of specific employment, more than half (54.9 percent) of females are in the informal sector (males: 45.1 percent) due to high women participation in trading/sales and services (about 76.2 percent) compared to any other occupations. Despite the great effort in reducing poverty in Ghana, household food insecurity remains a challenge. The World Food Programme (WFP) indicates that in 2009 around 1.2 million people in Ghana, representing 5 percent of Ghana's population were food insecure, and around two million people were vulnerable to become food insecure (WFP, 2009). The contribution of women to general household needs and in particular food security cannot be overemphasised. In Ghanaian societies, women are placed at the centre of ensuring adequate food for household members. Traditionally their role in the household involves food production, purchases and preparations (including decisions on what particular food to eat at any point in time, and when food is served in the household). Consequently, the physical and psychological burden of ensuring household food needs hangs on the face of women (Hesselberg and Yaro 2006), and hence they remain the centrepiece of food security in Ghana (Kunze and Drafor 2003 , Boakye-Akyeampong et al. 2012).

1.3 Data

This thesis used data from the Socioeconomic Studies (SES) arm of the International Lipid-Based Nutrient Supplement Project[2] in Ghana (iLiNS DYAD-G SES). The iLiNS study is a collaborative research project between the University of Ghana and the University of California, Davis. The iLiNS DYAD-G SES study began data collection in December 2009 and continued through to February 2014.

[1] The survey question was "*Is religion an important part of your daily life?*" and results are charted for those who said "yes". 1000 adults were polled in each of 114 countries

[2] The PhD researcher was the Manager for the iLiNS Socio-economic studies in Ghana and hence was actively involved in the research design and data collection.

It comprised of 1320 women and their households from the Yilo and Lower Manya Krobo districts, in the Eastern Region of Ghana. Women attending antenatal clinic in one of four public hospitals (St. Martins Deporres Hospital , Atua Government Hospital , Somanya Polyclinic and Kpong Reproductive and Child Health Clinic) were screened, recruited and enrolled into the study on a rolling basis over a two-year period (December 2009 to December 2011). As part of the eligibility criteria for participation in the iLiNS study, women needed to be at least 18 years of age, resident in the Lower Manya Krobo or Yilo Krobo districts throughout the study period, and be prepared to sign an informed consent form (with approval from her husband or household head). Once a woman was enrolled to participate in the study, her household automatically became part of the SES study. The iLiNS SES study protocol was approved by the Institutional Review Board (IRB) of the University of California, Davis United States of America (USA) and the Noguchi Memorial Institute of Medical Research, University of Ghana IRB. In line with the research objectives, the thesis used three different datasets from the iLiNS DYAD-G SES study including the Household Socioeconomic Characteristics Data, Risk Aversion Data and the Household Food Insecurity Data. The details of these datasets and the econometric specifications applied to specific sections are contained in the various chapters of this thesis.

1.4 Research Significance

According to Dohmen et al. (2012), risk aversion remains largely, a 'black box', in the sense that relatively little is known about its determinants. Therefore, it was important to investigate what factors influence risk-taking propensity. Besides, León and Pfeifer (2013) contend that even though there are several studies on correlates of individual risk taking preferences, only a few (mainly in developed countries) include cultural factors such as religion as an explanatory variable. There is a paucity of research particularly in the developing countries context on the effect of religion on risk behaviour, though religious beliefs, practices, tenets etc. shape people's attitudes; including preferences and attitude toward risk. Again, no study has to date particularly focused on risk behaviour of women and religion. Hence, it is anticipated that analysing the effect of religion on risk behaviour of women in this study will contribute to the empirical literature on risk behaviour.

A number of studies have separately examined risk behaviour (Dadzie and Acquah 2012; Liu 2013; Sovero 2013; Suziki 2014), livelihood activities (Yesuf and Bluffstone 2007; Asmah 2011; Onyemauwa et al. 2013) and household food insecurity (Saaka and Osman 2013). However, it is worth noting that the empirical literature on livelihood activities and household food insecurity has paid very little attention to the effect of risk preferences. Although there are some studies on the relationship between risk attitudes and occupation/livelihood choices, very few (much fewer in developing

countries and none in the context of Africa) attempt to investigate a causal relationship running from risk attitudes to occupational/livelihood choices. Based on the literature, it is apparent that no study has established a causal relationship between risk preferences and livelihood choice for any African country, and globally no study has focused on women specifically. This thesis, therefore, provides new evidence by isolating a causal relationship between risk behaviour and livelihood activity in Ghana.

Additionally, there is dearth of studies on the effect of risk behaviour on household food insecurity. Although most studies on household food insecurity explore food insecurity coping strategies they fail to investigate what factors influence these coping strategies, and in particular the effect of risk behaviour on coping strategies. Hence, analysing the effect of risk behaviour on household food insecurity and coping strategies, while controlling for other factors leads to a better understanding of how to deal with the problem of food insecurity. The outcomes of this research could potentially be useful both academically and for policy, as it hopes to contribute to knowledge and achieve significant milestones by filling in the gaps in the literature.

Furthermore, this study is unique because of its gender specificity in looking at risk preference of women and how it affects livelihood activities and household food insecurity. Indeed, it is interesting to focus on women especially in the context of Ghana because of their traditional role in terms of their contribution to household food needs while having to combine livelihood strategies with other responsibilities including child caring. Although men are responsible for taking care of all household needs (Oppong, 1974, Ogbu, 1978), increasingly women are becoming bread winners and hence have control over decisions about food (Amu 2005; Wrigley-Asante 2011). Despite the numerous studies on women's role in food security, to date, no study has examined the effect of women's risk-seeking propensity on household food insecurity. In this regard, the current study therefore makes significant contribution to the literature.

Most studies on risk behaviour use hypothetical data because it is very expensive to undertake economic experiments with real payoffs. Evaluating risk behaviour using hypothetical data might not reveal the true risk behaviour of individuals, owing to the fact that people may respond differently when presented with hypothetical gambles, relative to gambles with real payoffs. In the context of Ghana, this study is presumably the first to use real payoffs to measure risk preferences in a large sample (1320) of women. In addition, the uniqueness of this study stems from the fact that it used household data collected at certain intervals that can be explored in a longitudinal data structure to

understand the interactions and dynamics of risk behaviour, livelihood activities, and household food insecurity. The few studies that have been done separately on risk behaviour, livelihood activities, and household food security in Ghana and elsewhere mostly use cross-sectional data, making it difficult to evaluate these issues over time.

1.5 Structure of the Thesis

As indicted earlier, this PhD thesis is a collection of three essays focusing on individual risk behaviour, livelihood activities, and household food security. The thesis is made up of five chapters; with the first chapter broadly focusing on the background, research questions, objectives, and the significance of the study. This is followed by the first paper on the effect of religion on risk behaviour in Chapter Two. The second paper, Chapter Three, looks at the relationship between risk behaviour and livelihood activities. The third paper, in Chapter Four, is in two parts: part one explores the effect of livelihood activities on household food insecurity; and the second part examines the effect of risk behaviour on household food insecurity coping strategies. This is followed by the fifth and the final chapter that seeks to summarise and synthesise the conclusions.

CHAPTER TWO

Effect of Religion on Risk Behaviour of Rural Ghanaian Women: Evidence from a Controlled Experiment

2.1 Introduction

Risk behaviour is fundamental in explaining individual, household, and firm level decisions, and in predicting responses to various policy interventions, such as portfolio choice, education, occupation, livelihood, health insurance among others. An individual's attitude towards risk plays an important role in his/her economic decision-making in any situation that involves uncertainty around a future outcome. Understanding individual attitudes towards risk is critical in predicting economic behaviour, and thus for prescribing policy.

Generally, religious doctrines (beliefs, attitudes, values, norms, tenets, et cetera) may guide individual attitudes and preferences, including diet, marriage, investment, and risk-seeking propensity among others. Inzlicht et al. (2009) assert that religious beliefs may provide the basis for understanding and acting within one's environment; and for that matter, can influence individual preferences in general. Borrowing from the 'social identity theory' and 'identity theory' in social Psychology (Tajfel, 1972; Stets and Burke, 2000; Greenfield and Marks, 2007)[3], it can be argued that individuals belonging to a religious group behave in a particular way. Consequently, religion may lead to heterogeneity in individual attitudes, preferences, and traits. Thus, risk behaviour of an individual may differ based on his or her religious affiliation.

Notwithstanding the plethora of literature on risk behaviour, Dohmen et al. (2011) emphasize that risk behaviour still remains to a large extent, a 'black box', in the sense that, relatively little is known about the factors influencing risk-seeking behaviour. For instance, León and Pfeifer (2013) argue that even though there are several studies on individual risk taking preferences, only a few include cultural factors as determinants of risk preference. What is more, very few studies on correlates of risk behaviour include religion as an explanatory variable and those existing studies do focus on developed countries (For the U.S.: Halek and Eisenhauer, 2001; Hilary and Hui, 2009; Benjamin et al., 2010, 2013; For Germany: Dohmen et al., 2011; Weber, 2013; For the Netherlands: Renneboog and Spaenjers, 2012). An Extensive literature search reveals no such study in a developing country context.

[3] Stets and Burke(2000) posit that *social identity theory* emphasizes one's identification or association with a particular group, while *identity theory* examines the roles or behaviours persons enact as members of a group.

Most religious denominations promote individual risk averse behaviour, especially with respect to decisions about money/finance. Almost all religious doctrines in one way or the other have a strong opposition to engaging in any form of financial decisions that may be associated with high level of uncertainty of any form, especially gambling[4] of any form such as a lottery or other games of chance. Adherents of most religions therefore, may think about the moral or ethical implication of participating in lotteries. For instance, Islamic teachings tend to condition its followers to be risk averse in financial matters, because, Qur'an 5:90[5] prohibits games of chance (*maysir)* and speculative behaviour (*Gharar)*. Massah and Al-Sayed (2013) argue that Islamic finance discourages hoarding and prohibits transactions involving extreme uncertainties and gambling. Also, trading or investing in highly risky assets due to uncertainty, and taking interest (*Riba)*[6] are forbidden (*haram*) in Islam. According to some authors (Hassan and Kayed 2009; Hassan and Dridi 2010; Bohnet 2010), the Qur'an and the Islamic Law (*Sharia*) discourage people (and business) from engaging in excessive risk taken transactions. Hence, as a matter of principle, Sharia encourages the pursuance of risk-sharing strategies by individuals and businesses through the usage of less risky financial instruments.

Similarly, the Bible discourages adherents of the Christian faith from investing in assets that the investor sees as uncertain (Proverbs 19:2)[7]. Thus, indirectly the Bible promotes risk-averse behaviour. It is worth emphasizing, however, that the Bible does not explicitly speak against risk, and unlike the Qur'an, the Bible does not explicitly mention betting or engaging in a lottery; it also does not specifically condemn betting or engaging in a lottery. Indeed, a couple of verses in the Bible encourage risk taking (Ecclesiastes 11:4-6, Matthew 25:14-30, 2nd Kings 7:4). Ecclesiastes 11:4[8] criticizes those who are overly cautious and want to play it safe by not taking risk. Also, the so-called "prosperity messages" encourage Christians to act in faith; whereby many charismatic Christians take risks in exchange for perceived blessings from God. These could be considered to be akin to risk taking.

Doctrinal differences between various Christian denominations, in particular between Catholics and Protestants regarding gambling, may also lead to heterogeneity in individual risk behaviour. Though

[4] In general gambling is frowned upon by all religions: Buddhism advocates six evil consequences for indulging in gambling. Although the Bible does not explicitly *say*, "Thou shall not gamble", Christians also consider gambling to be based on the love of money and the promise of quick, easy riches; therefore, they condemn the act. Engaging in any form of gambling results in punishment under Islamic law, because gambling is considered '*haram'* (forbidden) in Islam.

[5] "'O you who believe, intoxicants, and gambling, and the altars of idols, and the games of chance are abominations of the devil; you shall avoid them, that you may succeed" (Qur'an 5:90).

[6] *Riba*, in Islam is seen as a form of extortion, hence forbidden. Literally, it means "an excess" and interpreted as "any unjustifiable increase of capital whether in loans or sales" (Massah and Al-Sayed, 2013).

[7] "Desire without knowledge is not good, and whoever makes haste with his feet misses his way." (Proverbs 19:2)

[8] "He who watches the wind will not sow and he who looks at the clouds will not reap." (Ecclesiastes 11:4)

the current study does not focus on gambling in the strict sense, it is worth emphasizing that the divergent views on gambling/lotteries held by Catholics and Protestants may go a long way to influence risk behaviour of the adherents of Catholicism and Protestantism. Whereas Catholicism[9] tolerates gambling activities, Protestants[10] and Pentecostals[11] have a strong moral opposition to lotteries of any form. Also, as explained by Friedman (2001), Judaism refers to the importance of diversification. This is contained in the Talmud (Babylonian Talmud, Bava Metzia 42a)[12] .

Aside from the fact that most studies fail to include a religion variable in explaining heterogeneity in individual risk-seeking behaviour, it is also worth emphasizing that in particular, heterogeneity in the risk preference of women also merits further examination. Understanding the risk behaviour of rural women is an area that has been explored very little. Although various studies have established that women generally are less willing to take risk relative to men, it is interesting to note that to our knowledge, no study has focused exclusively on the heterogeneity of risk preferences among women. An extensive literature search showed a dearth of empirical evidence on using economic experiments (risk games with real monetary pay-off) to assess the risk behaviour of rural women in general and in particular, to evaluate to what extent religion influences risk behaviour.

The current study contributes to the risk behaviour literature by attempting to find answers to the following questions in the context of Ghana: Does risk behaviour vary across women? If so, does belonging to a particular religious denomination affect individual risk behaviour? Specifically, the study used field economic experiment to assess risk behaviour of rural Ghanaian women, with a focus on whether religion plays a role in explaining heterogeneity in individual risk-seeking propensity. Very little empirical work on risk behaviour exists on Ghana, especially risk-taking behaviour among rural dwellers. This is particularly evident in using risk games with real pay-offs. The few studies (Dadzie and Acquah, 2012) that exist use hypothetical measures of risk which is not incentive

[9] The position of the Catholic Church on gambling is summarized in the New Catholic Encyclopaedia: "A person is entitled to dispose of his own property as he wills ... so long as in doing so he does not render himself incapable of fulfilling duties incumbent upon him by reason of justice or charity. Gambling, therefore, though a luxury is not considered sinful except when the indulgence in it is inconsistent with duty." (Gale Group, 2003).

[10] The United Methodist Church's 2004 Book of Resolutions stated its views on gambling which is typical of many Protestant churches: "Gambling is a menace to society, deadly to the best interests of moral, social, economic, and spiritual life, and destructive of good government. As an act of faith and concern, Christians should abstain from gambling and should strive to minister to those victimized by the practice."

[11]The general Board of the United Pentecostal church international in 1994 issued a position paper on gambling: Biblical faith with its emphasis on loyalty to God and it calls to a life trust tolerates no bowing of the knee to luck and no dependence on chance.

[12]Diversification- dividing one's assets into thirds: one third in land, one third in business, and one third kept liquid: Talmud (Babylonian Talmud, Bava Metzia 42a).

compatible, hence, may not reveal true risk preferences. This study is presumably the first to use real payoff to measure risk behaviour in a large sample[13] of rural women. Hence, analysing the effect of religion on risk behaviour of Ghanaian women in this current study makes it unique in many ways.

Generally, Ghanaians are very religious, as reported by the global Gallup International Religiosity Index (Gallup 2009). Hence, aside the fact that very little empirical work on risk behaviour exist on Ghana (none on effect of religion on risk), the country represents an interesting case to study the effect of religion on risk seeking behaviour. In terms of religious affiliation, the Ghana 2010 population census indicate that most Ghanaians (71.2percent) are Christians, followed by Muslims (17.6percent), traditional (5.2percent), no religion (5.2percent) and other religion (0.8percent). Out of the 71.2 percent Christians; 28.3percent are Pentecostals and Protestants also constitute 18.4poercent. Catholics and other Christians constitute 13.1percent and 11.4percent respectively (GSS, 2010). While Ghana is a multicultural society with a mixture of both ethnic/tribal as well as religious groups, the International Religious Freedom Report (2015), notes that, there is no significant link between ethnicity and religion in Ghana. Further, the literature has found that Ghanaians identify themselves more by their religious affiliation than by their ethnic affiliation. Langer (2010) found, after conducting a general survey in Ghana, that when considering many factors including gender, language, nationality, religion, ethnicity, region of origin, ideology, locality and occupation, that most Ghanaians considered religion most important in terms of their own self perception. In fact religion was more important than ethnicity in terms of their identity. This result is confirmed by Mc Cauley (2016) who found that religious divisions in Ghana are more important than ethnic ones. In so far as it is religion that seems most important to Ghanaians' identity, it seems plausible that their religious affiliation will influence many aspects of their decision making, be it consciously or subconsciously.

The rest of the paper is structured as follows: The next section (2), reviews some of the relevant literature on religion and other factors influencing risk-seeking behaviour. It is followed by the methodology in section 3, which looks at the data and experimental design, as well as the estimation strategy. Sections 4 and 5, respectively discuss the results and concludes the study.

[13] The large sample also gives a good statistical power as most experimental risk studies with real monetary payoff often use smaller samples because it is expensive to undertake.

2.2 Literature Review

2.2.1 Empirical Literature on Effect of Religion on Individual Risk Behaviour

Arguably, the study by León and Pfeifer (2013) is the first in the economics literature to focus directly on the effect of religion on individual risk behaviour. Earlier studies (Halek and Eisenhauer, 2001; Hilary and Hui, 2009; Benjamin et al. 2010, 2013; Dohmen et al., 2011; Renneboog and Spaenjers 2012; Weber 2013) included religion as part of an array of explanatory variables without necessarily focusing on religion as the main variable of interest. In their OLS regression estimation, León and Pfeifer (2013) report a negative and significant relationship between general risk taking propensity and religiosity, suggesting that in general, religiosity is associated with higher risk aversion. In particular, their results revealed that Catholics, Protestants, and Muslims are less risk tolerant. In terms of the effect of religious affiliation on individual financial risk attitude, León and Pfeifer (2013) found no significant relationship among Catholics and Protestants. However, they found Muslims and Traditional believers to be significantly less willing to take financial risk.

In an incentive-compatible experimental choice to evaluate risk aversion among a sample of 827 Cornell University students in the USA, Benjamin et al. (2013) examined whether there are religion-induced differences in financial risk taking. The authors show that whereas being a Protestant reduces risk-taking propensity, risk taking propensity increases with Catholics. In a study of cultural differences in risk tolerance in Germany, Weber (2013) revealed that both religion and nationality matter for risk aversion. In particular, he concludes that Protestants and Atheists are less risk averse than individuals belonging to other denominations.

In a Dutch study of religion and risk, Noussair et al (2012) report a positive correlation between religiosity and risk aversion. Additionally, they report Catholics to be less risk averse than Protestants. Noussair et al (2012) also report that respondents who pray more than once a week are more risk averse relative to those praying less frequently. However, they found no significant effect of the strength of religious beliefs on risk aversion. In another study in the Netherlands, Renneboog and Spaenjers (2012) used data from the annual Dutch National Bank (DNB) Household Survey and found a positive relationship between being Catholic and risk aversion.

Also, in a lottery experiment involving 450 adults in Germany, Dohmen et al. (2011) report that only Protestants and Atheists significantly influence risk-seeking behaviour with respect to financial risk, with Protestants willing to take less risk than Atheists do. With respect to general risk, their results indicate that Atheists are less risk averse than Protestants. Similarly, Bartke and Schwarze (2008)

analysed two possible determinants of individual risk attitudes - nationality and religion - and found that while nationality does not significantly determine risk behaviour, religion is a significant determinant of risk behaviour. They report that religious affiliation matters, and that in religious individuals Muslims are more risk averse than Christians. Halek and Eisenhauer (2001) also find that relative to Traditional religions, being a Catholic or a Jew increase one's level of risk aversion. Also, Benjamin et al. (2010) report that in the USA, Catholics are less risk averse than Protestants and Jews.

Generally, very little empirical work on risk behaviour exists in developing countries relative to developed countries. This is particularly so in the area of religion and risk behaviour. An extensive literature search revealed that very few empirical studies in developing countries do include religion as a covariate in explaining risk behaviour (in fact to our knowledge, only two so far: Liebenehm and Waibel, 2014; Haneishi et al., 2014). In a field experiment conducted in Mali and Burkina Faso, Liebenehm and Waibel (2014) indicate that risk preferences are correlated with religion. In particular the authors found that time spent in a Qur'anic school is positively related to greater risk-seeking behaviour. In a study of risk attitude of farmers in Uganda, Haneishi et al. (2014) included religion as part of their explanatory variables and found religion to be significant and positively correlated with risk aversion. The authors reported that Muslims are more risk averse than Christians.

2.2.2 Empirical Literature on Other Correlates of Risk Behaviour

Empirically, many studies have established that women are generally more risk averse than men (Hryshko et al. 2011; Charness and Gneezy 2012; Weber 2013; Bhandari and Kundu, 2014; Hanewald and Kluge, 2014 West and Worthington 2015). It is interesting to note, however, that contrary to the general belief that women are risk averse relative to men, some studies reveal the opposite (Embrey and Fox, 1997; Papke, 1998). Furthermore, others found no significant effect of gender on risk behaviour (Harrison et al., 2007; Adhikari and O'Leary 2011).

Empirical studies generally support the life cycle hypothesis that age influences risk-seeking behaviour negatively, implying that as age increases people become risk averse - *ceteris paribus* (Lin and Grace 2007, Chinwendu et al. 2012; Weber 2013). Contrary to the general belief that risk aversion is positively correlated with age, other studies have found opposing results indicating that younger people are more risk averse than older people (Hryshko et al., 2011; Dadzie and Acquah, 2012; Hanewald and Kluge, 2014; West and Worthington, 2015). Some studies have also established that the relationship between risk aversion and age exhibits a U-shape or non-linear effect (Cohen and Liran 2007; Faff et al., 2008; Lin 2009; Picazo-Tadio and Wall 2011; Bhandari and Kundu 2014).

Other studies (Grazier and Sloane 2008; Onyemauwa et al. 2013), however, found no effect of age on risk preference. In terms of marital status, whereas studies such as Lin (2009); Weber (2013) and Hanewald and Kluge (2014) report that married individuals are less willing to take risk compared to single and cohabiting individuals, other studies (e.g. . Adhikari and O'Leary 2011) found no significant effect of marital status on risk aversion.

The human capital theory of educational decision-making postulates that educated individuals show a lower level of risk aversion than the uneducated, However, contrary to theoretical expectations some studies have found that higher education is associated with greater risk aversion (Chinwendu et al, 2012; Liebenehm and Waibel 2014). Some studies (Hryshko et al. 2011; Dadzie and Acquah 2012; Outreville 2013; Bhandari and Kundu 2014; West and Worthington 2015) established that the number of years of education is negatively related to risk aversion thus confirming the human capital theory. Other studies (Hallahan et al., 2004; Mosley and Verschoor, 2005) found no significant relationship between risk aversion and literacy. It is commonly assumed that employed individuals have a higher risk-seeking preference than unemployed individuals do. Anbar and Eker (2010) found a higher risk tolerance among the employed relative to the unemployed. Similarly, Weber (2013) reports that unemployed individuals are more likely to be risk averters than the employed. Halek and Eisenhauer (2001) did not find any significant effect of unemployment on risk aversion.

Whereas Hartog et al. (2002) found income and wealth to be significantly negatively related to risk aversion, later studies (Cohen and Liran 2007, Weber 2013) report the opposite. On the contrary, studies undertaken by West and Worthington (2015) and Hanewald and Kluge (2014) report that willingness to take risk increases with household income, but decreases with household wealth. Bhandari and Kundu (2014) established that willingness to take risk decreases with the number of household members. Other studies (Yesuf and Bluffstone 2009; Dadzie and Acquah 2012) found similar results. In contrast, Chinwendu et al. (2012) found risk aversion to decrease with household size.

The literature also revealed other individual and household characteristics that influence risk behaviour such as, debts, shocks, access to credit, health, parental characteristics, previous luck, et cetera. It is important to note, however, that relatively very few empirical studies included these variables as covariates of risk behaviour. In the area of health, West and Worthington (2015) report that being in very good or excellent health positively influences the likelihood of risk tolerance. Dadzie and Acquah (2012) found that access to micro credit significantly positively influences risk attitude. Bhandari and

Kundu (2014) also established that risk-taking propensity decreases with household debt, but increases with family shock. Very little is known about the effect of previous luck on risk-seeking behaviour. In Zambia Wik et al. (2004) confirmed an earlier study in India by Binswanger (1980) that previous luck significantly influences risk aversion negatively.

The current study sought to fill in the gaps in empirical literature by making three important contributions to the risk behaviour literature. First, it focused on the effect of religion on individual risk behaviour, which has been under researched. Second, the study expanded the set of personal and household characteristics that may influence individual risk behaviour by including social capital and previous luck as part of our control variables. Lastly, there is dearth of studies focusing exclusively on the risk behaviour of rural women, using real monetary pay-off. Consequently, the current study is unique owing to its gender specificity.

2.3 Methodology

2.3.1 Data

In line with the objectives of the current study, we use the Risk Aversion data and the Household Socioeconomic Characteristics data on 1,209 women from the iLiNS DYAD-G SES study. The risk behaviour data were generated from a Risk Aversion Game, which was conducted immediately after the household socioeconomic characteristics survey on the same day.

Experimental Design: Risk Aversion Game (RAG)

Data on individual risk behaviour were collected using experimental economics games (Risk Aversion Game, herein referred to as RAG) with real monetary pay-offs. The game was designed to learn something about a woman's risk aversion behaviour by asking her to take decisions about how much money she would like to bet. Depending on the choices the woman makes and the outcome of those choices, she would either double her bet or lose half of her bet. The game was explained to participants as not being a form of gambling or a lottery (as they would understand it in the strict sense), rather, as a means of learning how they take decisions in the face of uncertainties. The initial approach to use the toss of a coin to determine the outcome of the game was replaced with a dice. This was because the toss of a coin was seen to be synonymous with gambling (which is normally frowned upon in typical Ghanaian societies), while the roll of a dice was acceptable, as people in the area were familiar with the popular game called Ludo (a game of chance based on roll of a dice).

The RAG was designed as follows:

Upon arrival at the subject's home, the Experimenter reminded subjects of the confidentiality of the data. The Experimenter began by giving the subject GH¢2 (approximately $1.22, using 2011 annual average exchange rates) and informed her that the money was hers to keep. The game was explained[14] to the participant, and at the end of the explanation she could either choose to play the game (decide to bet) or choose not to play the game (decide not to bet) and keep the GH¢ 2. If the subject indicated that she was not willing to play the game, the Experimenter told her the GH¢ 2 were for her to keep, and then proceeded to the Closing Statement.

If the subject wished to play the game, in the remainder of the game the Experimenter would ask her to indicate how much of the GH¢ 2 she wanted to bet (subjects could choose to bet GH¢ 0, GH¢ 2, or any amount in between their endowment). After she stated her bet, the Experimenter would ask her to roll a 6-sided die to determine the outcome of her bet. Depending on her choice and the outcome from rolling the dice, the participant either doubled her bet or lost half of her bet. If she rolled a one (1), two (2), or three (3), she was given double the amount of money she bet. If she rolled a four (4), five (5) or six (6), she lost half of her bet. In order to help the subject fully understand the game, the Experimenter led the respondent through three (3) practice[15] rounds before conducting the real round. The experimenter then concluded the game by giving the subject the money she won or took back the money she lost and told her that the money she was left with was hers to keep. A flow diagram of the experimental procedure is presented in Figure 2.1 (in the appendix).

Summary Statistics

Table 2.1 presents the sample mean (count and percentages for dummy variables), standard deviation, as well as, the minimum and maximum for individual and household characteristics, including our main variables of interest: risk preference and religion.

Participants' age and years of schooling are on average 27 years and 7 years respectively. In terms of marital status, approximately 37 percent of participants are married (legally married, either through ordinance or customary), 62 percent are in a loose union (not legally married, but have being living

[14] According to the principle of Salience in experimental design (Smith 1976, 1982) the connection between actions and payoffs should be clear to subjects. Therefore, in order to ensure maximum comprehension the Experimenter (Enumerator) takes time to explain the game clearly to the subject. The Experimenter will also demonstrate that the roll of the die is random (50/50 chance of winning or losing a bet) by rolling the die around 10 times in a row, each time declaring the outcome of the roll (the number on top).

[15] In experimental designs, it is very important to use repetition of task in other to maximize subject comprehension (Friedman 1998).

with their partner for a longer period and the relationship is generally known by family, friends, and colleagues), and just 1 percent are not married (single, separated, widowed, or divorced). Around 20 percent of the sample are unemployed; and the average monthly income from main economic activity is GH¢89 ($54). Additionally, 14 percent of the women are household heads; and in terms of social capital, approximately 53 percent are members of at least one group or association. On average, there are 4 people in a household, with an average dependency ratio of 0.7. In terms of household wealth, a mean score of -.01539 was recorded for the household asset index (a proxy measure of household wealth), and an average per-capita monthly income of approximately GH¢84 ($51). Also, roughly 13 percent of the participants indicated that their households were in debt.

Table 2.1 also shows the religious affiliation and ethnicity of study participants. The religious affiliation of include Pentecostals (Pentecost and Charismatics), Protestants (Methodist, Presbyterian, and Anglican), Catholics, Muslims, Traditional religion and No religion. With approximately 67 percent, Pentecostals constitute the largest religious group. This is followed by Protestants (18 percent) and Catholics (9 percent). Respondents of the Islamic faith constitute approximately 3 percent, and about 3 percent also belong to the traditional religion. Those who do not profess to any religion constitute 1 percent. In terms of ethnicity[16], the bulk of the sample (76.3 percent) belongs to the Krobo tribe/ethnic group. Ewes and Akans make up 11.6 percent and 7.2 percent respectively, with less than 1 percent (0.6 percent) from the Ga tribe. The remaining 4.4 percent belong to other tribes. It is not surprising that a greater proportion of the study women and their households are Krobos, since the survey area is part of the Krobo land of South Eastern Ghana.

Table 2.1A shows the cross tabulation of religious affiliation and ethnicity. All the ethnic groups/tribes, except other tribes have more than half of sample women belonging to the Pentecostal faith, followed by protestants, Catholics, Muslims, traditional and no religion, in that order. In particular, the largest tribe, Krobo, has approximately 69 percent of women being Pentecostals. Protestants, Catholics and Muslims, as well as traditionalist and women not affiliated to any religion constitute about 18 percent, 8 percent, 8 percent, 4 percent and 1 percent respectively within the Krobo tribe.

[16] The sample data do not have ethnicity/tribe data. However, the data contains information on the main language spoken in the household. Since most tribes are grouped along ethnolinguistic lines in Ghana, and tribal identity determines language, the main language spoken in the household is used as proxy for ethnicity.

Out of the total 1,209 respondents, 96 percent chose to play the game (Table 2.1). In terms of individual risk behaviour; approximately 4 percent are categorized as *'Not Willing to Take Risk'* (NWTR), 52 percent as *''Willing to Take Moderate Risk'* (WTMR) and 44 percent '*Willing to Take High Risk'* (WTHR), respectively. As indicated earlier, NWTR women are respondents who chose not to play the risk aversion game at all. WTMR women did play the game; but their bets were below the mean amount bet. WTHR women bet either the mean amount or higher. On average, amount bet was GH¢0.83 ($0.50), with a range of GH¢0.05 to GH¢2 ($ 0.03 - $1.2). Also, less than 1 percent (0.6 percent) and 13 percent of respondents bet the minimum and the maximum amount, respectively. The distribution of the amount bet is clearly depicted by the kernel density in Figure 2.2 (See Appendix).

Table 2. 1 Summary Statistics

	Variable	Definition	Mean	Std. Dev.	Min	Max
Risk Behaviour	Willingness to take risk	Bet=1,otherwise 0	.95864	.19920	0	1
	Not Willing to Take	=1 did not bet, otherwise 0	.04136	.19920	0	1
	Risk Moderately Willing to Take Risk	=1 bet below mean, otherwise 0	.52026	.49980	0	1
	Highly Willing to Take Risk	=1 bet mean and above, otherwise 0	.43838	.49639	0	1
	Amount bet in Gh¢*	Total amount bet as a continuous variable	.82722	.56620	0.05	2
Religious Affiliation	Pentecostal	=1penticostal, otherwise 0	.66749	.47131	0	1
	Protestant	=1 protestant, otherwise 0	.18114	.38529	0	1
	Catholic	=1 catholic, otherwise 0	.08602	.28051	0	1
	Muslim	=1 Muslim, otherwise 0	.02481	.15562	0	1
	Traditional religion	=1 traditional religion, otherwise 0	.03225	.17676	0	1
	No religion	=1 No religion, otherwise 0	.00827	.09061	0	1
Individual characteristics	Age in years	Age in years as a continuous variable	26.825	5.5079	18	44
	Marital Status					
	Married	=1 married, otherwise 0	.36642	.48203	0	1
	Loose union	=1 loose union, otherwise 0	.62200	.48509	0	1
	Not in any union	=1 not married , otherwise 0	.01157	.10703	0	1
	Education	Years of schooling completed	7.3143	4.4908	0	16
	Unemployed	=1 unemployed, otherwise 0	.20016	.40029	0	1
	Monthly income in Gh¢*	total monthly income from main occupation	88.736	172.0141	0	2100
	Household headship	=1 if household head, otherwise 0	.14227	.34947	0	1
	Social Capital	=1 belong to a group, otherwise 0	.53350	.49908	0	1
Household characteristics	Household debt	=1 if household borrowed money, otherwise 0	.12738	.33353	0	1
	Wealth	Asset index	-.01539	1.01087	-3.157	2.221
	Dependency Ratio	ratio of dependents per non-dependants	.65101	.68882	0	6
	Household Size	Total number of household members	3.91481	2.13692	1	16
	Per capita income	Per capita income	83.91224	96.06953	0	850
	Ethnicity/tribe					
	Krobo	=1 if Krobo, otherwise 0	0.76261	0.425660.262	0	1
	Akan	=1 if Akan, otherwise 0	0.07444	600.07590	0	1
	Ga	=1 if Ga, otherwise 0	0.00579	0.32012	0	1
	Ewe	=1 if Ewe, otherwise 0	0.11580	0.19920	0	1
	Other tribe	=1 if other tribe, otherwise 0	0.04136		0	1
Other	Previous luck	Continuous variable for previous luck	.05542	.97794	-1	1

Note:* Using yearly average 2011 exchange rate of Gh¢ 1= US$0.61

Table 2.1A Ethnicity/Tribe by Religious Affiliation

	Ethnic Group/Tribe					
Religious Affiliation	**Krobo**	**Akan**	**Ga**	**Ewe**	**Other tribe**	**Total Observation**
Pentecostal	633(68.7%)	60(66.7%)	7(100%)	89(63.6%)	18(36.0%)	807 (66.7%)
Protestant	163(17.7%)	21(23.3%)	0(0.0%)	30(21.4%)	5(10.0%)	219 (18.1%)
Catholic	77(8.4%)	6(6.7%)	0(0.0%)	16(11.4%)	5(10.0%)	104 (8.6%)
Muslim	7(7.6%)	1(1.1%)	0(0.0%)	0(0.0%)	22(44%)	30 (2.5%)
Traditional	34(3.7%)	2(2.2%)	0(0.0%)	3(2.1%)	0(0.0%)	39 (3.2%)
No religion	8(0.9%)	0(0.0%)	0(0.0%)	2(1.4%)	0(0.0%)	10 (0.8%)
Total	922(76.3%)	90(7.2%)	7(0.6%)	140(11.6%)	50(4.4%)	1,209

Pearson chi2(20) = 384.5934 Pr = 0.000

2.3.2 Econometric Framework

Effect of Religion on the Willingness to Take Risk

An individual's decision to play (bet) the risk aversion game or not, in itself is seen as a measure of risk behaviour. A person who is not willing to take risk will decide not to play the game and then keep the Gh¢2. Someone who is willing to take risk, will, however, decide to play or bet in the game, and may either win or lose more money, based on the outcome of the game. Since the decision to /bet or otherwise is binary, the basic econometric estimation framework to model the effect of religion on risk-seeking behaviour is indicated as a latent variable model in equation 2.1 below:

$$WTR_i^* = \alpha + \beta Religion_i + \gamma X_i^{'} + \varepsilon_i \quad ; \quad \varepsilon \approx N[0,\sigma^2], \sigma^2 = 1 \qquad [2.1]$$

Where WTR_i^* is an indicator of willingness to take risk, as a binary outcome ($WTR_i^* = 1$ if an individual is willing to play/bet, otherwise it is, 0). *Religion* represents a vector of variables related to religious affiliation (Pentecostal, Protestant, Catholic, Muslim, Traditional religion and no religion). The coefficient, β measures the effect of religion on risk behaviour (willingness to take risk). $X^{'}$ represents a vector of control variables - individual, household, and other characteristics - such as age, education, marital status, unemployment, income, wealth, social capital, household size, previous luck, et cetera, believed to influence risk-seeking behaviour. The parameter γ signifies the strength of the impact of the control variables; and α and ε_i are the intercept and error terms, respectively. The error term is normally distributed and is independent of the covariates, summarising all unobserved factors that affect risk behaviour with mean zero and a unity variance.

Since the decision to play/bet or otherwise is binary, the net benefit of being willing to take risk in the RAG is unobservable. However, the outcome of the individual's decision to take risk is observable, as depicted by equation 2.2 below:

$$WTR_i = \begin{cases} 1 \text{ if } \mathrm{WTR}_i^* > \tau & \text{willing to take risk} \\ 0 \text{ if } \mathrm{WTR}_i^* \leq \tau & \text{not willing to take risk} \end{cases} \qquad [2.2]$$

Where; τ is the threshold, which in this case is 0.

It is worth noting that estimating the parameter, β by regressing the observed WTR_i^* on *Religion* and the control variables (X') using Ordinary Least Squares (OLS) regression yields a biased and an inconsistent estimate of the slope coefficient and the intercept. The Probit regression estimation, however, is found to be consistent because it is a Maximum Likelihood Estimator (MLE). Hence, given the latent-variable model (1), the parameters (β_i and γ_i) are estimated using MLE for binary Probit regression. For *i*=1, 2,…, *N* individuals, by assuming a standard normal distribution function (*Φ)* of the error term, ε_i , the effect of religion on the willingness to take risk is given by the response probability (2.3) below:

$$\mathrm{Prob}(WTR_i = 1 \mid Religion_i) = \phi(\alpha + \beta Religion_i) \qquad [2.3]$$

The log likelihood for each observation, *i* , is a function of the k x 1 vector of parameters, which may be written as:

$$l_i(\theta) = WTR_i \log[\phi(\alpha + \beta Religion_i)] + [1 - WTR_i] \log[1 - \phi(\alpha + \beta Religion_i)] \qquad [2.4]$$

In the binary Probit model, the coefficient of *religion* has a qualitative effect on WTR_i^* (the dependent variable). Therefore, quantitative predictions are made only based on the marginal effects of the regressors, which are derived from the estimated coefficient. In the current study, since the dependent variable is WTR_i^* and the independent variable of interest is *Religion*, the marginal effect is as follows

$$\frac{\partial \mathrm{Prob}(WTR = 1 \mid \mathrm{Religion})}{\partial \mathrm{Religion}} = \phi(\mathrm{Religion})\beta \qquad [2.5]$$

Where, ϕ, is the Cumulative Distribution Function (CDF) of the normal distribution.

Effect of Religion on the Level of Risk Behaviour

As explained earlier study participants had the choice to play (bet) in the Risk Aversion Game (RAG) or not to play (not bet). The decision to bet, or not to bet, may result in more than two possible ordered multinomial outcomes, and hence, different risk-seeking behaviour categories. In this case, three (3) categories of risk behaviour are considered: Not Willing to Take Risk (NWTR), Willing to Take Moderate Risk (WTMR) and Willing to Take High Risk (WTHR). As indicated earlier, NWTR subjects did not play the RAG, and hence did not bet at all. WTMR subjects played the RAG, but bet below the mean amount bet. WTHR subjects played the RAG and bet either exactly the mean or above the mean. We assume an unobserved latent variable, $Risk^*$, corresponds to the individual risk behaviour category in the game. The effect of religion on risk behaviour for individual i=1, 2,…, N, is therefore given by equation (2.6) below

$$Risk_i^* = \beta Religion_i + \gamma X_i^{'} + \varepsilon_i \quad , \quad \varepsilon \approx N[0, \sigma^2], \sigma^2 = 1 \qquad [2.6]$$

Where, $Risk^*$ is unobserved or latent risk behaviour categories, signifying NWTR (0), WTMR (1) and WTHR (2). Hence, the higher the value of $Risk^*$, the more likely the individual is willing to take risk, and vice versa. All the other variables (β, Religion, γ, $X^{'}$ and ε_i) are as explained earlier.

The above model is imprecise, because $Risk^*$ cannot be observed directly, but only the range in which it falls (0, 1 or 2):

$$Risk = \begin{cases} 0 \text{ if } Risk^* \le \mu_1 & \text{NWTR} \\ 1 \text{ if } \mu_1 < Risk^* < \mu_2 & \text{WTM R} \\ 2 \text{ if } Risk^* \ge \mu_2 & \text{WTHR} \end{cases} \qquad [2.7]$$

The μ 's are threshold or cut-off values to be estimated, corresponding to different risk behaviour levels (NWTR, WMTR and WTHR).

The discrete risk behaviour levels of 0, 1 and 2 results in the following response probabilities:

$$\text{Prob}(Risk = 0 \mid Religion_i) = \text{Prob}(Risk^* \le \mu_1 \mid Religion_i)$$

$$= \text{Prob}(\beta Religion_i + \varepsilon_i \le \mu_1 \mid Religion)$$
$$= \phi(\mu_1 - \beta Religion_i) \quad [2.8]$$

$$\text{Prob}(Risk = 1 \mid Religion) = \text{Prob}(\mu_1 < Risk^* \le \mu_2 \mid \beta Religion_i + \varepsilon_i)$$
$$= \text{Prob}(\beta Religion_i + \varepsilon_i \le \mu_2 \mid Religion_i,) - \text{Prob}(\beta Religion_i + \varepsilon_i \le \mu_1 \mid Religion_i) \quad [2.9]$$
$$= \phi(\mu_2 - \beta Religion_i) - \phi(\mu_1 - \beta Religion_i)$$

$$\text{Prob}(Risk = 2 \mid Religion_i) = \text{Prob}(Risk^* > \mu_2 \mid Religion_i)$$
$$= \text{Prob}(\beta Religion_i + \varepsilon_i \le \mu_2) - \text{Prob}(\beta Religion_i + \varepsilon_i \le \mu_1)$$
$$= \phi(\mu_2 - \beta Religion_i) - \phi(\mu_2 - \beta Religion_i) \quad [2.10]$$
$$= 1 - \phi(\mu_2 - \beta Religion_i)$$

Note that for all the probabilities to be positive: $0 < \mu_1 < \mu_2 < ... < \mu_{j-1}$, Φ is the cumulative distribution function (CDF) of the normal distribution. Using the probabilities above. For i=1,2,…,N women, assuming a standard normal distribution function (Φ) of the error term ε_i, the parameters of the model are estimated using Maximum Likelihood Estimation for the ordered Probit regression. Following Green (2003), for each individual woman, i, the log-likelihood function is given as:

$$l_i(\mu, \beta) = 1[Risk_i = 0]\log[\phi(\mu_1 - \beta Religion_i)] + 1[Risk_i = 1]\log[\phi(\mu_2 - \beta Religion_i]) - \phi(\mu_1 - \beta Religion_i)] + ...$$
$$+ 1[Risk_i = j]\log[1 - \phi(\mu_j - \beta Religion_i)] \quad ; \text{Where, j=0, 1, 2} \quad [2.11]$$

As is the case of all discrete choice models, in the ordered Probit model, the coefficient of the explanatory variables have a qualitative effect. Therefore, quantitative predictions are made only based on the marginal effects of the regressors, which are different from the coefficients. In this case, of three categories, the marginal effects of changes in the regressors are as follows:

$$\frac{\partial \text{Prob}(Risk = 0 \mid Religion)}{\partial Religion} = -\phi(\beta Religion)\beta \quad [2.12]$$

$$\frac{\partial \text{Prob}(Risk = 1 \mid Religion)}{\partial Religion} = [\phi(-\beta Religion) - \phi(\mu - \beta Religion)]\beta \quad [2.13]$$

$$\frac{\partial \text{Prob}(Risk = 2 \mid Religion)}{\partial Religion} = \phi(\mu - \beta Religion)\beta \quad [2.14]$$

Effect of Religion on Amount of Risk (Bet)

How much a woman is willing and able to bet, is also an indication of her risk-seeking behaviour. The amount risk ($AMTrisk$) indicates different levels of risk behaviour, where the higher the amount the more willingness to take risk and vice versa. For individual i=1, 2,…, N ; we estimate the model below:

$$AMTrisk_i^* = \beta Religion_i + \gamma X_i^{'} + \varepsilon_i \quad , \quad \varepsilon \mid x \approx N[0, \sigma^2], \sigma^2 = 1 \qquad [2.15]$$

Where, $AMTrisk*$ is the amount that was bet, which represents the unobserved or latent risk behaviour. The other variables are as explained earlier. The variable $AMTrisk$ is defined to be equal to the unobservable or latent variable $AMTrisk*$, whenever the unobserved variable is above zero, and zero. Otherwise

$$AMTrisk = \begin{cases} 0 \text{ if } \text{AMT}risk* \le 0 & \text{zero amount bet for not willing to take risk} \\ AMTrisk* \text{ if } \text{AMT}risk* > 0 & \text{positive amount bet for being willing to take risk} \end{cases} \qquad [2.16]$$

From equation [2.16] , $AMTrisk$ is either zero for the women who chose not to play the game/did not bet (not willing to take risk) or a positive amount for those who chose to play the game/bet (willing to take risk):

$$AMTrisk = \max(0, AMTrisk*) \qquad [2.17]$$

Those who did not bet ($AMTrisk$ =0) could be discarded and, therefore, this could be treated as an Ordinary Least Sqaures (OLS) estimation problem. However, the distribution will be truncated, leading to biased and inconsistent estimates. Because some women chose not to bet, estimating the effect of religion on risk behaviour using the amount bet as the dependent variable will mean that there will be a problem of censoring. Hence, a Tobit regression is considered appropriate for the situation. A Tobit regression estimation is found to be consistent because it uses Maximum Likelihood Estimation (MLE) to combine the discrete and continuous distributions of the likelihood function. Hence, it takes account of all the information in $AMTrisk$. Following Green (2003), the conditional log likelihood function of the model is expressed as:

$$l_i(\theta) = 1[AMTrisk_i = 0]\log\left[1 - \phi\left(\frac{\beta \text{Re}ligion_i}{\sigma}\right)\right] + 1[AMTrisk_i > 0]\left\{\log\phi\left[\left(\frac{AMTrisk_i - \beta \text{Re}ligion_i}{\sigma}\right)\right] - \log\left(\frac{\sigma^2}{2}\right)\right\} \qquad [2.18]$$

The estimated coefficient of the Tobit regression is the marginal effect of a change in *Religion* on the observed variable ($AMTrisk$) as depicted below:

$$\frac{\partial E[(AMTrisk \mid \text{Religion})]}{\partial \text{Religion}} = \beta\phi\left(\frac{\beta' Rligion}{\sigma}\right) \qquad [2.19]$$

As a starting point, first the results for an Ordinary Least Square (OLS) regression using the amount risk as the dependent variable is presented, and then, the Tobit results as an alternative model which accounts for censoring. As a robustness check a Heckman selection two step model is also estimated.

2.3.3 Definition of Variables and Expected Signs

Table 2.5 presents the definitions (and the expected signs) of both the dependent and explanatory variables used in modelling the effect of religion on risk behaviour.

Dependent Variables: Risk Behaviour

There are three dependent variables because the study used three different estimations (binary Probit, ordered Probit and Tobit). The dependent variable for binary Probit, *WTR*, is a binary or dichotomous variable where: *WTR*=1 if the subject is willing to take risk, otherwise *WTR*=0. The dependent variable for the ordered Probit, *Risk,* is a multinomial ordered categorical measure of risk where 0 signifies NWTR (subjects who did not bet at all), 1 for WTMR (subjects who bet below the mean amount bet) and 2 for WTHR (subjects who bet either the mean or above the mean). The dependent variable for the Tobit, *AMTrisk*, is a continuous variable indicating the total amount bet by participants in the game.

Main Explanatory Variable of Interest: Religion

With respect to *Religion,* the main explanatory variable of interest, subjects are grouped based on their adherence to the major religious groups in Ghana. To capture the effect of religion on risk behaviour, six different dummy variables are used to represent various religious group affiliations (=1 if woman a member of the religious group, and 0 otherwise). These classifications are guided by the Ghana Statistical Service (GSS)[17] groupings, based on how close the beliefs or doctrines of the various religious denominations are. The religious affiliation variables used in this current study include Pentecostals (Pentecost and Charismatics), Protestants (Methodist, Presbyterian, and Anglican),

[17] Generally the main classification of religions groups in Ghana according to the Ghana Statistical Service include Catholics, Protestants (Methodist, Presbyterian and Anglican), Pentecostals (include charismatics), Muslims, Other Christian (Adventists, Later day Saints, Jehovah Witnesses, etc.), Traditional religion, other religion (Hindus, Buddhist, , Eckhankar, Jews, etc.) and No religion.

Catholics, Muslims, Traditional religion, and No religion. Adherents of various religious faiths may internalize the doctrines of their respective religions. In this regard, since almost all the various religious groups in one way or the other have strong opposition to engaging in any form of highly risky and speculative ventures because of uncertainty in outcomes (lotteries, speculative investments etc.) religious affiliation is expected to be negatively related to willingness to take risk, relative to the non-religious. However, it is expected that adherents of the Islamic faith are relatively less willing to take risk compared with the others (Pentecostals, Protestants, Catholics and Traditional Traditional religion). This is because Islamic law (*Sharia*) and the Qur'an have a much stricter stands against speculative behaviour, especially in financial matters.

Control Variables

Age: A subject's age is measured in completed years as a continuous variable. Generally, risk-seeking behaviour is considered to decrease with age as explained within the context of the lifecycle risk aversion hypothesis. The life cycle hypothesis posits that the further a person is from retirement, the more risk he or she is willing to take in their investments. After retirement, labour income is replaced by assets income and a person is not willing to take more investment risks (Bellante and Saba1986, Lin and Grace 2007). Therefore, a negative (positive) effect of woman's age (age squared) on her willingness to take risk is expected.

Marital Status: Three different dummy variables (married, loose union and not married)[18] are used to represent marital status. There are two schools of thought about the nature of the relationship between marital status and risk attitude. One school of thought asserts that married individuals have greater risk-taking propensities, while another suggests the opposite (Becker, 1974; Becker et al., 1977; Roszkowski et al. 1993; Jianakoplos and Bernasek, 1998). The marriage search-theoretic models explain that where individuals view marriage as a way to self-insure against income risks, risk-loving individuals would marry later relative to risk averse individuals. As argued by Bhandari and Kundu

[18] It is worth noting that most empirical studies only use just one dummy variable to represent marital status (mostly 1 for married, 0 otherwise). We wish to state that it is very common to find people in a long-term relationship (even to the extent of raising children together) though they may not be legally married (either by ordinance or customary). This is commonly so in the study area for this current study, but it is not typical of the general Ghanaian society. Hence, it is important to separate these two categories of marital status (married and loose union) as strictly or technically speaking they do not mean the same. Marriage by ordinance or customary is more binding and hence, cannot be easily dissolved (this would require the legalities of either divorce or separation) compared with a situation where people might be in less legally binding long-term relationships. Most studies fail to use these categories of marital status in their regressions possibly because of data limitations. Respondents were asked to indicate whether they are actually married, or in a loose union or divorce, separated etc. Hence, three different dummy variables for marital status (married, loose union, and not married) are included in this study.

(2014) marital status risk attitude relationship is ambiguous, hence, it is expected that there will be either a positive or a negative effect of marital status on risk-seeking behaviour.

Education: Education is measured by the number of completed years of schooling in formal education. Education is expected to be positively correlated with willingness to take risk, *ceteris paribus*. Generally, educated individuals show a lower level of risk aversion as postulated by Shaw (1996) in his human capital theory; where he suggests that human capital acquisition is an inverse function of risk aversion.

Unemployment: A dummy variable is used to represent the unemployment status of a woman (1=unemployed and 0, otherwise). The unemployed have higher income uncertainties and lower disposable income. Therefore, a negative effect of unemployment on willingness to take risk is hypothesised, *ceteris paribus*.

Income: Two income variables have been used in this study. The first income variable is individual income, measured as a continuous variable of the total monthly income of the women participating in the risk behaviour game. The second income variable is the household income variable, measured using per-capita income, also as a continuous variable. Theoretically, attitudes to risk are expected to increase with income (Riley & Chow, 1992, Grable et al. 2004), hence, income is expected to be positively correlated with willingness to take risk.

Household wealth: The household asset index[19] is used as a proxy measure of household socio-economic status, based on ownership of a set of assets. The asset index was constructed using Principal Component Analysis(CPA) of household ownership of a set of assets such that a higher score indicates a better relative socioeconomic status (Vyas and Kumaranayake, 2006). Just like income, theoretically attitudes to risk are seen to increase with wealth (Riley & Chow, 1992, Grable et al. 2004). Hence, household wealth is expected to be positively correlated with the willingness to take risk.

Household head: A dummy variable is used to represent household headship (=1 if a woman household head, 0 otherwise). The study hypothesizes a positive relationship between household headship and being willing to take risk. Household heads are generally considered to be risk-loving because being

[19] The assets included in the index were radio, television, refrigerator, cell phone, stove, lighting source, drinking water supply, sanitation facilities, and flooring materials.

a household head entails taking certain stringent and risky decisions and having responsibilities on behalf of all other household members.

Social capital[20]*:* Social capital is measured as a dummy variable, where, 1 means being in a group or association and 0 otherwise. Social capital may serve as a means of Traditional insurance, diversification, fall-back strategies or coping opportunities. Therefore, it was expected that social capital would be positively correlated with being willing to take risk.

Household debts: Generally, debt tends to make an individual behave in a conservative manner especially in relation to financial matters; this study, therefore, hypothesizes household debt would decrease willingness to take risk. Household debt[21] is measured using a dummy variable of whether the household borrowed money or not.

Household size[22]: Household size is a continuous variable, and was measured as the total number of members in a participant's household. The total number of household members may represent labour force for the household, and hence could be viewed as a wealth variable, providing insurance, and would thus have a positive effect on risk-seeking behaviour. Alternatively, a larger household size means higher consumption needs and more people to feed, which may decrease risk-seeking behaviour. Consequently, the study expected household size to have an ambiguous (negative or positive) effect on risk behaviours. As such, household size is included in the regression without any *a priori* expectation of the sign.

Dependency ratio: Age dependency ratio[23] is also measured as a continuous variable. In the study, a negative effect between dependency ratio and willingness to take risk was expected because higher dependency ratio means more people to feed, which therefore may decrease risk-seeking.

[20] Respondents were ask to indicate which of the following associations or groups they belong to: Susu, , Farmer's Association, sewing, singing, music, church, informal traders', income-earning, mothers/men's support groups.; School, developmental committees; , Queen Mother's Association; Market Association.

[21] For household debt, the following question was asked: "Over the past twelve months, did you or anyone else in your household borrow on credit from someone outside the household or from an institution?"

[22] Following the Ghana Statistical Service definition as used in various surveys (GLSS, GDHS, MICS etc.), household members are defined as people who have been regularly sleeping in the same dwelling and sharing food from the same cooking pots for at least the last three months.

[23] Age dependency ratio: measured by the ratio of number of dependants (below 18years+above 60 years) and non-dependants (18 years to 60 years).

Previous luck: It is believed that past experiences would influence current or future preferences, including risk preferences. Hence, a participant's previous risk-seeking experience was expected to influence her bet in the final or actual round of the risk behaviour game. To ascertain whether past risk-seeking experience has a significant effect on current risk behaviour, a previous lack variable was included as a proxy for previous risk-seeking experience. Previous luck is measured using the outcome of the last (third) practice round before the actual or final round of the risk aversion game. The third practice round was used because the last practice round would be a good indication of accumulated learning or experience. The previous luck variable takes a value of -1 when the subject bets and loses in the third practice round; 1 when she bets and wins; and 0 when she does not bet at all. Past risk-seeking experience is hypothesized to influence willingness to take risk, *ceteris paribus,* positively.

Table 2.5 in the appendix shows the definitions (and the expected signs) of both the dependent and explanatory variables used in modelling the effect of religion on risk behaviour.

2.4 Results and Discussion

Before moving on to our main regression results it important to have a look at bivariate relationships between risk behaviour and religion.

2.4.1 Risk Behaviour by Religious Affiliation

Table 2.2 shows the distribution of risk behaviour categories (Willing to Take High Risk - WTHR, Willing to Take Moderate Risk - WTMR and Not Willing to Take Risk – NWTR) of study women per their religious affiliation. A greater proportion of Pentecostals were WTMR (53.0 percent), followed by WTHR Pentecostals (43 percent) and then NWTR (4 percent). It can be seen that equal proportion of Protestants (48 percent) are WTMR or WTHR. Exactly half (50 percent) of Catholics are WTMR and about 46 percent are WTHR. For adherents of the Islamic faith, 57 percent are WTMR, followed by WTHR (37 percent) and NWTR Muslims (7 percent). Similarly, for women belonging to Traditional religion, a little over half (54 percent) are WTMR. Traditionalists who are WTHR and NWTR constitute 44 percent and 3 percent respectively. It is interesting to note that, none (0 percent) of the non-religious women are NWTR. The shares of women that are WTMR and WTHR among non-religious women are equal (50 percent each). It is also evident from Table 2.2 that on the whole, the proportion of women NWTR professing the Islamic faith (7 percent) are more than those in the other groups (Pentecostals, Protestants, Catholics, Traditional religion, and non religious). Additionally, the proportion of Catholics that are NWTR (4 percent) are more than Protestants (3 percent), but lower than Pentecostals (5 percent). In the same vein, in terms of WTMR, the proportion

of Muslims (57 percent) are more than any of the Christian denominations (Pentecostals, Protestants and Catholics), as well as, the traditionally religious and non-religious. Conversely, a lesser proportion of Muslims (37 percent) are WTHR, compared with Pentecostals (43 percent); traditionally religious (44 percent), Catholics (46 percent); Protestants (48 percent) and non religious (50 percent).

Table 2.2 Risk Behaviour by Religious Affiliation

	Risk Behaviour Category*			
Religious Affiliation	**WTHR**	**WTMR**	**NWTR**	**Total Observation**
Pentecostal	343(42.5%)	428(53.0%)	36(4.46%)	807
Protestant	106(48.4%)	106(48.4%)	7(3.20%)	219
Catholic	48(46.2%)	52(50.0%)	4(3.84%)	104
Muslim	11(36.7%)	17(56.7%)	2(6.67%)	30
Traditional religion	17(43.6%)	21(53.8%)	1(2.56%)	39
No religion	5(50.0%)	5(50.0%)	0 (0%)	10
Total	**530(43.83)**	**629(52.02%)**	**50(4.13%)**	**1,209**

***Note:** WTHR (Willing to Take High Risk): bet mean and above; WTMR (Willing to Take Moderate Risk): bet below the mean; NWTR (Not Willing to Take Risk): did not bet at all.

2.4.2 Estimation Issues

Before presenting and discussing the regression results, it is worth commenting on a few estimation issues relating to endogeneity concerns and the model specification.

An individual's religious affiliation is mostly inherited from previous generations (mostly parents) and it fundamentally remains unchanged (Guiso and Paiella, 2008; León and Pfeifer, 2013). This is true for Ghana, where, religion for the vast majority is inherited from birth. In Ghana, religious affiliation is typically constant overtime and the effect of religious conditioning is strong and lifelong. Individuals are born into various religious groups, and most often do not change such affiliations. Indeed, an analysis of the religious affiliation overtime for the sample women in this current confirm this, where, the religious affiliation of the study women remained unchanged over the 4 time period of data collection (See table 2.4 in the appendix). Therefore, religion is assumed exogenous. If religious affiliation is exogenous, this study assumes a causal link running between religion and risk behaviour only. Whilst the relationship between risk behaviour and religion, as well as some covariates (age, gender, household headship, dependency ratio, and household size) is self-evident, it may be unclear for others covariates (education, marital status, social capital, income, wealth, employment) because there is the potential for endogeneity between risk behaviour and these variables. Whilst on one hand these characteristics may affect risk behaviour, on the other hand a causal link may run from risk

behaviour to any of these characteristics. The focus of this current study is on the effect of religion on risk-seeking behaviour; hence, it does not attempt to address endogeneity. Nevertheless, in all the models, two different regressions are estimated: aside the main regression estimations with control variables; the study also undertake regression estimations without control variables. Thus the estimated results without and with endogenous variables are compared to see if the results are consistent.

A test of the specification of the binary Probit and ordered Probit models using the Ramsey's Regression Equation Specification Error Test (RESET) indicate that both models are correctly specified. With respect to the Tobit model, the Link test confirms that there is no misspecification.

2.4.3 Regression Results

Effect of Religion on Risk Behaviour

Because the results of the binary Probit, ordered Probit and Tobit regression coefficients just give a qualitative effect, in presenting and discussing the results, the marginal effects which gives quantitative effects are reported (Tables 2.3). Six (6) categories of religious affiliation in are used in the estimation namely; Pentecostal, Protestants, Catholics, Muslims, Traditional and Non-religious. In all the estimations the non religious are the reference category.

As expected, the binary Probit results (Table 2.3, Column 1) indicate that religion has a statistically significant negative effect on the likelihood of a woman's willingness to take risk (WTR). In particular, relative to non religious woman, being a Pentecostal decreases the likelihood of WTR by 28.2 percentage points. Likewise, relative to the non-religious, the WTR of Protestants and Catholics are 26.2 and 27.1 percentage points lower respectively. Also being a Muslim decreases WTR by 27.1 percentage points relative to the non-religious. With respect to adherents of Traditional religion, the study found a 26.5 percentage point decrease in willingness to take risk relative to the non-religious. It is evident that even though all the religious groups show a statistically significant negative effect on WTR, with no significant difference in this regard between the various religious groups.

The current results corroborate earlier studies that also observed various religious denominations to be less willing to take risk (León and Pfeifer, 2013; Noussair et al., 2012; Renneboog and Spaenjers, 2012; Bartke and Schwarze, 2008).

Columns 2, 3 and 4 of Table 2.3 show the Ordered Probit regression results. In the Ordered Probit regression, the dependent variable comprised of three ordered multinomial risk behaviour categories

0, 1 and 2; signifying Not Willing to Take Risk (NWTR), Willing to Take Risk (WTMR) and Willing to Take High Risk (WTHR) respectively. The results (Table 2.3, Columns 2-4) depict that none of the religious affiliations variables are statistically significant. This is an indication that degree or level of risk behaviour (NWTR, WTHR and WTMR) is not in any way explained by religious affiliation, at least, in the context of the Ordered Probit estimation.

As indicated earlier, conditioned on a subject's decision to play the RAG; how much a woman is willing to risk (AMTRisk) is used as an indicator of her willingness to take risk. As a starting point, an Ordinary Least Squares (OLS) regression is estimated (column 5). As a robustness check a Tobit regression is also estimated which account for censoring (column 6), and then, a Heckman two stage regression as a further check (column 7). It is worth noting from the results (Table 3.2) that the OLS specifications are robust, at least qualitatively, to using the alternative Tobit specification. It is also interesting to note that the results of all the three estimated models (OLS, Tobit and Heckman selection) show that none of the religious affiliation variables are statistically significant; implying that, again, religion does not explain the degree or level of risk behaviour (the amount risk). Given the very small number of zeros in the data (few individuals who chose not to play the game); it is not surprising that the OLS results are very close to the Tobit results.

In summary, the results show that religion is statistically significant in explaining risk behaviour only in the Binary Probit model, but not in the Ordered Probit and OLS, Tobit and Heckman regressions. This implies that whereas religion influences willingness to take risk, it does not in any way influence the degree or level of risk behavior once the decision to engage in risk has been taken.

Table 2. 3 Effect of Religion on Risk-seeking Behaviour

		Decision to engage in risk (Bet)	Level or degree of risk (Amount Bet)					
VARIABLES		Binary Probit Marginal Effect	Ordered Probit^2 Marginal Effect			OLS	Tobit^3 Marginal Effect	Heckman
		(1) WTR (Bet)	(2) WTHR	(3) WTMR	(4) NWTR	(5) AMTRisk (Amount Bet)	(6) AMTRisk (censored Amount Bet)	(7) AMTRisk (censored Amount Bet)
Religious Affiliation	Pentecostal	-0.2817***	-0.1203	0.0925	0.0278	-0.0285	-0.0420	-0.0169
		(0.038)	(0.130)	(0.100)	(0.030)	(0.169)	(0.168)	(0.176)
	Protestant	-0.2620***	-0.0783	0.0602	0.0181	0.0037	0.00118	0.00548
		(0.038)	(0.133)	(0.102)	(0.031)	(0.173)	(0.172)	(0.178)
	Catholic	-0.2713***	-0.1115	0.0857	0.0258	-0.0272	-0.0389	-0.0214
		(0.039)	(0.137)	(0.105)	(0.032)	(0.177)	(0.177)	(0.182)
	Muslim	-0.2705***	-0.0810	0.0622	0.0188	-0.0860	-0.0834	-0.0805
		(0.050)	(0.158)	(0.122)	(0.037)	(0.197)	(0.199)	(0.214)
	Traditional	-0.2650***	-0.1057	0.0813	0.0245	-0.0830	-0.0743	-0.0799
		(0.054)	(0.148)	(0.113)	(0.034)	(0.187)	(0.187)	(0.195)
Individual Characteristics	Age	0.0093	0.0406*	-0.0312*	-0.0094*	0.0228	0.0393	0.0158
		(0.009)	(0.021)	(0.016)	(0.005)	(0.026)	(0.0269)	(0.0303)
	Age Squared	-0.0002	-0.0008**	0.0006**	0.0002**	-0.0005	-0.0008*	-0.0003
		(0.0002)	(0.0004)	(0.0003)	(0.0001)	(0.0004)	(0.001)	(0.001)
	Married	-0.3075***	-0.1130	0.0868	0.0262	-0.160	-0.170	-0.148
		(0.040)	(0.114)	(0.088)	(0.027)	(0.169)	(0.170)	(0.153)
	Loose union	-0.3127***	-0.0996	0.0766	0.0231	-0.191	-0.204	-0.176
		(0.043)	(0.111)	(0.086)	(0.026)	(0.167)	(0.167)	(0.151)
	Years of Education	0.0006	0.0007	-0.0005	-0.0002	0.0008	0.0012	0.0004
		(0.001)	(0.003)	(0.002)	(0.001)	(0.004)	(0.004)	(0.005)
	Unemployed	0.0032	0.0849**	-0.0653**	-0.0197**	0.115**	0.114**	0.112**
		(0.019)	(0.038)	(0.029)	(0.009)	(0.049)	(0.049)	(0.048)
	Income	-0.0001	0.0001	-0.0001	-0.00003	0.0003	8.66e-05	0.0003
		(0.0001)	(0.0002)	(0.0002)	(0.00005)	(0.0003)	(0.0003)	(0.0003)
	Income Squared	1.09e-07	9.63e-09	-7.40e-09	-2.23e-09	-3.63e-08	5.68e-08	-7.12e-08
		(7.69e-08)	(1.24e-07)	(9.52e-08)	(2.87e-08)	(1.87e-07)	(1.94e-07)	(1.53e-07)
	Social Capital	-0.0070	0.0657***	-0.0505***	-0.015***	0.104***	0.0964***	0.107***
		(0.011)	(0.025)	(.0195)	(0.006)	(0.032)	(0.0323)	(0.033)
Household	Household Head	0.0967***	0.0772**	-0.0594**	-0.0179**	0.0435	0.103**	0.0078
		(0.031)	(0.038)	(0.029)	(0.009)	(0.051)	(0.052)	(0.083)
	Household Debts	-0.0249	-0.0132	0.0101	0.0031	-0.0131	-0.0371	0.0019
		(0.015)	(0.039)	(0.030)	(0.009)	(0.048)	(0.049)	(0.056)
	Asset Index	-0.0093	0.0044	-0.0034	-0.0010	0.0272	0.0142	0.0327

		(0.007)	(0.014)	(0.011)	(0.003)	(0.018)	(0.018)	(0.021)
	Dependency Ratio	-0.0220**	-0.0286	0.0220	0.0066	0.0199	-0.0007	0.0301
		(0.009)	(0.023)	(0.018)	(0.005)	(0.033)	(0.033)	(0.035)
	Household Size	0.0083**	0.0108	-0.0083	-0.0025	0.0126	0.0190**	0.0089
		(0.003)	(0.007)	(0.005)	(0.002)	(0.009)	(0.009)	(0.011)
	Per-capita Income	0.0001	0.0002	-0.0001	-0.00004	0.0003	0.0004	0.0003
		(0.0001)	(0.0002)	(0.0001)	(0.00004)	(0.0003)	(0.0003)	(0.0003)
	Akan	0.0052	0.0216	-0.0166	-0.0050	-0.0092	-0.0007	0.0644
		(0.021)	(0.051)	(0.040)	(0.0119)	(0.062)	(0.063)	(0.264)
	Ewe	0.0860	0.0251	-0.0193	-0.0058	0.0003	0.0069	0.1057
		(0.020)	(0.397)	(0.031)	(0.009)	(0.046)	(0.047)	(0.242)
	Ga		-0.1422	0.1093	0.0329	-0.0827	-0.0734	
			(0.132)	(0.101)	(0.031)	(0.154)	(0.149)	
	Other tribe	-0.0275	-0.1177	0.0904	0.0272	-0.1009	-0.1326	-0.3385
		(0.026)	(0.079)	(0.0604)	(0.019)	(0.098)	(0.101)	(0.366)
Other	Previous luck		0.3828***	-0.2942***	-0.0886***	0.4016***	0.469***	0.400***
			(0.028)	(0.021)	(0.013)	(0.037)	(0.0371)	(0.0374)
	Constant	7.5786***				0.385	0.555***	0.448
		(1.654)				(0.481)	(0.012)	(0.515)
	Constant cut1		-0.4449 (0.9642)					
	Constant cut2		1.6100* (0.9655)					
	Mills lambda							-0.311 (0.576)
	Rho							-0.573
	Sigma						0.5553	0.5433
	Pseudo/R-squared/	0.1010	0.0804			0.123	0.0821	
	Wald chi2	1064.62	169.52					159.36
	Observ.	1,201	1,208			1,158	1,208	1,208

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

^**Note:** WTR (Willing to Take Risk): bet/played the risk game; WTHR (Willing to Take High Risk): bet mean and above; WTMR (Willing to Take Moderate Risk): bet below the mean; NWTR (Not Willing to Take Risk): did not bet at all; AMTRisk (Amount Bet including 0 or censored): Total amount bet/risk

Reference category: no religion

1.RESET test : yf2=0 ; (1) [bet]yf2 = 0 ; chi2(1) = 0.85 ; Prob > chi2 = 0.3559
2. RESET test: yf2=0 ; (1) [riskbhvcat]yf2 = 0 ; chi2(1) = 1.44; Prob > chi2 = 0.2295
3. Link test, ll (0) **:** (_hat : 2.275782** ; _hatsq : -0.7834545)

Effect of Other Individual and Household Characteristics on Risk Behaviour

Although religion is not statistically significant in explaining risk behaviour in the Ordered Probit, OLS,Tobit and Heckman models (Table 2.4), it is clear from the results that the other covariates significantly explain the degree or level of risk taking. Thus, the effect of religious affiliation on willingness to take risk, as well as, the degree or level of risk taking depends on certain individual and household characteristics.

Turning to the control variables, the results in Table 2.3 depict that whereas age is not statistically significant in explaining risk behaviour in the Binary Probit (column 1) or the OLS, Tobit and Heckman models (columns 5, 6 and 7) , in the Ordered Probit, age has a significant positive effect on risk behaviour (columns 2, 3 and 4). Age increases the probability of being Willing to Take High Risk (WTHR) by around 4.06 percentage points. Thus, as age increases by one unit an individual is more likely to have a higher risk-taking propensity. As noted by Dadzie and Acquah (2012), older women are more likely to have accumulated more wealth than younger ones and are also likely to have a wider or greater social network, which can serve as a source of fall-back strategies or traditional insurance in the process of decision making. Whereas the results confirm earlier studies (Hryshko et al., 2011; Dadzie and Acquah, 2012; Hanewald and Kluge, 2014; West and Worthington, 2015), it also conflicts with other studies with respect to age (Hira et al. 2007; Chinwendu et al, 2012 and Weber 2013).

The ordered Probit and Tobit results depict a statistically significant non-linear (U shaped) effect of age on risk-taking behaviour, though the magnitude is very small (less than 0.1 percent in all cases). This is indicated by a negative significant marginal effect for HWTR (0.08 percentage points decrease). It is interesting to note that, although Age is not statistically significant in the OLS, Tobit and Heckman regressions, Age squared has a significant negative effect on the amount bet in the Tobit regression. Age squared significantly decreases the amount bet by less than 1 percent. Notwithstanding the fact that the size effect of the age squared variable is very small, the results imply that ceteris paribus*;* willingness to take risk increases with age up to a certain point and then decreases as age increases. This suggests that as expected, risk-taking behaviour decreases with increasing age. Thus, the non-linear relationship between age and risk behaviour in the current study validates the life-cycle risk aversion hypothesis, which posits that age negatively influences risk taking propensity. This could be explained by the fact that generally individuals behave conservatively as their age increases and hence are not daring, making them less risk-seeking. Consistent with the current study, Bhandari and Kundu (2014) found a positive but non-significant effect of age on risk-seeking behaviour and a negative significant effect of age squared on risk-seeking behaviour. Other studies that also found similar results

include Cohen and Liran (2007), Faff et al. (2008), Lin (2009), as well as Picazo-Tadio and Wall (2011).

Regarding the marital status variables, these are statistically significant in explaining risk-seeking behaviour only in the Binary Probit regression, but not in the Ordered Probit , OLS, Tobit and Heckman regressions. From Table 2.3 (Column 6) it can be seen that married women and those in informal union are respectively 30.75 and 31.27 percentage points less likely to be willing to take risk relative to unmarried women. This substantiates earlier studies that report that married individuals are less likely to be risk-loving (Grable and Roszkowski, 2007; Weber, 2013; Hanewald and Kluge, 2014).

In terms of the employment status of women, the results show a statistically significant effect of unemployment in the ordered Probit, OLS, Tobit and Heckman regressions; but not in the Binary Probit regression. Generally, it is assumed that unemployed individuals are less risk-seeking because they have lower disposable income and higher income uncertainties (Anbar and Eker 2010, and Weber 2013). However, contrary to the general belief, the results indicate that unemployed women are more willing to take risk as indicated by positive significant coefficient for risk-seeking propensity in both the Ordered Probit and Tobit regressions. These results confirm the job search theoretic model (Pissarides, 1974; Feinberg, 1977), which predicts a positive relation between willingness to take risk and unemployment. Unemployment is sure to have an immense sociological and psychological impact on those experiencing it (Diaz-Serrano and O'Neill 2004). Hence, the current results can also be explained by the fact that the unemployed experience adverse situations (the experience of challenging life events and circumstances), thereby conditioning them to be willing to take risk. Further, because of the uncertainties in future income the unemployed bet more (higher) relative to the employed. Intuitively, the unemployed see the lottery as a chance to get more money so they try to bet higher thinking they might be lucky.

As expected, the Ordered Probit, OLS, Tobit and Heckman results show a positive statistically significant effect of social capital on willingness to take risk (Table 2.3). The ordered Probit results depict that social capital increases the propensity o take risk by 6.57 percentage points.

Household headship is also seen to be statistically significant in all the regression estimations. In the Binary Probit results, being a household head increases the probability of willingness to take risk by 9.67 percentage points. If a woman is a household head, she is 7.22 percentage points more willing to take risk as indicated by the Ordered Probit results(column 2). Similarly, the Tobit results(column 6)

depict a positive significant effect of household headship on being willing to take risk. All things being equal, if a woman is a household head, she bets 0.103 more, implying that *ceteris paribus*, being a household head increases risk-seeking propensity. This result is not surprising, because, position of authority enables a person to take risky decisions compared to those who do not have authority.

Turning to household characteristics, dependency ratio is statistically significant only in the binary Probit regression with a 2.20 percentage point decrease in the probability of willingness to take risk. This indicates that women from households with a higher proportion of dependants are less willing to take risk, compared with those from households with fewer dependants. Household size is positive and statistically significant in the Binary Probit and Tobit regressions. The reason for the positive effect of household size on risk-seeking behaviour can be explained by the fact that the total number of household members may represent labour force for the household, and hence could be viewed as a wealth variable, providing insurance or coping opportunities.

The relationship between risk and religion may potentially be affected by tribal/ethnic identity, since the lines between religious and tribal identity are often vague. Hence, in order to assume away the influence of tribal identity, we included an ethnicity dummy in all our regressions estimations. We choose the Krobo tribe as the reference group simply because it is the largest tribe. We find that religion still continues to be significant in the decision to bet (willingness to take risk), but not the amount bet (degree or level of risk behaviour).

Regarding previous luck, this is controlled for only in the Ordered Probit, OLS, Tobit and Heckman models as the variable is not available for those who chose not to play the RAG. The results (Columns Column 1-7) indicate that previous luck is statistically significant in explaining the level of risk behaviour. These results are an indication that individuals who won in the last practice round are more willing to take risk, all things being equal. The expected positive significant effect of previous luck may suggest that participants who won in previous rounds are updating their subjective probabilities in favour of winning, as they move to the final round of the game. It is interesting to note that the previous luck variable was highly significant (at 1 percent level) and, has the largest impact as indicated by the large marginal effects in both the regressions compared with all other covariates in the current study. This therefore is suggestive of a strong impact of previous luck on risk-seeking behaviour. It is worth highlighting that the literature search revealed very little empirical work that included previous luck variable in explaining correlates of risk-seeking behaviour. An earlier study in India by Binswanger (1980) and a much later one by Wik et al. (2004) in Zambia are the only studies

found in the literature to have included a previous luck variable. Both studies also found a similar positive effect of previous risk-seeking experience on risk behaviour.

Effect of Previous Luck on Risk Behaviour

The current study attempted to take the previous luck results a little further, by estimating two different models (based on different previous luck measures) to explore the impact of previous luck on willingness to engage in risk. The results as presented in Table 2.6 in the appendix indicate that irrespective of the measure of previous luck used (a win in at least 1, 2 or all 3 practice rounds, relative to no win at all; interacting amount bet in each practice round and outcome of bet), a strong positive significant impact ($p<0.01$) of previous luck is established, with or without controls. It is also worth noting that similar to the previous Tobit regression results (table 2.3) the influence of religion remained unchanged.

2.4.4 Study Limitations

This study is not without limitations. Hence, before concluding and discussing the implications of the results, we highlight the limitations of the study. First, the study population in the risk behaviour game comprised of women who were recruited as part of the iLiNS Dyad Ghana nutritional intervention trial. One of the main inclusion criteria for a woman to be part of iLiNS Dyad Ghana study is that she should be in her reproductive years (18 years and above) and also resident in the Yilo and Lower Manya Krobo districts of Ghana. Thus, the study population was certainly not a random sample of women in Ghana as a whole and not a representation of all women in Ghana. Hence, to the extent that subjects who participated in the risk aversion game were exclusively women recruited from just two districts out of the current 216 districts in Ghana, caution must be exercised in attempting to generalize these results to the entire women population of Ghana; thus external validity is not possible.

Another limitation worth acknowledging is the fact that the women who obtained permission form their husbands to participate in the study may likely have more bargaining power in their households. Hence, such women may also have a greater propensity for risk taking, and therefore, it is possible that the more than 90 percent of the study women are willing to take risk for exactly these same reasons. It may also be the case that so many women are willing to take risk because they consider the amount of money used in the experiment as too small that it has no consequence for them in real life, beyond the experimental setting. Further rounds of the experiment, with cumulatively higher monetary

amounts[24] may have helped identify the real risk takers. Consequently, the limited variation in the decision to take risk is to some extent a limitation of this study.

Lastly, it is worth acknowledging that the sample sizes of three religious affiliations categories including Muslims, Traditional and Non-religious are small, and hence, the regression estimates may not have the necessary power to make reliable/consistent inferences.

2.5 Conclusions and Recommendations

The earlier external validity concerns and other limitations notwithstanding, it is worth acknowledging that important inferences can be made from the findings that may provide valuable insights into heterogeneity of risk behaviour of women. It is worth emphasizing that one of the strengths of the current study lies in its gender specificity, owing to the fact that it focuses on risk behaviour of rural women. Most risk preference studies are not gender specific, as they either focus on both men and women or on a particular group of people (farmers, managers, household heads, etc.).

The study found robust evidence that religion, measured by religious affiliation, is negatively correlated with the decision to engage in risk, but not in determining the level or degree of risk-taking once the decision has been made to engage in risk. With respect to the decision to engage in risk, while religious women are less willing than non-religious women to engage in risk, the differences between the various religious groups in this regard are not significant. Overall, the result of this study has important implications for understanding and predicting the effect of religion on individual economic behaviour among women in the study area, with particular reference to risk related decision-making. The current study therefore contributes to the existing empirical literature by providing evidence on the effect of religion in explaining heterogeneity of risk-seeking behaviour of women. Arguably, it is one of the few studies in a developing country context, if any at all, that principally focuses on the effect of religion on risk behaviour; and in particular risk behaviour of women.

In addition, the results have implications for policy and future research. Religious beliefs normally shape individual values and economic behaviour, and in the end affect the macro economy. Therefore,

[24] It is however important to emphasise that the amount used in experiment in this current study (GH¢2, approximately $1.22) is comparable to what participants received in previous studies in developing country settings: Biswanger (1980) in India (Rs.5= US$0.63); Schechter (2007) in Paraguay (PYG 8,000=0.8US$) ;South Africa, Brick et al (2012), ZAR 2-20 (ZAR 2-20 = US$0.28-2.85); Bhandari and Kundu (2014) in India (Rs.50 =US$ 0.91). There is however no consensus in the literature on what should constitute a significant amount of money (or monetary payoff) given to participants in an experimental risk preference game in order to help reveal true risk preferences.

any policy design and implementation process that are seen to be risk induced such as, uptake of public health insurance schemes among others, may affect individual economic behaviour and outcomes, and therefore should take into consideration religious background of women. Additionally, as suggested by Cox and Harrison (2008), it is recommended that governments and NGOs contemplating the design and implementation of new interventions especially targeted at women, such as public health insurance enrolment, employment schemes, new preventative health products, savings or investment products, et cetera, should take into consideration the religious affiliation. Aside from religion, other individual and household factors such as age, marital status, employment status, household headship, dependency ratio, household size, social capital, and previous experience should also be taken into consideration in developing policies and programmes that are directly or indirectly influenced by risk and uncertainty.

2.6 Appendices

Figure 2.1 Flow Diagram of the Risk Aversion Game Experimental Procedure

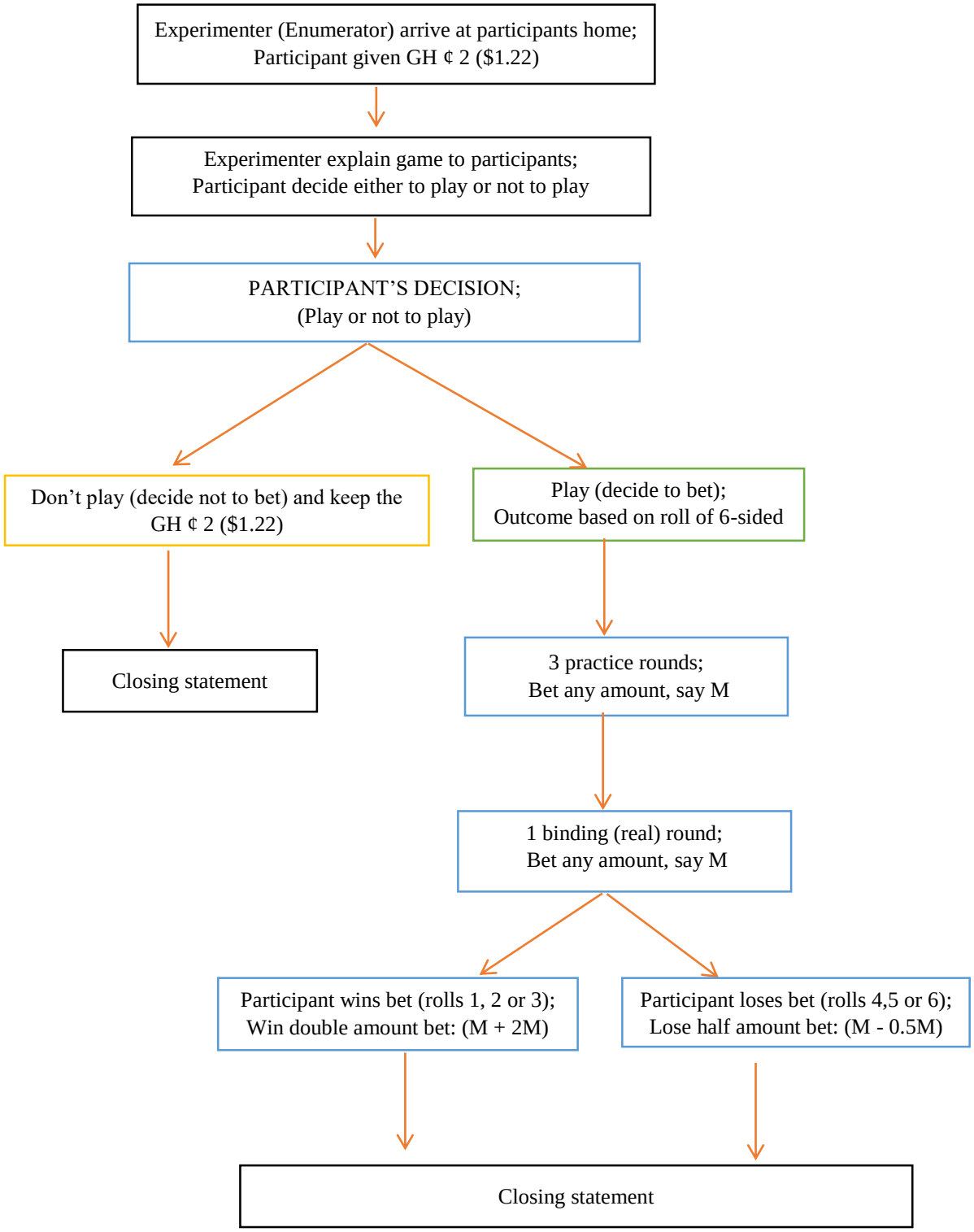


Figure 2. 2 Kernel Density Estimate of Amount Bet (Gh¢)

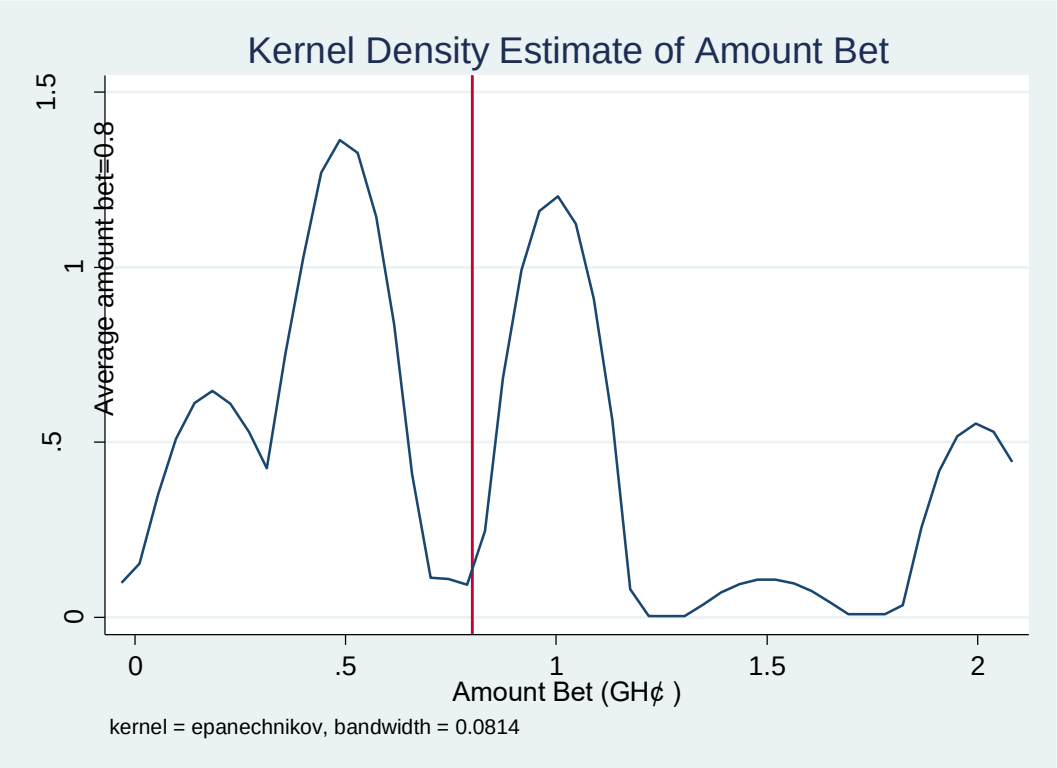


Table 2.4 Religious Affiliation Over Time

Religious Affiliation	Time 1 (N=1,207)	Time 2 (N=1,011)	Time 3 (N=967)	Time 4 (N=843)	Overall (N=4,019)
Pentecostal	.6677713	.6666667	.6628749	.6534772	.6633491
Protestant	.1814416	.181998	.1809721	.1846523	.1821349
Catholic	.086164	.090999	.0920372	.0971223	.0910674
Muslim	.024855	.0217606	.0279214	.028777	.0256283
Traditional	.031483	.0326409	.0289555	.028777	.0306046
No religion	.008285	.0059347	.0072389	.0071942	.0072157

Table 2.5 Variable Definitions for Effect of Religion on Risk-seeking Behaviour

Variable		Definition	Expected signs: Willingness to take risk
Dependent Variable	Bet	Bet=1 (Willingness to take risk), otherwise, 0	
	Risk	Ordered measure of risk behaviour categories: 0=did not bet (Not willing to take risk) 1=bet below mean(Willing to take moderate risk) 2=bet mean and above (Willing to take high risk)	
	Amount bet	Total amount bet as a continuous variable	
Religious Affiliation	Religion	=1 Pentecostal , otherwise 0 =1 Protestant , otherwise 0 =1 Catholic , otherwise 0 =1 Muslim, otherwise 0 =1 Traditional religion, otherwise 0 =1 No religion, otherwise 0	- - - - - -
Individual Characteristics	Age	Maternal age in years	-
	Age Squared	Quadratic term for age	+/-
	Marital Status	=1 married, otherwise 0 =1 loose union, otherwise 0 =1 not married , otherwise 0	+/- +/- +/-
	Education	Years of completed schooling	+
	Unemployment	=1 unemployed, otherwise 0	-
	Income	total monthly income from main occupation	+
	Squared income	Quadratic term for income	+
	Household head	=1 if household head, otherwise 0	+
	Social capital	=1 belong to a group, otherwise 0	+
Household Characteristics	Household debt	=1 if household borrowed money, otherwise 0	-
	wealth	Household asset index	+
	Dependency ratio	ratio of dependants per non-dependants in a household	-
	Household size	Total number of household members	+/-
	Household income	Per capita income	+
	Ethnicity/tribe Krobo Akan Ga Ewe Other tribe	 =1 if Krobo, otherwise 0 =1 if Akan, otherwise 0 =1 if Ga, otherwise 0 =1 if Ewe, otherwise 0 =1 if other tribe, otherwise 0	 +/- +/- +/- +/- +/-
Other	Previous luck	Continuous variable for previous luck	+

Table 2.6 Tobit Regression Results on the Effect of Previous Luck on Risk Behaviour

	Variables	***Wining in at least practice rounds** v2	Variables	****amount bet in practice round and win**
Risk experience	win1	0.368***	R1amountwin	0.393***
		(0.0589)		(0.0377)
	win2	0.486***	R2amountwin	0.284***
		(0.0669)		(0.0400)
	win3	0.444***	R3amountwin	0.314***
		(0.0636)		(0.0380)
Individual Characteristics	Age	0.0360	Age	0.0217
		(0.0276)		(0.0234)
	Age Squared	-0.000756	Age Squared	-0.000471
		(0.000471)		(0.000400)
	Married	-0.255	Married	-0.122
		(0.172)		(0.158)
	Loose union	-0.270	Loose union	-0.156
		(0.170)		(0.155)
	Years of Education	0.000783	Years of Education	0.00189
		(0.00420)		(0.00346)
	Unemployed	0.463***	Unemployed	0.266***
		(0.0916)		(0.0790)
	Self employed	0.363***	Self employed	0.183***
		(0.0817)		(0.0693)
	employee	0.317***	employee	0.126
		(0.0977)		(0.0813)
	income	0.000251	income	0.000211
		(0.000268)		(0.000245)
	Income sqaured	-5.60e-08	Income sqaured	-3.40e-08
		(1.89e-07)		(1.77e-07)
	Social capital	0.107***	Social capital	0.0924***
		(0.0333)		(0.0293)
	Household head	0.0863	Household head	0.0445
		(0.0531)		(0.0495)
	Pentecostal	-0.0172	Pentecostal	-0.0715
		(0.150)		(0.137)
	Protestant	0.0148	Protestant	-0.0410
		(0.154)		(0.141)
	Catholic	-0.00862	Catholic	-0.0829
		(0.160)		(0.145)
	Muslim	-0.152	Muslim	-0.146
		(0.170)		(0.153)
	Traditional	-0.0627	Traditional	-0.0893
		(0.170)		(0.158)
Household	Household Debts	-0.0252	Household Debts	-0.0128
		(0.0489)		(0.0420)

	Asset Index	0.0214	Asset Index	0.0132
		(0.0191)		(0.0168)
	Dependency Ratio	0.000493	Dependency Ratio	0.0156
		(0.0348)		(0.0302)
	Household Size	0.0187*	Household Size	0.0132
		(0.00980)		(0.00864)
	Per-capita Income	0.000346	Per-capita Income	0.000325
		(0.000255)		(0.000252)
	Akan	0.0310	Akan	0.0371
		(0.0656)		(0.0591)
	Ewe	0.0318	Ewe	0.00530
		(0.0497)		(0.0449)
	Ga	0.232	Ga	-0.0706
		(0.248)		(0.125)
	Constant	-0.274	Constant	0.157
		(0.480)		(0.412)
	Sigma	0.574***	Sigma	0.500***
		(0.0121)		(0.0121)
	Observations	1,208	Observations	1,208
	Pseudo R2	0.0533		0.2263

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Notes:

***risk experience: win in at least 1 practice round(1=win, otherwise 0)**

win1=won in at least one practice rounds

win2=won in at least two practice rounds

win3=won in all three practice rounds

****risk experience: amount bet in practice round and outcome of bet (1=win, otherwise 0)**

R1amountwin = amount bet in practice round 1 and outcome of bet

R1amountwin = amount bet in practice round 2 and outcome of bet

R1amountwin = amount bet in practice round 3 and outcome of bet

CHAPTER THREE

The Relationship between Women's Risk Behaviour and their Livelihood Activities: Empirical Evidence from Ghana

3.1 Introduction

Risk attitudes are fundamental in explaining choices individuals make in any domain that involves uncertainty around a future outcome. Choices such as occupation, education, insurance purchase, investment, marriage, asset ownership, amongst others, may, to a greater extent, be influenced by individual risk behaviour. As noted by Kouamé and Komenan (2012), "Risk behaviour is a central issue that affects many different aspects of people's livelihoods, including whether people can maintain assets and endowments, how these assets are transformed into incomes via activities and how these incomes and earnings are translated into broader development outcomes". This current study attempts to isolate the causal effect of the risk behaviour of Ghanaian women on their choice of livelihood activity.

From an economic perspective livelihood is an occupation, work, or other means by which one earns income to meet the necessities of life (Asong et. al., 2000). According to Chambers and Conway (1991), livelihood comprises the capabilities, assets, and activities required for a means of living. Savath et al. (2014) defined livelihood activity as any direct income-generating activity in which an individual engages, or any activity that might not bring in income directly but increases the consumption and/or well-being of an individual. Similarly, Yizengaw et al. (2015) view livelihood activities as actions taken by the household to obtain household income. Livelihood activities can be identified at the individual, household, village, regional, as well as national levels (Scoones, 1998), and hence, individual livelihood activities may be different from household livelihood activities. According to Tuyen (2013), a simple way to identify various types of livelihoods at the individual level is to focus on the main income earning activity[25], although in reality individuals may engage in multiple livelihood activities. Various

[25] However, as noted by Barret et al (2001) the same cannot be said of household livelihood activities because individuals in a household are likely to engage in different activities. Hence, according to Barret et al (2001) household livelihood strategies cannot be identified by a single income earning activity. The livelihood literature often uses livelihood activities and livelihood strategies interchangeably. It is therefore important to bring into perspective the major difference between the two concepts. According to Ellis (1998) livelihood strategy encompasses not only activities that generate income but many other kinds of choices, including cultural and social choices, that come together to make up the primary occupation of a household. Also, Brown et al (2006) defined livelihood strategy as the chosen combination of assets and activities. Hence, in simple terms, livelihood activities are subsumed under livelihood strategies.

studies have identified many possible factors that influence livelihood activity choice. Factors in the literature seen to affect the choice of livelihood activity are age, gender, marital status and education, household size, credit access, and remittances (Babulo et al 2008, Wanyama et al. 2010; Kuwornu et al. 2014, Tran et al. 2014). Others include access and distance to market, location, farm ownership, farm size, farm assets and access to grazing land (Brown et al. 2006, Dary and Kuunibe 2012, Shehu and Abubakar 2015). Some studies have also looked at factors such as access to electricity and mobile phone services (Shehu and Abubakar 2015), and social networks (Dary and Kuunibe 2012, Shehu and Abubakar 2015).

While there are numerous studies that have looked at the relationship between risk attitudes and occupation/livelihood choices, the majority of these studies do not establish a causal relationship between risk attitudes and occupational choices. Bellante and Lin (1981) showed that risk-averse individuals in the United States of America were more likely to work in the public sector than they were to work in the private sector. Cramer et al. (2002) showed that risk-averse individuals in The Netherlands were less likely to be self-employed. Bonin et al. (2007) found that risk-averse individuals in Germany were more likely to work in occupations with low earning risk. Bezabih et al. (2010) found that individuals in Ethiopia with risk neutral preferences were more likely to engage in off-farm activities. Cho (2012) looked at the entrepreneurship decisions of men and women separately for individuals in the United States. The author showed that while risk-averse men were more likely to choose paid employment than to be self-employed, there was no significant association between risk preferences and women's entrepreneurship decisions. Le et al. (2014) also established that risk-seeking individuals in Australia had a higher probability of being employed in more prestigious, high paying professional and administrative occupations. Falco (2014) studied the relationship between risk preferences and occupational choice in Ghana. Looking at urban Ghanaians, he examined the association between risk preferences and employment in the formal and informal sectors. He found that risk-averse individuals are more likely to be employed in the formal sector compared to the informal sector.

The relationship between risk preferences and engagement in certain livelihood activities is not so simple, however. While one would expect a risk-averse individual to choose a livelihood activity that does not involve too much risk, it is also true that an individual involved in a livelihood activity that involves a lot of risk might alter his/her general risk behaviour

accordingly. For example, he/she might choose to behave in a risk-averse way in other financial aspects of his/her life in order to compensate for the risky job. Further, there may be unobserved factors that influence both an individual's risk behaviour and his/ her choice of livelihood activity. The studies mentioned above do not consider the possibility of an endogenous relationship between risk preferences and livelihood activity/unemployment. Very few papers do indeed account for such possible endogeneity. For example, Dohmen and Falk (2011) carried out a controlled laboratory experiment in Germany in order to establish a causal relationship between risk preferences and choice of work schemes with different pay options. After risk preferences of participants had been elicited, participants had to carry out a work task. They could elect either a fixed pay work task or a variable pay work task. The results of the experiment showed that more risk-averse individuals were more likely to sort into fixed pay work schemes rather than variable pay work schemes. Skriabikova et al. (2014) used panel data from Ukraine, both before and after the country's transition to democracy. They explored the fact that before the transition occupations did not differ significantly in earning risk, whereas after the transition there was significant difference in earning risk between different occupations. Using risk preferences from before the transition, they show that risk-averse individuals changed to jobs with lower earning variance after the transition, while risk seekers changed to jobs with more earning variance. In this way, they established a causal relationship between risk preferences and occupational choice. Fourage et al. (2014) established a causal link between risk and occupational choice by looking at risk preferences of recent school graduates in the Netherlands and their subsequent career choices. They found that those graduates more willing to take risk opt for occupations with higher earning and employment risk.

Based on the literature it is apparent that no study has established a causal relationship between risk preferences and livelihood/occupational choice for any country on the African continent, and certainly not for Ghana. Further, aside from Cho (2012) who considered the cases of men and women separately in the United States, no study has focused on women specifically, and certainly not in the African context. This is important because according to the UNDP (2010), globally women undertake different livelihood activities to lift their families and communities out of poverty and hunger. In Ghana, various studies have also observed women to be involved in income earning activities such as agricultural-related activities, retailing and production-related activities (Owusu, 2007). The current study therefore sought to establish empirically a

causal relationship between risk behaviour and choice of livelihood activity, using experimental risk behaviour data matched with data on livelihood activities among a sample of 1,209 women in the Yilo and Lower Manya Krobo districts of Ghana. Seemingly Unrelated Bivariate Probit, as well as a multinomial logit and the General Structural Equation Modelling Regression Estimation (GSEM) are estimated, using a woman's religion as an instrument for her risk preference in order to deal with any potential endogeneity.

Five (5) main livelihood activity categories are identified, namely farming, petty retailing, vocation, paid employment and no livelihood activity. The results show that women who are willing to take risk are more likely to be farmers than to be unemployed (have no livelihood activity). They are indifferent between having a vocation, being involved in petty retailing and being unemployed, and are less likely to be in paid employment than to be unemployed. Other individual and household characteristics that influence livelihood activity choice of women in the sample include age, education, household headship, dependency ratio, per-capita income, household farm ownership, and household enterprise ownership.

The rest of the paper is structured as follows: Section 2 presents the theoretical model while Section 3 presents the data and methodology. The results are presented and discussed in Section 4, and Section 5 concludes the study.

3.2 Literature Review

3.2.1 Empirical Literature on Risk Preference and Livelihood Activities

While acknowledging the possibility of an endogenous relationship between risk preferences and livelihood activity, an extensive literature search revealed very few studies that indeed do take cognizance of such possible endogeneity. Most of these studies (Dohmen and Falk 2011, Skriabikova et al. 2014) are in the context of developed and transition economies, and they focus on occupational choice, whereas the present study is on livelihood activity choice. However, there is no theoretical underpinning why "occupational choice" and "livelihood activity choice" should be different, thus, they are completely interlinked and used interchangeably. This section attempts to review some of the existing studies on risk preferences and livelihood activities or occupational choices. The review first focuses on

studies that do not show any causal effect, then those showing causal effect and lastly studies on other factors influencing livelihood activities.

Studies with No Causal Effect

Bellante and Lin (1981) used the University of Michigan's Panel Study of Income Dynamics data to answer the question, "Are public sector workers more risk averse than private sector workers?" While controlling for other factors, their Probit regression results showed that risk-averse individuals in the United States were more likely to work in the public sector than they were to work in the private sector. Cramer et al (2002) researched the effect of risk attitude on entrepreneurial positions in the Dutch province Noord-Brabant. Their dependent variable, entrepreneurship, was measured as a dummy variable that takes on the value 1 for individuals that have ever been self-employed and 0 for all other respondents that have ever been part of the labour force. Their risk attitude measure is the reservation price of a hypothetical lottery (how much the respondent would pay for a ticket in a hypothetical lottery with 10 tickets and a single prize of 1000 guilders). In a binary Probit estimation of retrospective occupational choice, the authors found evidence supporting the general beliefs that risk aversion significantly influences entrepreneurship negatively.

Using the German Socio-Economic Panel (GSOEP), Bonin et al. (2007) studied individual risk preference and occupational sorting. They assumed that occupational choice is motivated by earnings risk, and therefore measured earnings risk using the cross-sectional variation in earnings in Mincerian wage regressions. The authors related earnings risk to individual subjective risk preference and found a positive significant relationship between willingness to take risk and occupational sorting. In particular, they found robust evidence that risk-loving individuals are more likely to be sorted into occupations with higher earnings risk. Findeisen (2013) in turn investigated whether variations in risk preferences are a good predictor of occupational choices, using data from the GSOEP. In the GSOEP risk attitudes are measured on a discrete 0-10 scale, with higher values indicating a higher risk tolerance. In a sample of youth workers, the author reported no evidence for significant correlation between risk attitudes on the probability of choosing an occupation.

Mauro and Musumeci (2011) interviewed 258 individuals aged between 25 and 40 in Southern Italy to analyse risk attitudes of employees in temporary jobs and those in permanent jobs. In

a Probit analysis to test the hypothesis that fixed income earners are more risk-averse than variable income earners, they reported that the probability of having a variable income job is associated with lower levels of risk aversion. Additionally, they found that women in temporary jobs are more risk averse relative to those in permanent jobs. In Ethiopia, Bezabih et al. (2010) investigated the importance of hypothetical risk preferences on households' decision to engage in off-farm employment and found that households with risk neutral preferences were more likely to engage in off-farm activities.

Much related to the current study is the paper by Falco (2014) that analysed the role of risk aversion in explaining occupational choice of 585 urban workers in Ghana. The author concluded that risk preferences play an important role in determining occupational choices. Using a Multinomial Logit with constant relative risk aversion as a key explanatory variable, the author modelled the likelihood of being in three occupational categories of informal sector, formal sector, and unemployment, and found that risk aversion significantly increases the likelihood of queuing for formal occupations, while it decreases the likelihood of working in the informal sector. Falco (2014) also controlled for certain individual and household characteristics and reports that whereas age, per capita income, marital status and household headship significantly decrease the likelihood of queuing for formal jobs, education and number of children increases the probability of queuing for formal job. It is important to emphasize that even though the current study is related to Falco (2014), the two are different in part because, whereas the current study focuses on willingness to take risk and livelihood activity choice of rural women, Falco (2014) investigated how risk aversion determines the allocation of urban workers into formal and informal occupations. Also, whereas this study looked at a gendered analysis by focusing on women, Falco (2014)'s study did not have a particular gender focus, neither did it investigate endogeneity between risk-attitudes and occupational choice.

Causal Effect

Very few studies account for possible endogeneity between risk behaviour and livelihood activities. In a controlled laboratory experiment among 360 students from the University of Bonn, Germany, Dohmen and Falk (2011) established a causal relationship between risk preferences and choice of work schemes with different pay options. Risk preferences of participants was elicited using lottery choices by asking individuals to indicate their

willingness to take risk in general on an 11 point scale, after which they were asked to carry out a work task. Participants could select either a fixed pay work task or a variable pay work task. The results of the experiment showed that more risk averse individuals were more likely to sort into fixed pay work schemes rather than variable pay work schemes.

Using the ROA School Leavers Survey, Fourage et al. (2014) established a causal link between risk preferences of 4,584 recent school graduates aged 35 years or younger in the Netherlands and their subsequent career choices. Using general risk attitude and risk attitude in financial matters to instrument career risk attitude, the authors related the risk attitudes of recent graduates to the timing and riskiness of earnings in their choice of occupations. They found that graduates who are more willing to take risk opt for occupations with higher earning and employment risk. In particular, they reported that individuals who are willing to take risk opt for occupations with higher cyclical sensitivity (agriculture, medical, and paramedical occupations) and higher risk of unemployment (lower level or unskilled production/services, transport, or agricultural workers)

Skriabikova et al. (2014) studied risk attitude and occupational choice/sorting, using panel data from the Ukrainian Longitudinal Monitoring Survey (ULMS). The authors exploit the fact that occupations differed in earnings risk during the period prior to the collapse of the communist regime in Ukraine and the early transition period. During the period prior to the collapse of the command economy in Ukraine, occupations did not differ significantly in earning risk, whereas after the transition there was significant difference in earning risk between different occupations. They reported that risk attitudes were not correlated with occupational earnings risk before the transition, while a significant positive correlation evolves after transition. Using risk preferences from before the transition, the authors showed that risk averse individuals changed to jobs with lower earning variance after the transition, while risk seekers changed to jobs with more earning variance. In this way, they established a causal relationship between risk preferences and occupational choice. Skriabikova et al. (2014) in turn analysed the impact of risk attitudes on the decision to become self-employed among individuals (18 to 65 years) who grew up under the communist regime in Ukraine. During the communist regime in Ukraine, individuals could not observe what it would be like to be self-employed, because self-employment was banned. They measured risk attitude using a subjective self-assessment of willingness to take risk in general on a scale from zero to ten, on which higher values reflect

greater willingness to take risk. The authors found a significant and strong correlation between risk attitudes and self-employment, and indeed, they conclude that the observed correlation between risk preferences and self-employment after the transition is unlikely to be driven by intra-family transmission of self-employment experiences during the communist regime in Ukraine. According to the authors, their findings shed light on a causal nature of the relation between risk preferences and the decision to become self-employed.

Other Factors influencing Livelihood Activities

Aside from risk behaviour, the literature has established that other individual and household characteristics influence livelihood activity choice. Brown et al. (2006) identified five distinct livelihood activity choices (part-time subsistence smallholders/unskilled workers, mixed smallholders, staples producers, off-farm skilled employment, and diversified commercial activity) among a sample of 240 households in Kenya's central and western highlands. The authors report that whereas household location and household size negatively influence livelihood activities, the opposite is same for male headed households, farming experience, access to credit and receipt of remittances. Wanyama et al. (2010) report that livelihood consists of gifts, petty business and formal employment. In a study of 1,850 rural households in Kenya, the authors showed that age, gender, distance to markets, credit access and ownership of farm machinery determine the choice of livelihood activities.

Studying household livelihood strategies and forest dependence among 360 households in the Tigray highlands of Northern Ethiopia, Babulo et al (2008) clustered households into four distinct livelihood activities based on the share of forest income in total household income. Livelihood strategies identified by the authors include low forest-dependent (crop and livestock production dependent), moderate forest- dependent (more dependent on crop, livestock and off-farm activities), high forest- dependent (less crop and livestock dependent), and very high forest- dependent households. Using a multinomial logit regression (with the forest- dependent as the base category), they reported report that female-headed households were more likely to engage in the collection of forest products than in other strategies (livestock production, crop farming), and households with large plots of land were less likely to engage in forest extraction. Additionally, they showed that male- headed households and better-educated households, as well as households with more land, better access to roads (proxy for market access) and credit are more likely to choose crop and livestock production than forest collection. Again larger

household size, households with good access to grazing land and households with little or no access to credit (liquidity-constrained households), were more likely to choose a forest-dependent activity, all things being equal.

In the Gaza province of Mozambique, Ng'ang'a et al. (2011) studied the factors that influence 110 households' choice of livelihood activity, by focusing on dependence on livestock production. They classified households into four mutually exclusive livelihood activities, based on the share of livestock income in total household income. They grouped livelihood activities into less dependent, moderately dependent, highly dependent and very highly dependent on livestock income. In their multinomial logit regression with the livestock-dominated livelihood activities as the base category, the authors found that male-headed households and households with bigger plot size were more likely to choose a livelihood activity dominated by crop production, non-agricultural income, and remittances. Thus, according to Ng'ang'a et al. (2011) female-headed households were more likely to engage in livestock production than in other activities. In contrast, they showed that households with an educated head, access to market (proxied by distance to road), and better endowed with agricultural farm tools were less likely to choose crop production, non-agricultural income and remittances. The authors, however, did not find significant results for household size, age of the household head, access to other resources and liquidity constraint.

Tran et al. (2014) in a study in Vietnam also grouped households into distinct livelihood categories, using partition cluster analysis. In particular, they clustered past livelihood activities and current livelihood activities based on the proportion of time allocated to different economic activities before farmland acquisition and proportions of income by various sources of livelihood strategies after farmland acquisition. They identified five livelihood activities namely, informal wage work, formal wage work, nonfarm self-employment (nonfarm household business), farm work, and non-labour income. Tran et al. (2014) estimated a multinomial logit regression model and showed that only the farmland loss in 2008 was positively associated with the choice of nonfarm-based activities. In terms of human capital, they reported that the higher the household size, the more likely it is that the household will choose informal wage or non-farm self-employment livelihood activity relative to farming. However, household size was not significant in determining the choice of formal wage activity.

Also, as the number of males in a household increases, the probability of choosing informal wage livelihood activity also increased. The number of males, however, did not influence the other livelihood activity choice. The authors also found that households with older working members were more likely to undertake wage work (formal/informal) relative to farm work. However, the age of working members was not significant in determining the choice of non-farm self-employment. Education increased the likelihood of pursuing a livelihood activity based on formal wage, however, it was found not to be related to non-farm self-employment and informal wage work. In terms of physical capital, the authors reported that the more farmland per adult a household owns the less likely it engaged in wage work or nonfarm self-employment. Additionally, they revealed that households located in prime areas were more likely to pursue nonfarm self-employment-based strategies. Tran et al. (2014) also included dependency ratio, gender of the household head, age of the household head, and residential land size in their regression model, but they did not find a significant effect in any of these variables.

Using cross-sectional data on farm households in Central Nepal, Ghimire et al. (2014) estimated a Probit model to establish the factors influencing a household's participation in nonfarm income work. Their result revealed that older farmers were less likely to participate in nonfarm activities. Also, households with more educated heads as well as male-headed households were more likely to participate in nonfarm work. However, households with larger farm size were less likely to participate in nonfarm work; also, distance to road and market were negatively related to the nonfarm work. In terms of regional differences, the authors established that farming households located in tropical plain terrain regions were more likely to participate in nonfarm work relative to those located in hilly areas. Ghimire et al. (2014), however, did not see any significant effect with respect to extension visits, access to seeds and access to credit.

Shehu and Abubakar (2015) used the Nigerian nationally representative household level data to examine the factors influencing the decision of 3,257 farming households to engage in non-farm enterprise activities in rural Nigeria. In a Tobit regression estimation, they showed that female-headed households and households with younger household heads were more likely to diversify into non-farm activity; furthermore, household size positively influences the likelihood of engaging in non-farm activities. Similarly, access to electricity, mobile phone

services, and access to social as well as financial capital were positively associated with the probability of engaging in non-farm activities. Shehu and Abubakar (2015) also report that households in communities close to market and in rural areas were more likely to diversify into non-farm activities.

Very few studies on livelihood activities exist on Ghana as far as the economics literature is concerned. Most livelihood studies in Ghana are in the realm of geography and sociology (Owusu 2007, Oberhauser, and Yeboah 2011, Tanle and Awusabo-Asare, 2012). These studies, however, do not investigate what influences livelihood activity choice. At best, most of these studies describe what kind of livelihood activities households are engaged in and their associated livelihood outcomes. In a cross-sectional data on 172 households, Dary and Kuunibe (2012) examined the types and determinants of participation in rural non-farm economic activities in the Upper West Region of Ghana. In a logistic regression estimation, they showed that the probability of participating in non-farm economic activities increases with being a woman, but decreases with age and being married. Also, they found a positive significant association between education and the decision to engage in non-farm economic activities. Additionally, persons with some form of vocational training were more likely to work on non-farm activities. Engagement in non-farm economic activities according to the results by Dary and Kuunibe (2012) is also influenced positively by one's social network and location (residence close to the city).

Using the fifth round of the Ghana Living Standards Survey (GLSS 5), Senedza (2012) classified household employment based on income into six categories, namely on-farm income, farm paid employment income, non-farm self-employment income, non-farm paid employment income, remittance income, and other income. The author used the Poisson regression model to estimate the determinants of the number of non-farm income activities participation. The number of non-farm income sources was positively related to the household head's average years of schooling. However, the effect of average years of schooling of the household head was significant for non-farm paid employment income but not for non-farm self-employment income. The household head's gender had no significant effect on non-farm activity participation. Also, both the number of adult males and females aged 15 years and above were positively related to non-farm income activities. Additionally, the number of adult females was positively associated with all three categories of non-farm income. Also, whereas

the author reported that remittance receipt did not have a significant effect on participation in non-farm income activity, it was negatively correlated with total non-farm income and non-farm self-employment income. Senadza (2012) also included location of the household in his model and found no significant effect on participation in non-farm activities. Among household agricultural assets (land owned, farm size, total livestock unit, and farm equipment), only farm size was positive correlated with the number of non-farm income activities. Access to credit and electricity was also positively correlated with the number of non-farm income activities. The author also found no significant effect regarding distance to the main road, but distance to the nearest market was significant for explaining the number of non-farm income activities.

Kuwornu et al. (2014) also employed the multinomial logit model to identify the determinants of households' choice of livelihood diversification strategy among 250 food crop farmers in the Upper West Region of Ghana. They grouped livelihood activities into three: Crop cultivation, Agro-processing, and Non-agro processing activities. Factors found to significantly influence the choice of livelihood activities (with crop cultivation as base category) include gender of household head, education of household head, household income, farm size, farming objective, value of farm asset and access to credit. All except gender of household head and farm size positively influenced household livelihood diversification strategies. They also showed that age and group membership had no significant influence on livelihood activities choice.

It is evident from the extensive empirical literature review that many studies exist on livelihood activities and in particular, factors that influence the choice of livelihood activities. Although some of these studies investigate the relationship between risk preference and livelihood activities, arguably, no study has established a causal relationship between risk preferences and livelihood/occupational choice for any country on the African continent, of which Ghana is by no means an exception. Also, there appears to be little or no gendered analysis of livelihood activity choice in the empirical literature. As indicated earlier, with the notable exception of Cho (2011) who did separate analysis for men and women in the United States, no study has focused on women specifically, and certainly not in the African context. Indeed, specifically focusing on how risk seeking attitude of women influence their livelihood activities is therefore significant. This is important since according to the UNDP (2010), globally women undertake different livelihood activities to lift their families and communities out of poverty and hunger.

In Ghana various studies have also observed women to be involved in income earning activities such as agricultural-related activities, retailing and production related-related activities (Owusu, 2007). Consequently, the current study sought to make two main contributions to the livelihood literature. First, the study investigated an endogenous relationship between risk behaviour and livelihood activities of women. As argued by Falco (2014), being able to identify the direction of causality between risk-attitudes and economic outcomes would be crucially important, because it would help resolve the debate on the endogeneity of risk-preferences. Second, this study is unique owing to its gendered dimension, as the issue of factors influencing livelihood activities of women has been under researched.

Conceptual Framework

The livelihood literature broadly dwells on the Sustainable Livelihood Framework (SLF) by Chamber and Conway (1991). In the SLF, assets and activities are required as a means of living by an individual or a household to construct a livelihood (Ellis 1998; Chambers and Conway, 1991). The SLF focuses on people's livelihoods, and highlights the different elements that shape livelihoods, the factors that influence them, the linkages between these various factors and the achievements or outputs of livelihood activities. The SLF also prioritises people's assets, their ability to withstand shocks, and policies and institutions that reflect people's priorities. Because livelihood activity and risk behaviour forms an integral part of the SLF, the study draws on the broader livelihood strategy literature and adapts the 'SLF' as the analytical or conceptual framework.

Conceptually, in the SLF schematic diagram (Figure 3.1) this study focuses on livelihood activities (Box [2]) and livelihood assets (Box [1]) as the basic framework to analyse the relationship between livelihood activities and risk-seeking behaviour. At the centre of the framework (Box [2]) is the livelihood activity choice of the study women. Under the SLF, a livelihood activity is defined as any direct income-generating activity in which an individual engages in or any activity that might not directly bring in income but increases the consumption and/ or well-being of an individual (Savath et al. 2014). Similarly, Yizengaw et al. (2015) defined livelihood activities as actions taken by the household to obtain household income. Generally, under the SLF livelihood activities fall under three categories: Income generating activities, Risk reduction strategies, and Loss management strategies (USAID 2009). The current study considered income-generating activities such as farming, petty retailing,

vocation, and paid employment as measures of livelihood activities as clearly depicted in Figure 3.1 (Box [2]). These activities are defined in detail in the methodology section.

The livelihood approach states that the type of activity undertaken by a household is a function of the assets at its disposal (Barrett et al., 2005; Brown et al., 2006). Ng'ang'a et al (2011) also assert that the choice of a particular livelihood strategy by an individual or household is conditioned by the assets it holds. Hence, the study suggests that the choice of pursuing a particular livelihood activity of women is contingent on their livelihood assets (see arrow, Box [1]). The SLF focuses on the accumulation of five types of livelihood assets, often called the asset pentagon (Savath et al. 2014), and these assets include:

2.1 *Human assets:* These are classified into intellectual, emotional or psychological, physical and spiritual. Intellectual refers to individuals' intellectual capabilities such as knowledge, skills and expertise, and education, emotional or psychological traits. Psychological or emotional traits involved resilience, self-confidence, courage, and risk-seeking behaviour, among others. The spiritual in turn concerns values, ego, principles, beliefs, believes, religion, et cetera. . Human assets encompasses physical and other traits such as height, weight, gender, age, household size, labour hours, health, leadership abilities, dependency ratio, et cetera.

2.2 *Material assets:* Encompasses basic infrastructure, as well as, productive and other assets including roads, railway, communication facilities, land, animals, tools, machinery, house, furniture, appliances, among others.

2.3 *Social assets*: This is about social capital, that is, social network and connectedness, resource-sharing, trust and reciprocity, family support, as well as group or community membership, et cetera.

2.4 *Natural assets:* Involve environmental and natural resources such as land, water, wildlife, and forest access, et cetera.

2.5 *Financial assets:* Savings, insurance, credit, remittances, pensions, cash transfers, assets held as store of value, et cetera, collectively constitute financial assets.

Scoones (1998) emphasizes that individuals or households use a range of assets to engage in farm or non-farm activities or both, while Babulo et al. (2008) argues that the ability to pursue

different livelihood activities depends on the possession of, or access to livelihood assets. Because risk behaviour constitutes an intangible character trait of a person, in this study individual risk behaviour is subsumed under the human assets category of the asset pentagon.

Within the SLF, an individual's livelihood activity choice generates certain outputs called livelihood outcomes (Figure 3.1, Box [3]). Livelihood outcomes are the achievements or outputs of livelihood activities (Scoones, 1998) and may be expressed in terms of increased income, improved well-being, good self-esteem, reduced vulnerability, improved health status, and improved food security, among others. An individual's livelihood outcomes in turn can affect his/her future livelihood capitals (Tran et al. 2014). As depicted clearly in Figure 3.1, livelihood outcomes may in turn influence livelihood assets. This could be possible through individuals with increased income investing more in, say, education/training, and hence, have a higher level of human capital. Therefore, as argued by various authors (Tran et al. 2014, Babulo et al. 2008), it is worth acknowledging that livelihood assets may be endogenously determined by livelihood outcomes. This is however not the focus of the current study, which addresses endogeniety only with respect to livelihood activities and risk seeking behaviour.

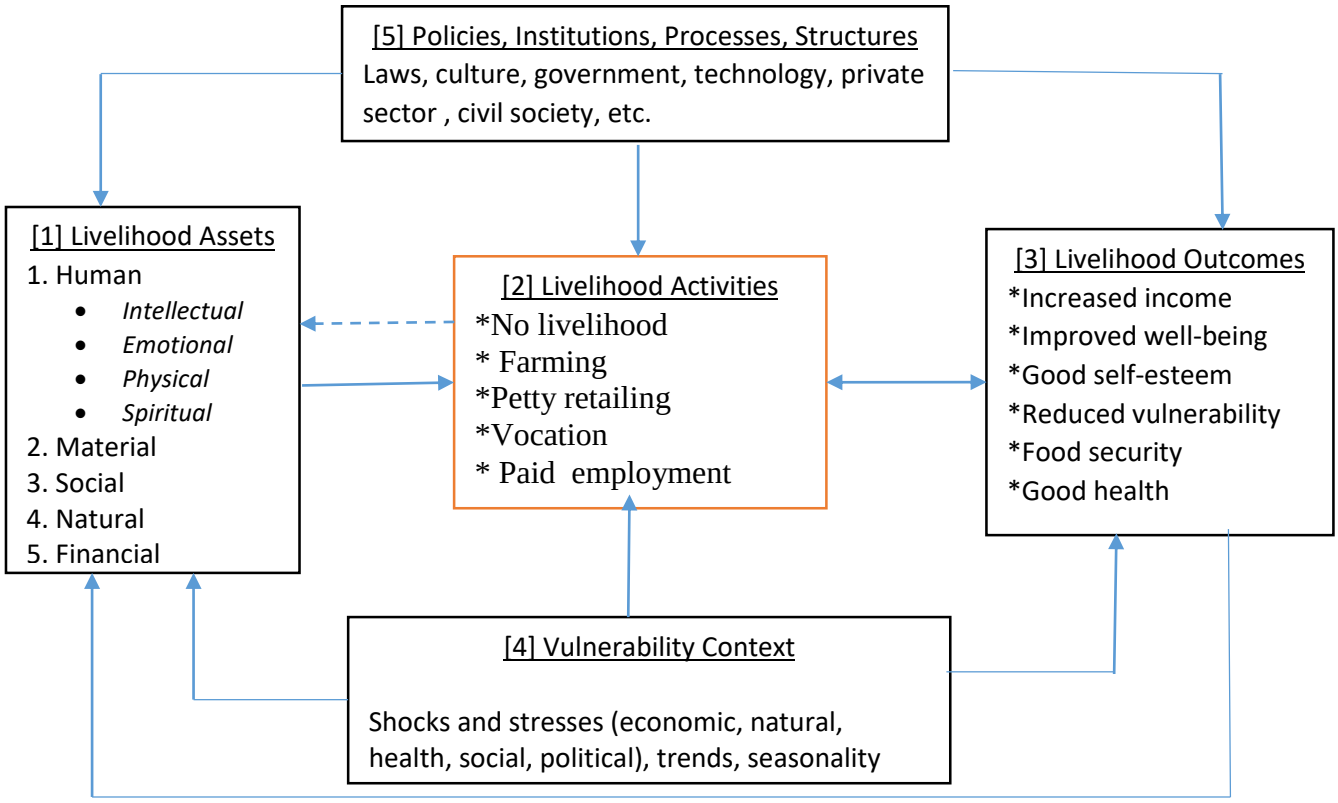
An individual's vulnerability context (Figure 3.1; Box [4]) may also affect his/her livelihood. These may include stresses and shock[26], resource trends, population trends, fluctuations in prices, among others, that affect an individual's ability to generate enough income to earn a livelihood. According to DFID (2000), the key attribute of vulnerability context is that at least in the short and medium term, they are not susceptible to control by people themselves. However, USAID (2009) argues that vulnerability context may be influenced by factors both outside of, and within, an individual's control. This implies that vulnerability context is either exogenously or endogenously determined. Scoones (1998) argues that policies, institutions, as well as structures and processes (Figure 3.1; Box [5]) such as culture, laws, government, private sector, and technology, et cetera, influence access to, and utilization of, different kinds of livelihood assets and livelihood activities, and hence livelihood outcomes. Consequently, existing policies and institutions are considered a very crucial and important aspect of the SLF,

[26] Source of stresses and shocks include: economic(recession, sudden price inflation, crop failure or other supply shock to basic staples) ; natural (drought, excessive rainfall, floods, earthquakes, tsunamis, landslides); health (illness, injury, death); political(strikes, disputed elections, violence, armed conflict) and social (social ostracism or sanction, breakdown of social networks due to deaths, illnesses, conflict, disasters, etc.)

as they help in achieving positive livelihood outcomes (DFID 2000). These are, however, exogenous as they are outside the control of the individual.

In summary, it is evident from the SLF that a woman's choice to pursue a particular livelihood activity (Box [2]) is determined by her access to, or endowment of, different types of assets (Box [1]). Besides, other exogenous factors such as shocks and stresses, trends, seasonality (Box [4]) or laws, culture, government, technology, private sector , civil society, et cetera (Box [5]) may also directly or indirectly impact on activity choice. Thus, in modelling the relationship between individual livelihood activity choice and risk behaviour, such endogenous and exogenous factors should be taken into account. Generally, studies on livelihood activity choice have pursued one-way causality paths between livelihood assets and livelihood activities. Some particular livelihood assets may influence livelihood activity choice, and livelihood activity choice may in turn influence livelihood assets. Hence, the study posits a bidirectional relationship between risk behaviour and livelihood activity choice. Therefore, in Figure 1.0 the study expands on the SLF by showing the endogenous relationship by adding a dash arrow linking livelihood activities (Box [2]) to livelihood assets (Box [1]). The suggested endogenous relationship is, however, in respect of specific livelihood assets and activities. For instance, whereas no endogenous relationship between a livelihood asset such as gender and livelihood activity choice is expected, an endogenous relationship between risk behaviour and livelihood activity choice is very likely.

Figure 3.1 Livelihood Activities Conceptual Framework



Source: Author's construct; adapted from DFID's sustainable livelihoods framework (Carney, 1998) and IDS's sustainable rural livelihoods framework (Scoones, 1998).

3.3 Theoretical Model

At any point in time, *t*, the reduced form utility function for a woman, i, choosing livelihood activity type *j* is given by

$$U_{\mathrm{i}} = U_{\mathrm{ij}} + U_{il} \qquad [3.1]$$

where U_{ij} is the utility derived from working in livelihood activity j, and U_{il} is the utility derived from leisure or non-paid work in the home.

It is assumed that utility from working in any particular livelihood activity, U_{ij}, is uncertain to varying degrees depending on the particular livelihood activity, because some livelihood

activities involve more income variation than others do. Utility from leisure (or nonpaid work in the home), U_{il}, is not assumed to be subject to any uncertainty.

Further,

$$U_{ij} = \frac{(Y_{ij})^{1-\theta_i}}{1-\theta_i} \qquad [3.2]$$

where ,

Y_{ij} = expected earnings for woman *i* at time *t* in *j* livelihood activity;

θ_i = the Arrow Pratt coefficient of relative risk aversion[27] for person *i* and is equal to $\frac{-Y_{ij}U''(Y_{ij})}{U'(Y_{ij})}$

θ_i Increases the more risk averse the individual. We assume $\theta_i \neq 1$.

The expected utility with respect to expected future earnings is derived by taking a second order Taylor series expansion around the mean of future earnings $\mu_{Y_{ij}}$ to get:

$$U(Y_{ij}) = U(\mu_{Y_{ij}}) + U'(\mu_{Y_{ij}})(Y_{ij} - \mu_{Y_{ij}}) + 0.5U''(Y_{ij} - \mu_{Y_{ij}})^2 + \varepsilon_{ij} \qquad [3.3a]$$

Taking expectations, it follows that:

$$E[U(Y_{ij})] = U(\mu_{Y_{ij}}) + U'(\mu_{Y_{ij}})E[(Y_{ij} - \mu_{Y_{ij}})] + 0.5U''E[(Y_{ij} - \mu_{Y_{ij}})^2] + \varepsilon_{ij} \qquad [3.3b]$$

Where, ε_i denotes the random error term due to approximation. Also, note that $E[(Y_{ij} - \mu_{Y_{ij}}) = 0$ and $Var(Y_{ij}) = E[(Y_{ij} - \mu_{Y_{ij}})^2] = \sigma^2_{y_{ij}}$; therefore, we have:

$$E[U(Y_{ij})] = U(\mu_{Y_{ij}}) + 0.5U''(\mu_{Y_{ij}})(\sigma^2_{Y_{ij}}) + \varepsilon_{ij} \qquad [3.3c]$$

[27] The Arrow Pratt coefficient of relative risk aversion: if relative risk aversion is decreasing with respect to the expected earnings (y), then an individual exhibits decreasing relative risk aversion. Hence an individual woman becomes less risk averse to gambles that are proportional to her earnings as her earnings increases.

Taking the first and second order partial derivatives of the utility function from livelihood activity type *j* (as in equation 2) with respect to expected earnings Y_{ij} we arrive at*:*

$$U'(Y_{ij}) = (Y_{ij})^{-\theta_i}$$

[3.4a]

$$U''(Y_{ij}) = -(Y_{ij})^{-\theta_i - 1} \quad [3.4b]$$

Substitute the 1st and 2nd order partial derivatives of the utility function (3.4a and 3.4b) and the utility function (2) into the expected utility of future earnings equation (3.3c) to get:

$$E[U(Y_{ij})] = U(\mu_{Y_{ij}}) + 0.5[-(Y_{ij})^{-\theta_i - 1}](\mu_{Y_{ij}})(\sigma^2_{Y_{ij}}) + \varepsilon_{ij} \quad [3.5a]$$

To get

$$E[U] \approx [\frac{(\mu_{Y_{ij}})^{1-\theta_i}}{1-\theta_i} - 0.5\theta_i(\mu_{Y_{ij}})^{-\theta_i - 1}(\sigma^2_{Y_{ij}})] + \varepsilon_{ij} \quad [3.5b]$$

$$= (\mu_{Y_{ij}})^{1-\theta_i}[\frac{1}{1-\theta_i} - 0.5\theta_i(\frac{\sigma^2_{Y_{ij}}}{\mu^2_{Y_{ij}}}) + \varepsilon_{ij}]$$

At any point in time a woman will choose to work in a particular job, *j*, if the expected utility from working in this job exceeds the expected utility of leisure/not working for pay. Mathematically, a woman, *i*, will engage in livelihood activity *j*, if

$$(\mu_{Y_{ij}})^{1-\theta_i}[\frac{1}{1-\theta_i} - 0.5\theta_i(\frac{\sigma^2_{Y_{ij}}}{\mu^2_{Y_{ij}}}) + \varepsilon_{ij}] > U_{il} \quad [3.6]$$

The following conclusions could be made from equation 3.6

a) The more risky a livelihood activity the higher the variance around income ($\sigma^2_{Y_{ij}}$). Thus, for any positive level of risk aversion, θ_i the more risky the livelihood activity, the lower will be the expected utility from engaging in this livelihood activity, and the more likely that the woman will choose not to work[28].

[28] In contrast, a risk-seeking individual will be more likely to choose to work, the more risky the livelihood activity.

b) Similarly, for a given level of risk, ($\sigma^2_{Y_{ij}}$), a woman with a higher degree of risk aversion, θ_i will have a lower expected utility of working, and will be more likely to choose not to work.

c) The greater the effect of a more risky livelihood activity (higher $\sigma^2_{Y_{ij}}$), the higher is the level of risk aversion, θ_i. Simply, a more risk- averse woman will avoid a risky job more than a less risk- averse woman.

d) In summary, a very risk averse woman would require a livelihood activity with very little risk to induce her to work, while a risk-seeking woman would require a livelihood activity involving high risk to induce her to work.

3.4 Methodology

3.4.1 Data and Summary Statistics

The current study used the Household Socioeconomic Characteristics Data (HSCD) and Risk Aversion Data (RAD) from the iLiNS DYAD-G SES. Table 3.1 shows the summary statistics of women's five main livelihood activities. These are farming, petty retailing, vocation, paid employment and no livelihood activity (unemployed). The women are on average 27 years of age, with approximately 90 percent have at least primary education. Around 98.8 percent are married and less than one-fifth (14 percent) are household heads. In terms of religious affiliation, more than half of the women (67 percent) are Pentecostals, followed by Protestants (18 percent) and Catholics (9 percent). Muslims and Traditional religion constitute 3 percent each, with the non-religious (Atheists) forming just 1 percent. On average, there are four people in a household, with a per-capita monthly income of approximately GH¢83.91 ($51). Around 22 percent of households own farms and as high as 84 percent owned household enterprises/businesses.

Table 3. 1 Summary Statistics

	Variable	Definition	Mean	Std. Dev.	Min	Max
*Livelihood Activities	No livelihood	=1 No livelihood activity, otherwise 0	.20016	.40029	0	1
	Farming	=1 Farmer , otherwise 0	.0132341	.114323	0	1
	Petty Retailing	=1 Petty retailer, otherwise 0	.5227461	.499689	0	1
	Vocation	=1 Vocation , otherwise 0	.1662531	.3724617	0	1
	Wage Employed	=1 Wage-employed, otherwise 0	.0967742	.2957724	0	1

Risk Behaviour	Willing to take risk	=1 Willing to take risk , otherwise 0	.9586435	.1991958	0	1
Individual characteristics	Age in years	Age in years as a continuous variable	26.82465	5.50788	18	44
	Marital Status	=1 Married , otherwise 0	.9884202	.107029	0	1
	Education	=1 at least primary education, otherwise 0	.9065343	.2912044	0	1
	Social Capital	Number of groups or associations a woman belongs to	.6683209	.7335371	0	5
	Household headship	=1 if household head, otherwise 0	.14227	.34947	0	1
	Religious Affiliation					
	Pentecostal	=1 Pentecostal, otherwise 0	.66749	.47131	0	1
	Protestant	=1 Protestant , otherwise 0	.18114	.38529	0	1
	Catholic	=1 Catholic, otherwise 0	.08602	.28051	0	1
	Muslim	=1 Muslim, otherwise 0	.02481	.15562	0	1
	Traditional	=1 Traditional religion, otherwise 0	.032258	.17676	0	1
	No religion	=1 No religion, otherwise 0	.00827	.09061	0	1
Household characteristics	Household Size	Total number of household members	3.91481	2.13692	1	16
	Per capita income	Per capita income in Gh¢**	83.91224	96.06953	0	850
	Household farm	=1 if household owns a farmland, otherwise 0	.2158809	.4116023	0	1
	Household enterprise	=1 if household operates an enterprise, otherwise 0	.8378825	.368711	0	1

Note: * Livelihood activities are explained as follows: Unemployed do not engage in any livelihood activity; farming involves subsistence food crop cultivation; petty retailers are those whose livelihood activities are mainly into buying and selling small consumable and non-durable items. Vocation as a livelihood activity involves various professional or vocational work such as seamstress and beauticians (hairdressing, giving pedicure and manicure); and wage- employed are those in either formal or informal livelihoods (nurses, teachers, labourers, factory hand, etc.).

****** Using yearly average 2011 exchange rate of Gh¢1=US$0.61.

3.4.2 Econometric Specifications

This study sought to analyse the relationship between risk behaviour and livelihood activities, by assuming that a woman's choice of engaging in a particular livelihood activity depends on her risk behaviour, as well as individual and household characteristics. For a woman faced with an array of livelihood activity choices, this study hypothesised that there is a relationship between her risk behaviour and livelihood activity choice and therefore estimated the equation (3.7) below,

$$LA_{ij} = \beta + \gamma WTR_i + \delta X_i + \mu_i \quad ; \quad \mu_i \approx Normal(0,1) \quad [3.7]$$

Where, LA_{ij} represents livelihood activities of the woman including farming, petty retailing, vocation, paid employment or no livelihood activity (unemployed). *WTR* (Willing to take risk) is a dummy of individual risk behaviour measure (WTR_i=1 if an individual is willing to take risk, otherwise, 0) and X_i is a vector of individual and household control variables that are likely also to affect choice of livelihood activity. β is the intercept, γ and δ are the parameters, μ_i is a normally distributed random error term, summarising all unobserved factors that affect livelihood activity with mean zero.

From the structural equation [3.7] whereas *X* is exogenous, *WTR* is believed to be endogenous to the choice of *LA*. The error term $_i$ μ_i is an unobserved heterogeneity correlated with the endogenous regressor, *WTR*, but is uncorrelated with the exogenous regressor *X*. Hence, *WTR* is affected by μ_i - the unobserved component of equation [3.7] - that also affects LA, giving rise to the endogeneity. Intuitively, while one would expect a woman's risk preference to affect her choice of livelihood activity; it is also expected that a woman's livelihood activity would affect her willingness to take risk in financial domains outside of her work. If the parameters (γ and δ) of the reduced form of the structural equation [3.7] are estimated by regressing LA_{ij} on *WTR* and *X*, without taking into consideration endogeneity, the estimation may yield a biased and an inconsistent estimate of the relationship of interest between *WTR* and *LA*.

To clarify the nature of interdependence between *WTR* and μ_i, the religious affiliation of the woman is used as instrument for *WTR*, and then a reduced form equation is specified. From

the results of the previous study in Chapter Two of this thesis, where, using the same sample/data as the current study, it was shown that religion was a significant determinant of Ghanaian women's propensity to take risk, it is strongly believed that a woman's *Religion* (measured by religious affiliation) can serve as a relevant instrument for the endogenous regressor *(WTR).* The instrument, *Religion*, must satisfy the conditional moment restriction: $E(\mu_i \mid Religion_i) = 0$. Therefore, another equation (3.8) is added to the model to be estimated,

$$WTR_i^* = \alpha_0 + \alpha_1 Religion_i + \varepsilon_i \quad ; \quad \varepsilon_i \approx Normal(0, \sigma_{WTR}) \qquad [3.8]$$

Where, WTR_i^* is an indicator of willingness to take risk, as a binary outcome ($WTR_i^* = 1$ if an individual is willing to take risk, otherwise, 0). *Religion* represents a vector of variables related to religious affiliation (Pentecostal, Protestant, Catholic, Muslim, Traditional religion, and no religion). The coefficient, α_1 measures the effect of religion on risk behaviour.

$$WTR_i = \begin{cases} 1 \text{ if} & \text{willing to take risk} \\ 0 \text{ otherwise} & \text{not willing to take risk} \end{cases}$$

[3.9]

The errors (μ_i and ε_i) of equations (7) and (8) are assumed to be correlated in a bivariate normal fashion with Var (μ_i) = σ^2; Var(ε_i)=1 and Cov (μ_i and ε_i) = $\rho\sigma^2$

Assuming that the errors (μ_i and ε_i) are related, where ε_i is a common factor that affects both LA and WTR and is the only source of dependence between LA and WTR, after controlling for the exogenous variables X, then:

$\mu_i = \rho\varepsilon_i + \eta_i$; Where, $\eta_i \approx [0, \sigma_\eta^2]$ is independent of $\varepsilon_i \approx [0, \sigma_\varepsilon^2]$ [3.10]

If the errors correlation, $\rho \neq 0$, then *WTR* is endogenous because it is correlated with μ_i in [3.7] , because both *WTR* and μ_i depend on ε_i. Conversely, if $\rho = 0$, then the errors (μ_i and ε_i) are independent and therefore there is no endogeneity.

If there is endogeneity, then a standard single equation estimator such as multinomial logit will be biased. Hence, to control for endogeneity the structural equation model approach with endogenous regressors is used. The structural model approach defines explicit models for both the dependent variable of interest (livelihood activity) and the endogenous regressor (risk behaviour). Possible ways of estimating the model taking into account endogeneity include using Two-Stage Least Squares (2SLS), Seemingly Unrelated Regression (SUR), Generalized Methods of Moments (GMM) and General Structural Equation Modeling (GSEM). It is worth noting however that, in 2SLS information on the correlation between the error terms is not used in the estimation. This makes the 2SLS estimates inefficient with large standard errors, which may lead to a loss of precision. GMM also focuses on continuous endogenous variables and with the current study, the endogenous variable, *WTR*, is a dummy. SUR and GSEM are very flexible as they correct for endogeneity bias and could be applied to binary and multinomial outcomes, respectively (Knapp and Seaks, 1998; Cameron and Trivedi, 2009 and Drukker, 2014). In addition to providing consistent estimates, SUR and GSEM are also easy to implement. Therefore, the model is estimated using the Seemingly Unrelated Bivariate Probit (SUR biProbit) for endogenous regressors. As a robustness check, the Generalized Structural Equation Model for Multinomial Logit (GSEM mlogit) with endogenous regressors is also estimated.

Knapp and Seaks (1998) and recently Cameron and Trivedi (2009) suggest that a Wald test or Likelihood Ratio (LR) test of rho (ρ), where $H_0 : \rho = 0$ is used to detect whether using the instrument makes a difference compared to not using it. A positive significant estimated rho coefficient indicates a positive correlation between the error terms μ_i and ε_i, and hence, endogeneity. In the SUR biProbit model, if $\rho=0$, the null hypothesis of exogeneity between the outcome variable and the endogenous variable is rejected: in this case, the joint model collapses into separate models. Consequently, if the Wald test shows no endogeneity, a normal Probit or multinomial logit estimation will suffice.

Therefore, a standard multinomial logit model is estimated if the Wald test in the SUR biProbit model proves that *WTR* is an exogenous determinant of *LA* (if the null hypothesis in the Wald test is rejected). An unordered multinomial model such as multinomial logit is appropriate in estimating [3.7] because there is no natural or clear ordering of the outcome variable. Thus, the multinomial logit probabilities of the *i*th woman choosing livelihood activity (*LA*) *j* as a

function of risk behaviour (*WTR*), while controlling for individual and household characteristics (*X*) is given by:

$$P_{ij} = \Pr ob[LA_i = j] = \frac{\exp(\beta_j + \gamma_j WTR_i + \delta_j X_i + \tau_j \mu_i)}{1 + \sum_{j=1}^{4} \exp(\beta_j + \gamma_j WTR_i + \delta_j X_i + \tau_j \mu_i)}; j \in \{1,2,...4\} \quad [3.11]$$

The model [3.11] ensures that: $0 < P_{ij} < 1$ and $\sum_{j=1}^{4} P_{ij} = 1$.

An important feature of the multinomial logit model is that it estimates *k-1* models, where *k* is the number of levels of the dependent variable. Hence, to ensure identification of the model one of the livelihood activity categories is set to zero (i.e. the base or reference category), and then coefficients are interpreted with respect to the base category. In this instance, no livelihood activity is set as the reference category, and therefore the model is estimated for the other livelihood activity choices (farming, petty retailing, vocation, and paid employment) relative to no livelihood activity.

Hence, for the Livelihood Activities (LA) outcome categories (1=no livelihood activities, 2=farming, 3=retailing, 4=vocation and 5=paid employment) with probabilities *Pr(LA=1), Pr(LA=2), Pr(LA=3), Pr(LA=4)* and *Pr(LA=5*). If *WTR* coefficient for no livelihood activity (LA=1), which is the alternative normalized, is arbitrarily set to zero (γ_1 = 0), then the *WTR* coefficients for the remaining *LA* (farming, retailing, vocation or paid employment) will measure the change relative to *LA*=1. This is observed as:

$$Pr[LA_i = 1] = \frac{1}{1 + e^{\gamma_2 WTR_i} + e^{\gamma_3 WTR_i} + e^{\gamma_4 WTR_i} + e^{\gamma_5 WTR_i}} \quad [3.12]$$

$$Pr[LA_i = 2] = \frac{e^{\gamma_2 WTR_i}}{1 + e^{\gamma_2 WTR_i} + e^{\gamma_3 WTR_i} + e^{\gamma_4 WTR_i} + e^{\gamma_5 WTR_i}} \quad [3.13]$$

$$Pr[LA_i = 3] = \frac{e^{\gamma_3 WTR_i}}{1 + e^{\gamma_2 WTR_i} + e^{\gamma_3 WTR_i} + e^{\gamma_4 WTR_i} + e^{\gamma_5 WTR_i}} \quad [3.14]$$

$$Pr[LA_i = 4] = \frac{e^{\gamma_4 WTR_i}}{1 + e^{\gamma_2 WTR_i} + e^{\gamma_3 WTR_i} + e^{\gamma_4 WTR_i} + e^{\gamma_5 WTR_i}} \quad [3.15]$$

$$Pr[LA_i = 5] = \frac{e^{\gamma_5 WTR_i}}{1 + e^{\gamma_2 WTR_i} + e^{\gamma_3 WTR_i} + e^{\gamma_4 WTR_i} + e^{\gamma_5 WTR_i}} \quad [3.16]$$

Note that if the base category is changed, the coefficients will differ because they have different interpretations. However, the predicted probabilities for *LA*=1, 2, 3, 4 and 5 will still be the same. Thus, either parameterisation will be a solution to the underlying model.

Quantitative predictions are made only based on the marginal effects of the regressors, since the parameters of multinomial models are generally not directly interpretable. The marginal effects of a change in the *WTR* on the probability that an individual i chooses alternative j *LA* is therefore computed as

$$\frac{\partial P_{ij}}{\partial WTR_i} = P_{ij}(\gamma_j - \overline{\gamma_i}) \qquad [3.17]$$

where $\overline{\gamma_i} = \sum_i P_{ij}\gamma_i$ is a probability-weighted average of the parameter, γ_i. The marginal effects vary with the point of evaluation of *WTR*, because the probability of the ith individual choosing livelihood activity j varies with WTR. For WTR, the marginal effect is positive if $\gamma_j > \overline{\gamma_i}$.

A major concern of the multinomial logit (Mlogit) estimation technique is the relationship between probabilities, that is, the popular assumption of Independence of Irrelevant Alternatives (IIA). The IIA shows the relationship between probabilities, and it means the odds of an alternative, *i*, being chosen over the other, *j*, is independent of the availability or attributes of alternatives other than *i* and *j* (Hausman and McFadden, 1984; Cheng and Long, 2007). This current study uses the Hausman IIA specification test procedure (Hausman 1978)[29] proposed by Hausman and McFadden (1984) to test for whether there is a significant difference between two sets of coefficients: one set which is consistent and efficient under the null (IIA holds) and the other set, the consistent but with inefficient estimates under the alternative (IIA does not hold). The test is based on eliminating one or more alternatives from the choice set to ascertain if underlying choice behaviour from the restricted choice set obeys the IIA property. The unknown parameters are estimated from both the unrestricted and the restricted choice sets, and the specification is not rejected if the parameter estimates are approximately the same.

[29] The Hausman test (Hausman 1978) is defined as: $HM = (\hat{\beta}^r - \hat{\beta}^f)'\left[\widehat{\text{var}}(\hat{\beta}^r) - \widehat{\text{var}}(\hat{\beta}^f)\right]^{-1}(\hat{\beta}^r - \hat{\beta}^f)$; Where; $\widehat{\text{var}}(\hat{\beta}^r)$ and $\widehat{\text{var}}(\hat{\beta}^f)$ are the estimated covariance matrices. The test compares the estimates $\hat{\beta}^f$, which are consistent and efficient if the null hypothesis is true, to the consistent but inefficient estimates $\hat{\beta}^r$. If IIA holds, the test is asymptotically distributed as chi-square with df equal to the rows in $\hat{\beta}^r$. Significant values of the test indicate that the IIA assumption is violated. Hausman and McFadden (1984:1226) note that HM can be negative if $\widehat{\text{var}}(\hat{\beta}^r)$ - $\widehat{\text{var}}(\hat{\beta}^f)$ is not positive semi-definite, but they conclude that this is evidence that IIA holds.

According to Hausman and McFadden (1984), significant values of the Hausman test indicate that the IIA assumption has been violated.

As a robustness check, the model parameters are also estimated using the Generalized Structural Equations Model for a Multinomial Logit (GSEM MLogit) with the endogenous variables estimation technique. GSEM corrects the endogeneity bias by including common, unobserved components into the equations for different variables (Drukker, 2014).

3.4.3 Variable Definitions

Dependent Variable: Livelihood Activities

In this study, women's livelihood activities are grouped into five (5): farming, petty retailing, vocation, paid employment, and no livelihood activity (unemployed) [30]. Farming involves subsistence food crop cultivation. Petty retailers are those whose livelihood activities involve mainly buying and selling of small consumable and non-durable items. Vocation primarily involves self-employed professional or vocational work, such as seamstress or a beautician, hairdressing, and giving pedicures and manicures, and wage employed are those in either formal or informal livelihoods (nurses, teachers, labourers, factory hand,etc.). Lastly, 'no livelihood' constitutes unemployed women who do not engage in any livelihood activity.

As indicated earlier, the outcome variable of interest is the choice of livelihood activities of women. With respect to the Seemingly Unrelated Bivariate Probit estimation, *LA* is a dummy variable, = 1 if the woman chooses a particular livelihood activity, otherwise 0. For the standard multinomial logit and the Generalized Structural Equation Model for Multinomial Logit, the dependent variable, Livelihood Activities (LA_{ij} =1, 2, 3, 4 and 5), include five multiple unordered livelihood activities where; *LA*=1 represents no livelihood activities; *LA*=2 denotes farming; *LA*=3 represents petty retailing; *LA*=4 represents vocation, while *LA*=5 is paid employment

Main explanatory Variable: Risk Behaviour

[30] The implications of childcare as a constraint to engaging in livelihood activities is recognised.

Risk behaviour, the main explanatory variable of interest is a measure of a woman's Willingness to Take Risk (*WTR*) in a risk aversion game with real monetary pay-offs. The game was designed to learn something about a woman's willingness to take risk, by asking her to make decisions about how much money she would like to bet. The details of the game were outlined in Chapter Two. In this study, women who were willing to play (bet) in the risk aversion game were classified either as being willing to take risk, and those declining to participate or play in the risk game were also classified as not willing to take risk. Hence, as before, the risk behaviour variable (WTR) is binary, where; WTR_i=1 if a woman is willing to take risk; otherwise, 0. As seen earlier from the theoretical model, the relationship between risk behaviour and livelihood activities is based on the type of livelihood activity. A positive relationship between WTR and self-employed livelihood activities such as farming, retailing, and vocation among others is expected. Conversely, a negative relationship is also expected between WTR and paid employment. Also, an ambiguous relationship between WTR and no livelihood activities is expected.

Instrumental Variable: Religion

With respect to the instrumental variable, *Religion,* the study used dummy variables representing the religious affiliation of women (=1 if a member of a religious group and 0 otherwise). As before (Chapter 2), the religious affiliation variables used include Pentecostal, Protestants, Catholics, Muslims, Traditional religion and no religion (Atheists).

Control Variables

Age: Women's age was measured in completed years as a continuous variable.

Marital Status: Study participants were asked to indicate whether they were actually married, in a loose union, divorced, separated, or never married. Marital status was therefore measured using a dummy variable, with 1 representing women who are legally married either through ordinance (civil) or customary (Traditional) and 0 if not married (including those in a loose or informal unions, divorce, separated, or never married).

Education: Education is measured as a dummy with 1 indicating having at least primary education and 0 otherwise.

Household head: A dummy variable was used to represent household headship (=1 if female household head, 0 otherwise).

Social capital[31]*:* Social capital may serve as a means of social network or support, fall-back strategies through which people get access to various kinds of livelihoods. In this study, social capital was measured as a continuous variable, indicating the total number of groups or associations a woman belongs to.

Per capita income: This is a continuous variable measured as total household monthly income per the total number of household members[32].

Household Farm: This is a dummy variable for household ownership of a farm (=1 if the household owns a farm, otherwise 0).

Household Enterprise: A dummy variable is used to represent household ownership of an enterprise (=1 if the respondent's household owns an enterprise, 0 otherwise).

3.5 Results and Discussion

3.5.1 Livelihood Activities by Risk Behaviour

The results (Table 3.2) show that a greater proportion of women (approximately 52 percent) identified petty retailing as their main livelihood activity, while 17 percent and 10 percent identified vocation and paid employment, respectively, as their livelihoods activities. Those who reported farming as their main livelihood activity constitute just a little over 1 percent. Though the sample is rural, this result is not surprising because the study area is along a long stretch of road with a busy commercial activity. As with most towns along busy commercial corridors in Ghana, non-farm livelihood activities contribute significantly to livelihood activities of residents of such areas, relative to farming. It is also worth acknowledging that about one-fifth indicated they are not engaged in any livelihood activity. It is evident from Table 3.2 that whereas approximately 97.5 percent of women with no livelihood activities were

[31] Respondents were ask to indicate which of the following groups they belong to: Susu group, Farmer's Association, Sewing group, Singing or music group, Church group, Informal retailer's group, School committee, Development committee, Queen mothers' association, Market association, Income earning group, Mother's/Men's support group

[32] Following the Ghana Statistical Service definition as used in various surveys (GLSS, GDHS, MICS etc.), household members are defined as people who have been regularly sleeping in the same dwelling and sharing food from the same cooking pots for at least the last three months.

willing to take risk, all farmers (100 percent) were willing to take risk. Farming is a high-risk activity; therefore, this result is not surprising. Also around 95.4 percent and 96.5 percent of petty retailers and those in vocation, respectively, were willing to take risk. Around 93 percent of women in paid employment were the least willing to take risk. Lastly the chi square test (Pr = 0.288) shows that the observed differences between the various livelihood activities and willingness to take risk are not statistically significant.

Table 3.2 Livelihood Activities by Risk Behaviour

Livelihood Activities	Risk Behaviour		Total (%)
	Not Willing to Take Risk (%)	Willing to Take Risk (%)	
No Livelihood	2.48	97.52	20.02
Farming	0	100	1.32
Retailing	4.59	95.41	52.27
Vocation	3.48	96.52	16.63
Paid employment	6.78	93.22	9.76
Total	**4.14**	**95.86**	**100**
likelihood-ratio chi2(4) = 5.5969 Pr = 0.231			

Table 3.5 (Appendix) shows the correlation matrix for risk behaviour and livelihood activities. Whereas petty retailing and paid employment are negatively correlated with willingness to take risk, the remaining three livelihood activity categories (no livelihood, farming, and vocation) are positively correlated with willingness to take risk. It is evident from Table 3.5 that risk behaviour exhibits very weak bivariate correlations with all the livelihood activities. The correlation coefficients do not take into account endogeneity between risk behaviour and livelihood; hence, the study uses the SUR biProbit for endogeneity regression technique.

3.5.2 Estimation issues

Before presenting the regression results, it is important to highlight some key estimations issues particularly with respect to the endogenous variable estimation. As with all endogenous variable estimations, the instrument should satisfy two key conditions: validity and relevance[33]. Instrument validity relies on persuasive arguments, economic theory, and norms established in

[33] It is worth emphasizing that whereas several post estimation diagnostics and tests are available in Stata for testing instrument validity and relevance such as estat post estimation command following ivregress or ivProbit for 2SLS and GMM, to date there is no STATA post estimation command for the two endogenous variables estimations (SUR biProbit and GSEM mlogit) used in our current study.

prior related empirical studies. For relevance of the instrument, after controlling for the remaining exogenous regressors, the instruments must account for significant variation in the endogenous regressor (Cameron and Trivedi 2009). Intuitively, the stronger the association between the instrument, and the endogenous regressor, the stronger the identification of the model will be, and vice versa. In this study it is strongly believed that a woman's *Religion* (measured by religious affiliation) can serve as a relevant and valid instrument for the endogenous regressor *(WTR),* based on the results of the previous study in chapter 2 of this thesis which uses the same sample/data as the current study, as well as other empirical studies elsewhere. Indeed, in Chapter 2 of this thesis, which examined the effect of religion on risk behaviour, using the same experimental data as in the current study, a strong association ($p<0.01$) was established between religious affiliation and willingness to take risk. As evident in the current study, from the SUR biProbit and GSEM Mlogit regressions (see Tables 3.6 - 3.8 in appendix), after controlling for the exogenous regressors (*X*), the instruments (*Religion variables*) account for significant variation in *WTR*. A strong ($p<0.01$) association between the instrument, *Religion*, and the endogenous regressor, *WTR* was found.

As indicated earlier, a major drawback of the multinomial logit is the Independence of Irrelevant Alternatives (IIA). In other words, when the study women were asked to choose among a set of alternative livelihood activities, the IIA assumption says that the odds of choosing say farming over petty retailing should not depend on whether some other alternative, say paid employment, is present or absent. The mlogit hinges upon the validity of the assumption of IIA, implying that all the alternatives are dissimilar or the random components of the utility function are independent. It is worth emphasizing that the IIA assumption would be least likely to hold in the presence of close substitutability between different livelihood activity options. Given the clear difference between different livelihood activities in the study area as a whole and in this study in particular, it is less likely that a woman would be indifferent between different livelihood activities. Therefore, even without subjecting the mlogit regression to any formal tests, it is clear that the IIA assumption would be valid. With this notwithstanding, the IIA assumption was tested using the Hausman specification tests (Hausamn and McFadden 1984) by comparing the general estimated model with a restricted model. The 1st livelihood activity category was eliminated first, and then the 2nd, later the 3rd, and then the 4$^{th;}$ lastly, the 5th alternative from the livelihood activity choice set out to ascertain if the underlying livelihood activity choice behaviour from the restricted livelihood activity

choice set obeys the IIA property. The results of the Hausman tests (Table 3.11 in appendix) reveal that IIA holds in all cases, hence, the Mlogit specification is not rejected.

3.5.3 Regression Results

Relationship between Risk Behaviour and Livelihood Activities: Seemingly Unrelated Bivariate Probit (SUR biProbit) Regression Results

Table 3.3 shows the SUR bi-Probit for endogeneity marginal effect results for the relationship between risk behaviour and livelihood activities. The detailed results for the SUR bi-Probit regression coefficient, including the instrumental variables, are presented in Tables 3.6 and 3.7 in the appendix. In running the SUR bi-Probit for endogeneity, each of the equations has different predictors. However, the equations are not independent because they are computed on the same set of subjects.

The results (Table 3.3) indicate a statistically significant negative relationship between willingness to take risk and the likelihood of not engaging in any livelihood activity. In particular, women who are willing to take risk are 35.5 percentage points less likely to be unemployed (no livelihood activity). The current finding is plausible, because the unemployed are generally not engaged in any high-risk activities. The results also show a positive statistically significant relationship between willingness to take risk and farming. If a woman is willing to take risk, her probability of choosing farming as a livelihood activity increases by about 9.8 percentage points, all things being equal. This result is indeed expected because farming is a high- risk activity. On a regular basis, farmers have to deal with risk associated with the rain, drought, pests, diseases, low crop yields, et cetera.

If a woman is willing to take risk, she is about 60.5 percentage points less likely to engage in petty retailing. *A priori* one would expect the opposite; however, in the context of the current study this result is not surprising. The type of petty retailing engaged in by women in the study area involves buying and selling of small, inexpensive, and non-durable items. Such items may not be associated with any form of risk or may be associated with very low risk. Table 3.3 also depicts that there is no statistically significant relationship between willingness to take risk and vocation. However, willingness to take risk is statistically significant and positively related to paid employment. Women who are willing to take risk are approximately 14.5 percentage points more likely to engage in paid employment, *ceteris paribus*.

The Wald test of rho (p) =0 shows that Athrho is statistically significant (p<0.01) only for petty retailing. This implies that the null hypothesis of exogeneity between risk behaviour and petty retailing is rejected (chi2 = 12.1802, df=1, Prob = 0.0005). However, the study failed to reject the null hypothesis of exogeneity between risk behaviour and no livelihood (chi2 = 1.86461, df=1, Prob = 0.1721), vocation (chi2= 0.242598, df=1, Prob= 0.6223) and paid employment (chi2 = 2.38405 , df=1, Prob = 0.1226). Thus, whereas there is an endogenous relationship between risk behaviour and petty retailing, the relationship between risk behaviour and unemployment (no livelihood), vocation, and paid employment is exogenous. Full convergence was not achieved for the farming estimations, and hence, the Wald test of rho could not be estimated. The reason for not achieving full convergence could be attributed to the fact that all the farmers indicated they were willing to take risk, as indicated in Table 3.2.

Table 3.3 Seemingly Unrelated Bivariate Probit Marginal Effects Results

Variables	Livelihood Activity				
	No Livelihood	Farming	Petty Retailing	Vocation	Wage Employed
WTR	-0.355*	0.098***	-0.605***	-0.306	0.145*
	(0.1874)	(0.0278)	(0.0811)	(0.5334)	(0.0970)
Athrho	1.031	3.353	1.313***	0.629	-0.656
	(0.755)	0	(0.376)	(1.226)	(0.425)
Wald Test of Exogeneity (rho=0)	chi2 (1) = 1.86461; Prob > chi2 = 0.1721	full convergence was not achieved	chi2 (1) = 12.1802; Prob > chi2 = 0.0005	chi2 (1) = 0.242598; Prob > chi2 = 0.6223	chi2 (1) = 2.38405; Prob > chi2 = 0.1226
Observations	1,209	1,209	1,209	1,209	1,209
Robust standard errors in parentheses ; *** p<0.01, ** p<0.05, * p<0.1					

Relationship between Risk Behaviour and Livelihood Activities: Standard Multinomial Logit and Generalized Structural Equation Model Multinomial Logit

Because the SUR bi-probt model indicates no endogeneity, it suggests that a standard multinomial logit regression will suffix. Hence, a multinomial logit was estimated with no livelihood activity (unemployed) as the reference category. The results (Table 3.4) show that risk behaviour is statistically significant (p<0.01) and positively related to farming. Women who are willing to take risk are 13.5 percentage points more likely to be farmers relative to

having no livelihood activity, while holding all the other variables in the model constant. Farming involves many risky decisions, especially in relation to unpredictable weather conditions (rain and drought), diseases, and pest outbreaks, post-harvest loses, et cetera. Hence, the current result for farming and risk behaviour is not surprising. It is evident also from Table 3.4 that as expected, willingness to take risk significantly decreases the probability of being in paid employment, relative to the benchmark category by about 5.9 percentage points. Paid employment is characterized by lower variability and relatively no uncertainties in income streams. Hence, it is reasonable to establish a negative statistically significant relationship between risk behaviour and paid employment. Whiles it is evident from tables 3.3 and 3.4 that the wage employment variable has opposite signs, this does not undermine the results since the SUR Bivariate Probit results (table 3.2) are estimated with no reference category, but the Multinomial Logit (TABLE 3.4) does, with farming as the reference category. Hence, the interpretation for these two results are slightly different. Table 3.4 also clearly shows that the relationship between risk behaviour and petty retailing, as well as risk behaviour and vocation, is not statistically significantly different from no livelihood activity.

Table 3.4 Multinomial Logit Marginal Effects Results (No Livelihood as Benchmark)

	VARIABLES	Farming	Petty Retailing	Vocation	Wage Employed
Risk Behaviour	WTR	0.135***	-0.0925	-0.00513	-0.0594*
		(0.0348)	(0.0669)	(0.0586)	(0.0346)
Individual characteristics	Age	0.000585	0.0157***	0.00343*	0.00470***
		(0.000511)	(0.00259)	(0.00188)	(0.00143)
	Married	0.00644	-0.0186	0.0233	0.0237
		(0.00768)	(0.0293)	(0.0236)	(0.0155)
	Education	0.000997	-0.146***	0.0703	0.0322
		(0.00913)	(0.0462)	(0.0433)	(0.0309)
	Social capital	-7.30e-05	-0.0282	0.0235*	0.00638
		(0.00284)	(0.0176)	(0.0141)	(0.00944)
	Household head	0.0170**	0.0756*	0.0776***	-0.00435
		(0.00854)	(0.0416)	(0.0296)	(0.0225)
Household characteristics	Dependency ratio	-1.82e-05	0.0926***	-0.0853***	-0.00697
		(0.00424)	(0.0221)	(0.0217)	(0.0123)
	Per-capita income	-0.000104	0.000385**	2.32e-06	0.000169***
		(7.34e-05)	(0.000159)	(0.000104)	(6.24e-05)
	Household farm	0.0354***	-0.0126	-0.0107	0.00269
		(0.0105)	(0.0322)	(0.0263)	(0.0197)
	Household enterprise	-0.0172***	0.339***	0.122**	-0.171***
		(0.00536)	(0.0549)	(0.0496)	(0.0145)
	Observations	1,209	1,209	1,209	1,209
	Standard errors in parentheses ; *** p<0.01, ** p<0.05, * p<0.1				
	Wald chi2(40) = 1398.05 ; Prob > chi2 = 0.0000 ; Pseudo R2 = 0.1978				

As a robustness check, the Generalized Structural Equation Model for Multinomial Logit (GSEM Mlogit) for endogenous variable regression estimation is also estimated. As with the SUR bi-Probit model, willingness to take risk is instrumented for using religious affiliation in the GSEM Mlogit. Quite strikingly, the coefficients of the GSEM Mlogit with endogenous variables regression (see appendix Table 3.8) are of the same size and exhibit the same signs and significance as in the standard Mlogit regression (see appendix Table 3.9). This is an indication that endogeneity is not biasing the results. In the current study, this points to the conclusion that the relationship between endogeneity of risk behaviour and livelihood activity may not be an issue.

Association between Livelihood Activities and Other Exogenous Variables

In addition to individual risk behaviour, the decision to participate in a livelihood activity may be influenced by other exogenous individual and household characteristics. This section focuses on the other exogenous variables associated with livelihood activities.

The results (Table 3.4) show that a unit increase in the age of a woman increases her probability of engaging in petty retailing by 1.6 percentage points relative to no livelihood activity. Similarly, as a woman's age increases by one year, she is 0.3 percentage points and 0.4 percentage points more likely to engage in a vocation and paid employment, respectively in relation to no employment. This result is expected because women assume more responsibilities of contributing to households' needs as they age. Therefore, they engage in livelihood activities as a means to support the household. However, age does not significantly change the probability of engaging in farming relative to having no livelihood activity. In contrast to the current finding, an earlier study in Ghana by Dary and Kuunibe (2012) reports that participating in non-farm economic activities decrease with age. Similarly, in Nepal and in Ethiopia, Ghimire et al. (2014) and Eneywe and Bekele (2012) respectively revealed that age negatively influences livelihood activities. However, other studies (Ng'ang'a et al. 2011; Tran et al. 2014; Kuwornu et al. 2014) show that age has no significant influence on livelihood activity choice.

In the current study, marital status was shown not to have a significant effect on engaging in any livelihood activity (farming, petty retailing, vocation, and paid employment) relative to having no livelihood activity (Table 3.4). However, an earlier study in Ghana by Dary and

Kuunibe (2012) shows that the probability of participation in non-farm economic activities decreases if married.

A priori, education is one of the key factors expected to influence livelihood activity choice. In the current study, the education variable was statistically significant only for petty retailing. With a negative statistically significant marginal effect ($p<0.01$), the result shows that a woman with a minimum of primary education is 14.6 percentage points less likely to engage in petty retailing, relative to no livelihood activity. This is an indication that women with at least primary education would rather not engage in any livelihood activity than to engage in petty retailing until they secure formal or paid employment. This is particularly so, because in Ghana engaging in petty retailing is considered the preserve of the uneducated and unskilled. While the result in the current study corroborates earlier studies (Ng'ang'a et al 2011; Eneywe and Bekele 2012; Gecho et al. 2014) it also contradicts others (Dary and Kuunibe 2012; Kuwornu et al. 2014; Ghimire et al. 2014 and Tran et al. 2014).

The results in the current study also indicate that social capital is positive and statistically significant in explaining the choice of vocation, but not significant with respect to farming, petty retailing, and paid employment. Relative to no livelihood activity, a unit increase in the number of groups a woman belongs to increases her probability of engaging in vocation by around 2.4 percentage points. In this study, vocation mainly encompasses self-employed activities such as seamstress, hairdressing, pedicures, and manicures, et cetera. Setting up and operating such activities often involve financial and logistical investments that require greater networking and the support from friends, family, and groups/associations. Dary and Kuunibe (2012) report that social network positively influence non-farm economic activities. However, in Kuwornu et al. (2014) and Ghimire et al. (2014), group membership did not have a significant effect on livelihood activity choice.

As expected, the current study reports a positive statistically significant relationship between household headship and farming, petty retailing, and vocation. If a woman is a household head, she is 1.7 percentage points more likely to be a farmer and 7.6 percentage points more likely to engage in petty retailing relative to no livelihood activity. Similarly, the probability of a household head engaging in vocation increases by 7.8 percentage points relative to no livelihood activity. Every household head is responsible for the care of household members. Hence, household heads would engage in livelihood activities just to enable them provide for

their household needs. This result is in accord with earlier studies (Babulo et al 2008; Kuwornu et al. 2014; Shehu and Abubakar 2015) but contradicts the study by Ghimire et al. (2014).

In terms of household characteristics, a unit increase in dependency ratio significantly increases the probability of choosing petty retailing by 9.3 percentage points, and decreases the probability of engaging in vacation by 8.5 percentage points, relative to no livelihood activity. Compared with petty retailing, vocation involves relatively higher financial and logistical investments. Hence, it makes sense that high dependency ratio increases the probability of engaging in petty retailing, but decreases the likelihood of engaging in a vocation. While Eneywe and Bekele (2012) report similar results, Tran et al. (2014) did not find any significant association between dependency ratio and livelihood activity choice. Per-capita income is also positive and significantly associated with choosing petty retailing ($p<0.05$), as well as paid employment ($p<0.01$), but the effect is very marginal in both cases (less than 1 percentage point increase). The finding in the current study is not different from recent studies (Gecho et al. 2014 and Kuwornu et al. 2014).

All things being equal, if a woman's household owns a farm, it is expected that she will engage in farming rather than no livelihood activity. As expected, we see a positive significant relationship between household farm ownership ($p<0.01$) and a woman's choice of farming, relative to no livelihood activity. The likelihood of choosing farming increases by approximately 3.5 percentage points if a woman's household owns a farm. Various authors (Babulo et al 2008; Eneywe and Bekele 2012; Ghimire et al. 2014; Kuwornu et al. 2014 and Tran et al. 2014) also established farm ownership as one of the factors that significantly determine livelihood activity choice. Asmah (2011), however, found no significant effect of farm ownership on the decision to participate in non-farm livelihood activity.

Lastly, household enterprise ownership is positive and significantly related to petty retailing ($p<0.01$) and vocation ($p<0.05$) and negatively related to farming ($p<0.01$) and paid employment ($p<0.01$), relative to the reference category. In particular, the results show that if a woman's household owns an enterprise, she is approximately 40 percentage points more likely to engage in petty retailing. In the same vein, with no livelihood as the reference, the probability of engaging in vocation increases by about 12.2 percentage points with household enterprise ownership. On the other hand, household enterprise decreases the probability of choosing farming and paid employment by 1.7 and 17.1 percentage points, respectively. These

results are not farfetched. Generally, it is expected that women from households owning an enterprise are likely to pick up entrepreneurship traits from early stages in life, and so are more inclined to take up self-employment activities such as petty retailing and vocation.

For the purpose of comparison, Table 3.10 (see appendix) shows the results of the multinomial logit coefficients with farming as the benchmark (a mirror image of having no livelihood activity as benchmark).

3.5.4 Study Limitations

Whereas the study focuses on just five multinomial livelihood activities (no livelihood, farming, petty retailing, vocation, and paid employment) it is acknowledged that a comprehensive livelihood activity involves a wide range of activities. Given the profile of Ghana, which is true in many developing countries, multiple livelihood activities would be the norm. However, owing to data limitations, and because it is difficult to exhaust all livelihood activities, in this study livelihood activities were restricted to the main livelihood activities relevant to the study area.

The empirical model is based on the assumption of risk causally influencing people's livelihood activity choices. However in instances where only a small number of wage employment jobs available due to supply constraints, many risk takers will not be able to choose such a livelihood activity. In this regard it is the supply constraints and not the risk seeking behaviour of the job seeker that determines the choice of the livelihood activity. However, because of data limitations the current analysis does not take into consideration supply side constraints.

3.6 Conclusions and Recommendation

This study examined the relationship between risk behaviour and the livelihood activities of women in Ghana. The study established that overall endogeneity between risk behaviour and livelihood activities is not a problem, except in the case of petty retailing. The study concludes that women who are willing to take risk are most likely to be farmers, followed by being unemployed (no livelihood activity), having a vocation, or being involved in petty retailing. Risk loving women are less likely to be in paid employment.

The results lend credence to the debate on the importance of risk behaviour in determining livelihood activities. It is recommended that any policy intervention aimed at enhancing livelihood activities of women should take into consideration individual risk behaviour. For instance, developing a better understanding of how risk behaviour influences a woman's livelihood activity choice might indeed be important in improving anti-poverty programmes, at least in the context of women in the study area. Particularly, in designing programmes or policies aimed at improving livelihood activities of women, if risk behaviour of beneficiaries is not considered, the implication would be that such policies or programmes might not have the desired outcome. However, such risk induced policies or programmes should be context specific, because the results show that different livelihood activities are influenced by risk behaviour differently. In addition to risk behaviour, the results suggest that other individual and household factors such as age, education, social capital, household farm, and household enterprise, should also be considered in programmes and policy designs aimed at enhancing women's livelihood activities.

In this study, non-farm livelihood activities, especially petty retailing and vocation, contribute significantly to livelihood activities of women. This is contrary to the general belief that most rural women are primarily engaged in farming. Therefore, policies and programmes should ensure the promotion of the non-farm sectors, at least in the context of the study area. In addition, the sizeable number (20 percent approximately) of the study women were not engaged in any livelihood activity shows the extent of unemployed women in the context of the study area. As such, there is a need to implement programmes and policies aimed at creating sustainable livelihoods for women. Social capital was also found to be one of the factors that significantly explain the choice of vocation as a livelihood activity. Therefore, co-operatives or group formation should be encouraged as a way of increasing the participation of women in various vocations. Formation of groups or associations will serve as a means of pooling resources together to achieve economies of scale.

3.6 Appendix

Table 3.5 Correlation between risk behaviour and livelihood activities

	bet	No livelihood	Farming	Petty retailing	Vocation	Wage employed
Bet	1.0000					
No livelihood	0.0416	1.0000				
Farming	0.0241	-0.0579	1.0000			
Petty retailing	-0.0238	-0.5236	-0.1212	1.0000		
Vocation	0.0146	-0.2234	-0.0517	-0.4673	1.0000	
Wage employed	-0.0444	-0.1637	-0.0379	-0.3426	-0.1462	1.0000

Table 3.6 Seemingly Unrelated Bivariate Probit Regression Coefficient

	VARIABLES	**No Livelihood**	**Farming**	**Petty Retailing**	**Vocation**	**Wage Employed**
Risk behaviour	Bet	-1.700*	3.851***	-1.811***	-1.296	0.915*
		(0.894)	(0.587)	(0.239)	(2.303)	(0.528)
Individual characteristics	Age	-0.109***	0.0191	0.0389***	0.00882	0.0242**
		(0.0141)	(0.0178)	(0.00729)	(0.00957)	(0.0102)
	Married	-0.204*	0.347	-0.0525	0.0981	0.110
		(0.111)	(0.263)	(0.0807)	(0.101)	(0.110)
	Education	0.212	0.0730	-0.345***	0.311*	0.346*
		(0.183)	(0.339)	(0.126)	(0.186)	(0.195)
	Social capital	-0.0128	0.0151	-0.0773	0.0870	0.0288
		(0.0664)	(0.111)	(0.0489)	(0.0602)	(0.0653)
	Household head	-0.775***	0.680**	0.145	0.300**	-0.0215
		(0.156)	(0.303)	(0.112)	(0.130)	(0.146)
Household characteristics	Dependency ratio	-0.0337	0.00580	0.232***	-0.344***	-0.0429
		(0.0817)	(0.129)	(0.0597)	(0.0818)	(0.0760)
	Per-capita income	-0.00221***	-0.00333	0.000747*	-9.56e-05	0.00119***
		(0.000759)	(0.00228)	(0.000387)	(0.000487)	(0.000425)
	Household farm	-0.0829	1.291***	-0.0413	-0.0489	0.0387
		(0.115)	(0.293)	(0.0892)	(0.111)	(0.130)
	Household enterprise	-1.135***	-0.462*	1.326***	0.943***	-1.084***
		(0.113)	(0.245)	(0.130)	(0.172)	(0.145)
	Constant	4.645***	-7.089	-0.211	-0.980	-2.459***
		(0.751)	0	(0.364)	(2.490)	(0.509)
Instrumental variables	Bet					
	Pentecostal	-3.856***	-4.021***	-3.887***	-4.216	-3.537***
		(0.149)	(0.148)	(0.168)	-1,206	(0.747)
	Protestant	-3.667***	-3.870***	-3.643***	-4.057	-3.282***
		(0.203)	(0.220)	(0.215)	-1,206	(0.868)

	Catholic	-3.772***	-3.950***	-3.705***	-4.196	-3.423***
		(0.249)	(0.251)	(0.247)	-1,206	(0.756)
	Muslim	-4.203***	-4.212***	-3.891***	-4.476	-3.741***
		(0.411)	(0.371)	(0.358)	-1,206	(0.817)
	Traditional	-3.535***	-3.769***	-3.693***	-3.957	-3.329***
		(0.423)	(0.454)	(0.437)	-1,206	(0.588)
	Constant	5.555***	5.721***	5.553***	5.920	5.221***
		(0.125)	(0.0278)	(0.147)	-1,206	(0.735)
	Athrho	1.031	3.353	1.313***	0.629	-0.656
		(0.755)	0	(0.376)	(1.226)	(0.425)
	Observations	1,209	1,209	1,209	1,209	1,209
	Wald test for exogeneity (rho=0)	chi2(1) = 1.86461 Prob > chi2 = 0.1721	full convergence was not achieved	chi2(1) = 12.1802 Prob > chi2 = 0.0005	chi2(1) = .242598 Prob > chi2 = 0.6223	chi2(1) = 2.38405 Prob > chi2 = 0.1226
	Robust standard errors in parentheses ; *** p<0.01, ** p<0.05, * p<0.1					

Table 3.7 Seemingly Unrelated Bivariate Probit Regression Marginal Effect

	VARIABLES	No Livelihood	Farming	Petty Retailing	Vocation	Wage Employed
Risk behaviour	bet	-0.355*	0.098***	-0.605***	-0.306	0.145*
		(0.1874)	(0.0278)	(0.0811)	(0.5334)	(0.0970)
Individual characteristics	Age	-0.023***	0.0005	0.013***	0.002	0.004**
		(0.0026)	(0.00045)	(0.0024)	(0.0023)	(0.0015)
	Married	-0.043*	0.009	-0.018	0.023	0.017
		(0.0231)	(0.007)	(0.0269)	(0.0450)	(0.0167)
	Education	0.044	0.002	-0.115***	0.073*	0.055*
		(0.0381)	(0.0087)	(0.0416)	(0.0450)	(0.0307)
	Social capital	-0.003	0.0004	-0.026	0.021	0.005
		(0.0138)	(0.0029)	(0.0162)	(0.0143)	(0.0103)
	Household head	-0.162***	0.017	0.048	0.071**	-0.003
		(0.0326)	(0.0082)	(0.0375)	(0.0309)	(0.0232)
Household characteristics	Dependency ratio	-0.007	0.0001	0.077***	-0.081***	-0.007
		(0.0170)	(0.0033)	(0.0195)	(0.0197)	(0.0760)
	Per-capita income	-0.0004***	-0.0001	0.0002*	-0.00002	0.0002***
		(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
	Household farm	-0.017	0.033***	-0.014	-0.012	0.0062
		(0.0240)	(0.0094)	(0.0298)	(0.0263)	(0.0207)
	Household enterprise	-0.237***	-0.0118*	0.443***	0.222***	-0.172***
		(0.0211)	(0.0061)	(0.0378)	(0.0414)	(.0172)
	Athrho	1.031	3.353	1.313***	0.629	-0.656
		(0.755)	0	(0.376)	(1.226)	(0.425)
	Observations	1,209	1,209	1,209	1,209	1,209
	Robust standard errors in parentheses ; *** p<0.01, ** p<0.05, * p<0.1					

Table 3.8 Generalized Structural Equation Modelling for Multinomial Logit Coefficient: No livelihood as base category

	VARIABLES	Farming	Petty Retailing	Vocation	Wage employed
Risk behaviour	bet	11.40***	-0.348	-0.214	-0.716
		(0.677)	(0.496)	(0.632)	(0.634)
Individual characteristics	Age	0.227***	0.217***	0.203***	0.210***
		(0.0500)	(0.0261)	(0.0278)	(0.0308)
	Married	0.794	0.193	0.370	0.499*
		(0.658)	(0.220)	(0.256)	(0.270)
	Education	-0.246	-0.687*	0.0489	0.102
		(0.859)	(0.357)	(0.461)	(0.507)
	Social capital	-0.00169	-0.0570	0.146	0.0824
		(0.270)	(0.134)	(0.155)	(0.158)
	Household head	2.644***	1.451***	1.754***	1.011**
		(0.758)	(0.343)	(0.371)	(0.395)
Household characteristics	Dependency ratio	0.0262	0.212	-0.503**	-0.0712
		(0.399)	(0.158)	(0.217)	(0.212)
	Per-capita income	-0.00560	0.00416**	0.00336*	0.00476***
		(0.00647)	(0.00165)	(0.00172)	(0.00163)
	Household farm	3.135***	0.0672	0.0191	0.156
		(0.719)	(0.224)	(0.266)	(0.320)
	Household enterprise	0.513	3.109***	3.141***	-0.271
		(0.589)	(0.333)	(0.427)	(0.265)
	Constant	-22.11***	-6.732***	-8.073***	-5.971***
		(1.590)	(0.859)	(1.126)	(1.073)
Risk behaviour instruments	Bet				
	Pentecostal	-3.814***			
		(0.163)			
	Protestant	-3.661***			
		(0.219)			
	Catholic	-3.745***			
		(0.270)			
	Muslim	-4.013***			
		(0.380)			
	Traditional	-3.565***			
		(0.448)			
	Constant	5.514***			
		(0.146)			
	var(e.bet)	0.0396***			
		(0.00524)			
	Observations	1,209	1,209	1,209	1,209
	Robust standard errors in parentheses ; *** p<0.01, ** p<0.05, * p<0.1				

Table 3.9 Multinomial Logit Coefficients: No livelihood as base category

	VARIABLES	Farming	Petty Retailing	Vocation	Wage employed
Risk behaviour	bet	11.40***	-0.348	-0.214	-0.716
		(0.678)	(0.496)	(0.632)	(0.634)
Individual characteristics	Age	0.227***	0.217***	0.203***	0.210***
		(0.0500)	(0.0261)	(0.0278)	(0.0308)
	Married	0.794	0.193	0.370	0.499*
		(0.658)	(0.220)	(0.256)	(0.270)
	Education	-0.246	-0.687*	0.0489	0.102
		(0.859)	(0.357)	(0.461)	(0.507)
	Social capital	-0.00169	-0.0570	0.146	0.0824
		(0.270)	(0.134)	(0.155)	(0.158)
	Household head	2.644***	1.451***	1.754***	1.011**
		(0.758)	(0.343)	(0.371)	(0.395)
Household characteristics	Dependency ratio	0.0262	0.212	-0.503**	-0.0712
		(0.399)	(0.158)	(0.217)	(0.212)
	Per-capita income	-0.00560	0.00416**	0.00336*	0.00476***
		(0.00647)	(0.00165)	(0.00172)	(0.00163)
	Household farm	3.135***	0.0672	0.0191	0.156
		(0.719)	(0.224)	(0.266)	(0.320)
	Household enterprise	0.513	3.109***	3.141***	-0.271
		(0.589)	(0.333)	(0.427)	(0.265)
	Constant	-22.11***	-6.732***	-8.073***	-5.971***
		(1.590)	(0.859)	(1.126)	(1.073)
	Observations	1,209	1,209	1,209	1,209
	Robust standard errors in parentheses ; *** p<0.01, ** p<0.05, * p<0.1				
	Wald chi2(40) = 1398.05 ; Prob > chi2 = 0.0000 ; Pseudo R2 =0.1978				

Table 3.10 Multinomial Logit Coefficients: Farming as Base Category

	VARIABLES	No livelihood	Petty Retailing	Vocation	Wage employed
Risk Behaviour	bet	-11.40***	-11.75***	-11.61***	-12.12***
		(0.681)	(0.523)	(0.619)	(0.579)
Individual characteristics	Age	-0.227***	-0.0101	-0.0236	-0.0166
		(0.0500)	(0.0442)	(0.0456)	(0.0478)
	Married	-0.794	-0.601	-0.424	-0.295
		(0.658)	(0.639)	(0.655)	(0.662)
	Education	0.246	-0.441	0.295	0.347
		(0.859)	(0.815)	(0.860)	(0.868)
	Social capital	0.00169	-0.0554	0.147	0.0841
		(0.270)	(0.252)	(0.265)	(0.267)
	Household head	-2.644***	-1.193*	-0.890	-1.633**
		(0.758)	(0.720)	(0.740)	(0.765)
Household characteristics	Dependency ratio	-0.0262	0.186	-0.529	-0.0973
		(0.399)	(0.374)	(0.404)	(0.404)
	Per-capita income	0.00560	0.00975	0.00895	0.0104
		(0.00647)	(0.00637)	(0.00640)	(0.00638)
	Household farm	-3.135***	-3.067***	-3.115***	-2.979***
		(0.719)	(0.708)	(0.725)	(0.740)
	Household enterprise	-0.513	2.597***	2.629***	-0.783
		(0.589)	(0.599)	(0.671)	(0.589)
	Constant	22.11***	15.37***	14.03***	16.13***
		(1.592)	(1.457)	(1.616)	(1.576)
	Observations	1,209	1,209	1,209	1,209
	Robust standard errors in parentheses ; *** p<0.01, ** p<0.05, * p<0.1				

Table 3.11 Hausman Tests of the independence of irrelevant alternatives (IIA) Assumption

Omitted Livelihood Activity	Chi2 values	df	Prob>chi2	Evidence
1. No livelihood	-0.07	7	1.0000	for Ho
2. Farming	-2.51	32	1.0000	for Ho
3. Petty retailing	-206.92	19	1.000	for Ho
4. Vocation	0.28	7	0.9999	for Ho
5. Paid employment	-5.40	23	1.000	for Ho

Note: Ho: (Odds outcome I vrs outcome j) are independent of other alternatives

CHAPTER FOUR

Household Food Insecurity and Coping Strategies in Ghana: Does Women's Risk Behaviour Matter?

4.1 Introduction

Food insecurity is among the numerous problems faced by households in Sub-Saharan Africa, of which Ghanaians are by no means an exception. The United Nations Food and Agriculture Organization (FAO, 2002) defines food security as "when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for a healthy and active life." Thus, household food security is the application of this concept to the household, with individual household members as the focus. In his seminal paper on 'food entitlements', Sen (1981) asserts that food insecurity is more of a demand issue affecting poor people's access to food, than a supply phenomenon affecting availability of food. The primary cause of food insecurity is the continued lack of economic opportunity to produce adequate amounts of food, or to obtain sufficient income to purchase adequate amounts of food (USAID 1995).

Jones et al. (2013) note that policymakers and development practitioners have a keen interest in ensuring food security; this is because the consequences of food insecurity can affect the larger society. Notwithstanding the numerous efforts by the Government of Ghana and various development partners, household food insecurity remains a challenge. The World Food Programme (WFP) indicates that in 2009 around 1.2 million people in Ghana, representing 5 percent of Ghana's population, were food insecure, and around two million people were vulnerable to become food insecure (WFP, 2009). The effects of food insecurity on individuals and a nation cannot be over- emphasized. Food insecurity has been shown to impact on an individual's physical, mental, and emotional health. It may prevent people from consuming enough of the right kinds of nutrients to ensure good health and developmental outcomes (Campell, 1991; Guildford et al., 2003; Laraia et al., 2010, Saaka and Osman, 2013). According to Braun et al. (1992), food insecurity leads to diminished work performance, lowered cognitive ability and low school performance. Also, Kuwornu and Demi (2013) assert that no country can develop with food insecure citizenry.

Globally, the contribution of women to food insecurity cannot be overemphasized. Women in Ghana contribute greatly to household food security and produce around 80 percent of the food

consumed (Kunze and Drafor 2003). In Ghana and other African societies, the traditional role of women in the household, among other things involves food production purchases and preparations (including decisions on what particular food to eat at any point in time, and when food is served in the household). Societal and cultural norms impose on women the role of ensuring adequate food for household members (Geheb et al. 2008). According to IFAD (1998), in Ghana women increase their contribution to household food security by either growing food or by earning income to purchase food. Fonjong (2004) affirms that women's triple roles as food producers, income earners, and home managers, make them indispensable in the drive towards food security. The World Bank et al. (2009) also report that women tend to be responsible for food preparation, and are more likely to spend their income on household food needs. Similarly, Karl (2009) notes that in many cultures women are tasked with the responsibility for providing food for their household. Also, Hamilton (1984) finds that men typically contribute to large and one-off payments, while women spend on daily household expenditures, including food. Bass (2009) notes that maternal income effects on food security can be significantly larger than paternal income effects.

Men are considered as the head of the home, and have the responsibility of taking care of all household needs in a traditional Ghanaian society (Oppong, 1974, Ogbu, 1978). However, various studies in Ghana report that the status quo has changed (Hesselberg and Yaro, 2006; Wrigley-Asante 2011; Boakye-Akyeampong et al. 2012). Thus, women have become important economic actors and they assume major economic responsibilities in the household. Amu (2005) notes that increasingly women are becoming the breadwinners; hence they are the backbone of their households. Women remain the centrepiece of food security in Ghana (Boakye-Akyeampong et al. 2012). According to Hesselberg and Yaro (2006), the inability of men to increase agricultural production and income is translated into heavier burdens on Ghanaian women because they are expected to prevent the family from starvation. Consequently, the physical and psychological burden of ensuring household food needs, hangs on the face of every woman (Hesselberg and Yaro 2006). In addition, Wrigley-Asante (2011) emphasized that improvements in the economic position of women in Ghana over the years, has also led to their increased contribution to household food and other needs. Thus, women contribute to sustaining household livelihoods through crop cultivation, adapting the food types

eaten, and earning income to purchase food (Hesselberg and Yaro (2006)[34]. Again, Wrigley-Asante (2011)[35] revealed that in Ghanaian households women have control over decisions about food. Hence, women are taking over men's Traditional role as 'breadwinners', and men are often reduced to mere 'figureheads' (Wrigley-Asante 2011). Though the assertions of these authors (Hesselberg and Yaro 2006 ; Wrigley-Asante 2011) cannot be said to be the situation in all Ghanaian households, it goes to buttress the view earlier shared by Quisumbing et al. (1995) and later by Karl (2009) that women in Ghana are the key to food security for their households.

While there is a substantial body of research looking at women's contribution to household food insecurity, these studies largely focus on women's roles with such variables as income, livelihood, age and education (Hamilton 1984; Hopkins et al. 1994, Hoddinott and Haddad 1995, Quisumbing et al. 1995 ; IFAD 1998; Levine et al. 1999; Canagarajah et al. 2001; Kunze and Drafor 2003; Fonjong 2004; Hesselberg and Yaro 2006; Geheb et al. 2008; Hadley et al. 2008; Karl 2009; World Bank et al. 2009; Owusu et al. 2011; Wrigley-Asante 2011; Boakye-Akyeampong et al. 2012 ; IFPRI 2013). Despite the quantity of empirical studies on women's role in food security, to date, no study has explicitly looked at the effect of women's risk propensity on food insecurity and coping strategies. Perhaps this obvious gap in the literature is due to data limitations. The question is: "Does risk behaviour of women matter?"

This particular study argues that risk behaviour does matter, through the effect it has on guarding against uncertainty by saving to ensure a stable and predictable path of consumption, or otherwise. Though it is difficult to directly explain the link between women's risk behaviour and food insecurity, it can be explained through the mechanism of individual precautionary

[34] Hesselberg and Yaro, (2006) in a Focus Group Discussion in Ghana report that the main preoccupation of women is chasing money and food to take care of the family'.

[35] Participants report in a Focus Group Discussion in Ghana (in Wrigley-Asante 2011) revealed that: 'When a woman asks her husband for money he will bluntly tell her that he doesn't have money. In that case, what will you do? The woman has to work hard to feed the family' (Woman 3, in Wrigley-Asante 2011). 'Some of our husbands even depend on us; we cook for them without asking them for housekeeping money and so we have to decide on what to cook' (Woman 4 in Wrigley-Asante 2011). Likewise, Focus Group Discussion participants prior to the main data collection for the current study in 2009 revealed similar circumstances y as reported by Wrigley-Asante (2011). The Focus Group Discussion for the current study also revealed that in the study area, wives (women) mostly spend on food while husbands spend on huge payments such as rents, school fees, electricity bills, et cetera, , confirming the findings of Hamilton (1984). This is not surprising as the study area for the current study (Yilo and Manya Krobo Districts) and the site for Wrigley-Asante (2011) study (Dangme West District) share a border and have similar socio-cultural and economic characteristics.

savings. A theoretical model is presented in section 4.3 that shows the link between risk aversion and prudence (a characteristic that gives rise to precautionary savings). In general (as long as certain conditions are met), risk averse people save to guard against future uncertainty and to ensure consumption smoothening. Therefore, if uncertain future income is not guarded against through savings, it will lead to low food consumption and hence, food insecurity in future. Thus, this study hypothesised that if a woman is willing to engage in risk, she is more likely to contribute positively to her household's food insecurity. This sets the background for, and constitutes the major focus of this study, which seeks to answer the research question: "What is the effect of risk behaviour of women on household food insecurity and food insecurity coping strategies?' Specifically, the study focuses on four main outcomes including the effect of risk-taking propensity on the following: (1) household food insecurity; (2) likelihood of adopting a food insecurity coping strategy; (3) the number of food insecurity coping strategies resorted to; and (4) the type/form of coping strategies adopted.

To the extent that Ghanaian women contribute immensely to household food needs, as explained by various authors (Hesselberg and Yaro, 2006, Wrigley-Asante 2011, Boakye-Akyeampong et al. 2012), investigating the effect of risk propensity of women on household food insecurity and coping strategies is crucial. Fighting food insecurity and its associated consequences requires knowledge and an understanding of the factors that enhance food security (Gundersen and Garasky, 2012). Thus, aside from extending the argument on women's role in food insecurity, this study may also lead to a better understanding of how to better deal with food insecurity situations. Using a unique data set obtained from households in the Yilo and Manya Krobo Districts of the Eastern Region of Ghana, the study established that risk-taking propensity of women increases household food insecurity. Similarly, if a woman is willing to engage in risk, her household is more likely to adopt coping strategies when faced with food insecurity. Consistent with the finding on risk behaviour of women and food insecurity, risk behaviour is also positively associated with the number of strategies households resort to in order to cope with food insecurity. Besides, the impact of risk behaviour is greater for resorting to a more drastic coping strategy (limiting adult food intake to feed children) relative to other strategies, all things being equal. The study failed to reject the null hypothesis of exogeneity of risk behaviour of women on food insecurity and food insecurity coping strategies.

The remainder of the paper is organized as follows: A review of the literature is done in Section 4.2; Methodology (data and estimation techniques) is dealt with in Section 4.3; and Sections 4.4 and 4.5, respectively, discuss the results and conclude the paper.

4.2 Literature Review

The concept of food security has evolved over the years with a myriad of definitions and measurements. Hence, to set the stage for the empirical literature review, this sub-section first looks at some definitions, concepts, and measurements of food insecurity. This is then followed by a review of the empirical literature.

4.2.1 Household Food Security: Definitions, Concepts, and Measurement

Definitions and Concepts: The literature is awash with various definitions of food security, with different organizations and individuals, all defining it differently: Maxwell and Smith (1992) identify around 200 definitions of food security in the literature. During the World Food Conference in 1974, the United Nations defined food security as, "availability at all times of adequate world supplies of basic food-stuffs" (United Nations, 1975). However, in its 1986 report on poverty and hunger, the World Bank narrowed the focus of food security from the global and national level to households and individuals and it also broadened the emphasis from food availability to include access to food. The World Bank (1986) defined food security as "access by all people at all times to sufficient food for an active healthy life." Household food security is therefore the application of this concept to the household, with individual household members as the focus. Subsequently, during the world food summit (and later in their State of Food Insecurity 2001 report), the FAO (1996) amplified the definition of food security to include the nutritional value and food preferences. The FAO defined food security as "when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for a healthy and active life". Indeed, the FAO (1996) definition seems to be universally accepted because it encompasses availability of nutritionally adequate food, access to food, food utilization, and stability. Given that the current study is on Ghana, it is important also to look at the definition by Ghana's Ministry of Food and Agriculture (MoFA), an important authority in Ghana as far as food security is concerned. The operational definition of food security by MoFA (2003) as contained in their Food and Agriculture Sector Development Policy (FASDEP) report is "Good quality nutritious food, hygienically packaged, attractively presented, available in sufficient

quantities all year round and located at the right place at affordable prices."

Based on these earlier definitions by the international bodies (UN, World Bank, and FAO), various authors working on food security have also come up with their operational definitions. For instance, Barret (2002) broadly defines food security as "access by all people at all times to enough and appropriate food to provide the energy and nutrients needed to maintain an active and healthy life." Beaumier and Ford (2006) in turn assert that "food insecurity occurs when food systems are stressed so that food is not accessible, not available, and not of sufficient quality." Food insecurity exists when people do not have adequate physical, social, or economic access to food (Clay, 2002). Bickle et al. (2013) for their part define food insecurity as a situation of "limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways."

FAO (2013) identifies four (4) food security dimensions: food availability, economic and physical access to food, food utilization, and stability over time. Food availability relates to the supply of food through production, distribution, and exchange, and food access refers to the affordability and allocation of food, as well as the preferences of individuals and households (Gregory et al., 2005). Access depends on whether the household has enough income to purchase food at prevailing prices, or has sufficient land and other resources to grow its own food (Garet and Ruel, 1999). Food utilization refers to the metabolism of food by individuals, while food stability is the ability to obtain food over time. Webb et al. (2006) note that these concepts are inherently hierarchical, with availability necessary but not sufficient to ensure access, which is, in turn, necessary but not sufficient for effective utilization. The focus of this study was on the access dimension of household food insecurity. Whereas household assets including income, use of and/or ownership of land, livestock, inheritances, gifts and transfers, among others, determine a household's access to food (FAO, 1997), household demographic structure (number of children, elderly, gender of the household head) and education levels, et cetera, determine household preferences, which influences the type of food that is purchased (Garet and Ruel, 1999). While focusing on the effect of risk behaviour on food insecurity, the current study includes some of these variables as covariates.

Measurement of Household Food Insecurity: An extensive review of literature shows that several measures have been developed to gauge household food security; however, there does not seem to be a gold standard measure. Barrett (2010) indicates that approaches to the

measurement of household food security follow the four dimensions of availability, access, utilization, and stability. According to Barret (2010), the difficulty in getting a standardized measure of food security is due to its multidimensional nature.

Over the years, several measures or indicators of food insecurity have been identified and used in the literature, notably, Household Consumption and Expenditure Surveys (HCES) to estimate per capita caloric availability (Smith and Subanduro 2007; Fiedler 2013), and the Household Dietary Diversity Score (HDDS) and Household Food Frequency Score (HFFS) that respectively capture the number of different kinds of food that people eat and the frequency of eating (Coates et al. 2007; IFPRI 2006; Kennedy et al. 2011). Other measures include the Household Food Insecurity Access Scale (HFIAS)[36], which is continuous measure of the degree of food insecurity. It is designed to capture household behaviours that signify insufficient quality and quantity of food, as well as anxiety over insecure food access (Coates, et al 2006; Swindale and Bilinsky 2006; Webb et al. 2006; Deitchler et al. 2010; Knueppel et al 2010). The HFIAS has been validated through estimates of its correlation with commonly used indicators of poverty and food consumption (Webb et al. 2002; Coates et al. 2003; Frongillo and Nanama 2006).

Additionally, the Household Hunger Scale (HHS) is a culturally-invariant continuous measure of the experience of household food deprivation based on a set of predictable reactions (Coates, et al 2006; Swindale and Bilinsky 2006; Webb et al. 2006; Deitchler et al. 2010; Deitchler et al. 2011). HHS is considered as a measure of extreme or severe food insecurity. The Coping Strategies Index (CSI)[37] has also been developed and validated as an instrument to assess household behaviours in times of food deprivation or the coping strategies that households rely on to manage problems of food access that they see arising in the future (Maxwell et al. 2003; Coates et al. 2006; Maxwell et al. 2008). According to Maxwell et al. (2013), a higher score on the HFIAS, HHS and CSI indicates greater food insecurity, whereas higher HDDS and HFFS scores indicate greater dietary diversity and food frequency and, thus, less food insecurity.

[36] USAID, FAO, WFP and others have adopted and promoted the HFIAS and are most widely used in an international context for programmatic purposes. (Swindale and Bilinsky 2006; Coates, Swindale, and Bilinsky 2006).
[37] Developed by CARE international and WFP

In this study, the survey associated with the HFIAS refined to fit local conditions, is the primary data collection instrument for measuring household food insecurity. In addition to the HFIAS survey, a modified version of the surveys associated with the CSI is used to elicit context specific household food insecurity coping strategies.

4.2.2 Empirical Literature

The empirical literature is replete with studies on factors influencing household food security. This section reviews some of the existing literature, by first focusing on studies related to household food insecurity, and then on food insecurity coping strategies.

Household Food Insecurity

Using data from the seventh round of the Ethiopian Rural Household Survey, Abafita and Kim (2014) examined the determinants of food security among 1,577 households in 15 villages. In an instrumental variable estimation to account for endogeneity, they found that age and education of household head, participation in off-farm activities, rainfall adequacy, and total livestock unit, per capita consumption expenditure and soil conservation practices were statistically significant and positively related to household food security. On the other hand, access to credit and remittance income was negatively associated with food security. More recently, in West Abaya District, Southern Ethiopia, Shone et al. (2017) studied the factors associated with household food insecurity in a community-based cross-sectional study on 779 households. Their logistic regression result indicates that households with an unmarried head and female-headed households were more likely to be food insecure. Besides, households headed by the aged (persons aged >65 years) were more likely to be food insecure. Additionally, they established a positive and negative significant association between food insecurity and household size and land size, respectively. However, they did not find a statistically significant association between household food insecurity and educational status, dependent members in the household, opinions on land fertility, oxen ownership, livestock ownership, farm input use, food crops produced and available in store, and average monthly income.

In a study of 107,335 households in Pakistan, Uzma and Muhammad (2004) found that whereas a woman's age positively affects household per capita calorie intake (a measure of food security), women's education affects it negatively. Also, household income, urban residence, access to safe water and per capita room all had a positive effect on per capita calorie intake.

However, dependency ratio and access to toilet facilities had negative effect on per capita calorie intake. Shariff and Khor (2008) used the Radimer/Cornell Hunger and Food Insecurity instrument to assess food insecurity among 200 women and their households in a rural Malaysian community. In their logistic regression estimation, they reported that the likelihood of household food insecurity significantly increases with household size, number of children and children of school-going age. Additionally, food insecure households were more likely to have non-working mothers (housewives), where the households live below the poverty line, have no savings and are less likely to own land. Again Shariff and Khor (2008) find that, father's income significantly reduced food insecurity.

Zakari et al. (2014) in turn investigated the factors affecting food security among 500 households in Niger, and found that male-headed household, labour supply and the distance from the main road significantly increase the odds of a household being food secure. On the contrary, whereas, diseases and pests, flooding, poverty, access to market, and food aid significantly decrease food security, education of household head, age, household size, assets, drought, soil fertility, farming inputs, land, and food prices had no significant effect on food security. In Osun state, Nigeria, Adepoju et al. (2015) studied the role of 240 women aged 20-70 years in household food security. The authors report that the specific contribution of women in household food security include participating in food processing and meal preparation, purchasing and distributing food for household consumption, buying food for storage keeping, food preservation, as well as production/cultivation. In a logit estimation, they established that a woman's education and household size significantly decrease household food security, but household expenditure has the opposite significant effect. They also included other women variables such as age, marital status, ownership of property, primary occupation (farming), years of farming experience, membership of cooperative society, distance to a relative and women total income in their regression, but none of these were significant.

Generally, there have been many studies on food insecurity in Ghana. Maxwell et al. (2000) evaluated determinants of household food security (using household calorie availability) in Ghana and they reported that female-headed households, per capita household expenditure, mean cluster price of rice and red palm oil are positive and significantly related to food availability. They also reported that households with a relatively high number of school-aged children and men of prime working age, as well as, mean cluster price of cassava and tomatoes were significant and negatively correlated with food availability. In an in-depth study of three

villages (Kajelo, Chiana and Korania) in the Kassena-Nankani district of Ghana, Hesselberg and Yaro (2006) assessed the determinants of the odds of being food insecure among 600 households. They did separate regressions for each village using the same factors (household size, education level, farmland size, bushland owner, and irrigation land) and found mixed results. Whereas they reported a positive statistically significant effect of household size on food insecurity in all three villages, educational level was not statistically significant in Chiana, but it was significant in both Kajelo and Korania. The authors found a positive and negative effect of educational level on household food insecurity for Kajelo and Korania, respectively. Also, they showed that the larger the size of a household's farmland, the lower the odds of being food insecure in both Kajelo and Chiana. Farmland size was not significant in Korania. Additionally, bushland ownership and having irrigated land were significant (and negative) only for Korania.

Owusu et al. (2011) also examined the impact of non-farm work on household income and food security among 300 farm households in 10 rural communities in the Northern Region of Ghana. Using a propensity score matching method, the authors showed that for both female-headed and male-headed households, participation in non-farm work had a positive and statistically significant effect on household food security. Also, there was a negative and statistically significant effect of non-farm employment participation on the probability of declining household food stocks during critical periods of food shortages. According to Boakye-Akyeampong et al. (2012), notwithstanding the emphasis on women's role in ensuring household food security, empirical evidence focusing on women appears to be very sketchy in Ghana and elsewhere. As a result, the authors studied the role of 100 rural women in the attainment of household food security in the Ejura-Sekyeredumasi District of Ghana. In a chi-square test they found that household food security status significantly depends on backyard gardening by women, the number of crops cultivated by women, and the income (both farm and off-farm) of women.

Kuwornu et al. (2012) also examined the food security status of 120 farming households from eight communities in two districts in the forest belt of the Central Region of Ghana. Using a binary logit estimation, they found a significant positive association between household food security and household income, access to credit, as well as own food production, and a negative significant association with dependency ratio. Age and age squared of household head, gender of household head, the level of education of household head, farm size, non-farm activities,

and land ownership were all included in their model, but they were not statistically significant. Mustapha et al. (2016) also examined factors influencing the relative occurrence of various degrees of food insecurity among 4,288 households. Using an ordered Probit model, they established that whereas maize crop output and marital status had a negative effect on food insecurity; rural location, age, land size and access to credit significantly increased food insecurity. In the Upper East and Upper West Regions of Ghana, Osarfo et al. (2016) investigated the impact of participation in non-farm activities on household income and food security among farming households. They measured household food security using the Recommended Daily Calorie Required (RDCR) approach. In a Propensity Score Matching (PSM) estimation, their results showed that participation significantly increases food security.

Though the empirical literature on factors influencing household food insecurity have looked at women's role variables such as income, occupation/livelihood, age and education, it is interesting to note that no study has precisely focused on the risk- taking propensity of women. As indicated earlier, the dearth of empirical literature on this important topic may be because of data constraints. Using a unique dataset that combine risk- taking propensity data and household food insecurity data, the current study contributes to literature by extending the arguments on women's role in food insecurity, focusing on the effect of risk behaviour of women on household food insecurity. Aside from the main variable of interest (risk behaviour), it is also worth noting that this study is somewhat different from earlier studies with respect to certain control variables. In particular, very few studies, if any, report on the specific livelihood activities that women are engaged in. Related to the focus on livelihood activities are studies that looked at the impact of farm/non-farm work on household food insecurity (Canagarajah et al., 2001; Gladwin et al., 2001; Owusu et al. 2011, Osarfo et al. 2016). The current study is, however, different from these studies because they did not look at precise livelihood activities such as farming, petty retailing, vocation, and paid employment. Combining all non-farm income activities may give different results, compared to the current study, which focus on the effect of each non-farm livelihood activity separately. Aside from the fact that this current study fills existing literature gaps, it is also unique because of the data sets used and by extension the econometric estimation technique applied. The panel structure of the data helps to understand the interactions and dynamics of household food insecurity over time. Most household food insecurity studies use cross- sectional data, which makes it difficult to evaluate the issue over time. Because the data is panel, and hence look at food insecurity over time, it is possible to apply a system GMM estimation technique. The system GMM estimation has the

benefit of analysing the effect of past food insecurity on current food insecurity, which is almost non-existent in the literature.

Household Food Insecurity Coping Strategies

During food insecurity episodes, households employ varied strategies to cope with the situation. A number of studies have explored some of these coping strategies. In South Africa, Wilna (2006) studied household food insecurity coping strategies in an informal settlement in the Vaal Triangle, and showed that limiting caregiver's food intake in order to make food available for children, limiting portion sizes, cooking a limited variety of foods, and skipping of meals are the most common coping strategies. Also, in a cross- sectional qualitative survey of 17 farm worker households, Kruger et al. (2008) gathered data on food stress coping strategies by women (aged 18 to 57 years) in a small farm-worker community in Fouriesburg, South Africa and classified the coping strategies in terms of severity: "least severe" (eat less preferred food and limit and allocate money available for specific food purchases), "severe" (borrow food, gather wild food, send members to eat elsewhere, send members to beg, limit or reduce portion size and feed working members at the expense of nonworking members); and "very severe" (buy food on credit, consume seed stock, restrict consumption in favour of children and skip meals for an entire day).

Ververs (2010) identified coping strategies used by smallholder farming communities in Southern Sudan that include consuming less preferred foods, reducing the size and number of meals, eating immature crops, as well as increasing collection and consumption of wild foods. In a cross- sectional study of 200 rural Malaysian women, Shariff and Khor (2008) reported that a greater proportion of respondents indicated 'cooking whatever food is available at home' was their most adopted food insecurity coping strategy. Other coping strategies included borrowing money to buy foods, selling valuable assets such as jewellery and land, reducing children's education expenditure, getting cheaper treatments for illness, reducing the number of meals, as well as receiving foods from family members, relatives and neighbours.

Very few studies attempt to investigate factors that are associated with household food insecurity coping strategies quantitatively. Regassa (2011) collected data on 614 households in the Sidama Zone of Southern Ethiopia to examine smallholder farmers' coping strategies to food insecurity. The author reports that in responding to food insecurity situations, households employ several strategies, such as minimizing the number of meals and amount of food

consumption, using buffer stock, and out-migration of household members during chronic food shortage. The rest include diversifying livelihood, using local saving mechanism, neighbourhood resource exchange mechanism, and using food aid. In a multivariate analysis, Regassa (2011) found a statistically significant positive relationship between household size, and age of household head on the number of coping strategies. He also established that the number of coping strategies is negatively associated with land size and household head's education. However, the proportion of working adults, religion, and marital status were not significant.

Also, Ahmed (2015) et al., in a study of Pakistan households, identified five coping strategies, namely borrowing from friends, sticking to simple food, reducing expenditures on health and education, as well as adults skipping a meal and selling assets. Correlation between coping strategies and socioeconomic factors revealed that age of the household head, household size, and number of income earners in the household influenced the choice of coping strategy to adopt during food insecurity situations. In a more recent study in Bangladesh, Farzana et al. (2017) examined the factors influencing the propensity towards food insecurity coping strategies adaptation among 23,374 food insecure households. They identified six coping strategies and then categorised the strategies into *financial* (sale or mortgage of assets, stop schooling of household members, borrowing money and food), *food compromised* (consumption of low quality food and consumption of fewer items of food) and *both financial and food compromised*. They then estimated a multinomial logit multivariate regression with financial category as the reference outcome, and found that seasonality, women's and household head education, women with income generating activity, occupation of primary earner, household income, food insecurity status, asset index, as well as size and possession of agricultural land were found to be significantly associated with the adaptation of both financial and food compromising coping strategies. However, location of household and sex of household head were not significant.

The paper by Maxwell et al. (1999) on 'alternative food-security indicators' is arguably the first study to give an in-depth analysis of the frequency and severity of food security coping strategies in Ghana. They identified nine (9) household food insecurity coping strategies that include relying on less preferred and less expensive foods; borrowing food, or money to buy food; purchasing food on credit; relying on help from relatives or friends outside the household; limiting portions at mealtimes; rationing the little money to household members to buy street

foods; limiting adult food intake to ensure children eat adequately; reducing the number of meals eaten in a day and not eating for a whole day. . Quaye (2008) examined how farming households cope during food insecure periods in the three northern regions of Ghana, and showed that households use a range of food insecurity coping mechanisms such as migration to Southern Ghana for wage labour; support from relatives and friends; collection of wild foods; reduction in the number of meals served each day; as well as a reduction in the portions/sizes of meals and consumption of less preferred foods. Others include sales of livestock and household valuables; work for food as pay, and sending some household members to live elsewhere.

Demi and Kuwornu (2013) in turn evaluated the level of food insecurity and coping strategies among 360 household in the Central Region of Ghana. Their empirical results revealed that the level of food insecurity was not severe and the main coping strategies households adopt in order of frequency when faced with food insecurity included eating less preferred food, limiting size of food consumed (food rationing), and skipping meals. The rest comprised of maternal buffering (the practice where parents forego their food to ensure the children have enough); borrowing money to buy food and borrowing food; collecting food from the wild or gardens, selling asset to buy food and travelling to search for a job. In an earlier study with different sampled respondents (120 farming households), also in the central region of Ghana, Kuwornu et al. (2012) reported similar results as those in Demi and Kuwornu (2013)'s study.

In a qualitative study, Chagomoka et al. (2016) used Focus Group Discussions (FGD) and in-depth interviews to investigate how households cope with food shortages and how the coping strategies vary along the urban–rural continuum in and around Tamale, Ghana. They identified the main food insecurity coping strategies to include borrowing food or money to buy food, buying food on credit, going a whole day without food, consuming seed stock and restricting adult intake in favour of feeding children. Less resorted to strategies include consuming less preferred food, taking occasional jobs, and engaging in small trading and hunting. The authors reported that whereas in urban settings a more frequent coping strategy is to reduce the number of meals, in peri-urban and rural areas, households widely practice gathering wild food and selling charcoal during food insecurity situations.

Whereas it is common knowledge that households are likely to adopt certain strategies to cope with food insecurity episodes, which factors influence adoption of coping strategies or

otherwise is a question that needs empirical investigation. This review of the literature has shown that although past studies on food security have analysed strategies adopted by households to cope with food insecurity, most of these studies fail to investigate factors influencing the adoption of the coping strategies. Thus, there remains limited research into the factors that influence household food insecurity coping strategy adoption, particularly in Ghana. Additionally, the few studies that investigate factors influencing coping strategies are mostly qualitative. Notable exceptions include studies by Regasa 2011, Ahmed et al 2015, and more recently by Farzana et al (2017). Besides, although women are the key actors in household food insecurity, research to date provides very limited understanding on women's role in the adoption of food insecurity coping strategies. For instance, what role risk propensity of women can play in explaining adoption and the number of food insecurity coping strategies have been ignored in the literature. This study focused on an unexplored area in the empirical literature, by examining the effect of risk behaviour on household food insecurity coping strategies. In particular, the study examined three outcomes: decision to adopt coping strategies, number of coping strategies adopted, and the severity of the type of coping strategy adopted.

4.3 Risk Behaviour and Food Insecurity: Theoretical Model

Assume that there are two time periods, the present, denoted by t, and the future denoted by t + 1.

Assume also that at any time period t, a woman has the power to make consumption decisions for her household, and aims to maximize the lifetime utility of her household.

Lifetime utility of the household is given by

$$U = \mu_t(c_t) + E_t(\beta\mu_{t+1}(c_{t+1}))$$

[4.1]

with the dynamic budget constraint at any time, k, given by

$$x_k = (x_{k-1} - c_{k-1}) * R + y_k$$

$$= a_k * R + y_k$$

[4.2]

where $\mu_t(c_t)$ represents instantaneous utility of the household at time period t; and c_t is household food consumption in time period t, β is the discount factor $\frac{1}{1+\rho}$ with p being the rate of time preference, x_k is cash available to be used for consumption in time period k, y_k is income in period k, R is the fixed gross return on assets, a ; and is equal to (1 + *r*), where *r* is the interest rate common to borrowing and lending. Assuming that household income in time t + 1 is uncertain, so that c_{t+1} and hence μ_{t+1} are uncertain, therefore, the expectation operator *E* for period t + 1.

Assume that at any time period t, utility is of the CRRA (constant relative risk aversion) form, i.e.,

$$\mu_t(c_t) = \frac{c_t^{1-\theta}}{1-\theta} \qquad [4.3]$$

where, θ is the coefficient of relative risk aversion.

The first order conditions pertaining to consumption for the maximization problem result in the following Euler equation

$$\mu'(c_t) = \beta R E \mu'(c_{t+1}) \qquad [4.4]$$

where ,

$$\mu'(c_k) = (c_k)^{-\theta}$$

[4.5]

for k = t; t + 1

Hence, equation [4.4] results in

$$(c_t)^{-\theta} = E_t(\beta R(c_{t+1})^{-\theta}) \qquad [4.6]$$

Now, dividing through by $(c_t)^{-\theta}$ and using an exponential -log representation we have

$$1 = E_t \exp[\ln(\beta R(c_{t+1})^{-\theta}(c_t)^{\theta})] \qquad [4.7a]$$

$$1 = E_t \exp[\ln\beta + \ln R - \theta \ln(\frac{c_{t+1}}{c_t})] \qquad [4.7b]$$

$$1 = E_t \exp[\ln\beta + \ln R - \theta(\Delta \ln c_{t+1})] \qquad [4.7c]$$

where $\Delta \ln c_{t+1}$, shows the percentage change in consumption between time t+1 and time t, or the growth rate in consumption.

Now, since y_{t+1} and hence c_{t+1} are uncertain, $\Delta \ln c_{t+1}$ is uncertain. In particular, as put forward by Pratt, 1964 (and subsequently become common place in the literature), if $\Delta \ln c_{t+1}$ is conditionally normally distributed, with variance σ^2_{t+1} , then

$$E_t \exp[-\theta(\Delta \ln c_{t+1})] = \exp[-\theta E_t(\Delta \ln c_{t+1}) + \frac{\theta^2}{2}\sigma^2_{t+1}] \quad [4.8]$$

where , $\frac{\theta^2}{2}\sigma^2_{t+1}$, can be seen as the risk premium for uncertain future consumption. Thus, we get:

$$1 = \exp[\ln \beta + E_t \ln R - \theta E_t(\Delta \ln c_{t+1}) + \frac{\theta^2}{2}\sigma^2_{t+1}] \quad [4.9]$$

Now we can solve for $E_t(\Delta \ln c_{t+1})$ by taking logs so that:

$$0 = [\ln \beta + E_t \ln R - \theta E_t(\Delta \ln c_{t+1}) + \frac{\theta^2}{2}\sigma^2_{t+1}] \quad [4.10]$$

Hence:

$$E_t(\Delta \ln c_{t+1}) = \tfrac{1}{\theta}[(E_t \ln R + \ln \beta) + \frac{\theta}{2}\sigma^2_{t+1}] \quad [4.11]$$

Now the term, $\frac{\theta}{2}\sigma^2_{t+1}$, can be seen as precautionary saving, that is a saving caused by future income being uncertain instead of determinate. Precautionary saving requires the characteristic of prudence (Kimball 1990), a characteristic which is distinct from (although related to) risk aversion. While risk aversion is described by the second derivative of the utility function, specifically concavity of the utility function, prudence is described by the third derivative of the utility function, specifically convexity of the marginal utility function.

In the model presented the *precautionary saving* term is positively related to θ , the *risk aversion parameter*. Indeed, the more risk- averse the woman, the greater the level of precautionary saving of the household, that is saving aimed at food consumption against future income shocks. Therefore, if uncertain future income is not guarded against through savings, it will lead to low food consumption in the future and hence, food insecurity.

To generalise the model, while risk aversion alone does not guarantee precautionary saving, when the marginal utility function is convex, that is, the third derivative of the utility function is positive, it has been shown by some authors (Leland 1968, Sandmo, 1970 and Kimball 1990) that indeed risk aversion will guarantee the existence of precautionary saving.

Because food security can be defined as the availability of food and stability of such over time, a lack of precautionary savings could lead to food insecurity as stability of food availability and hence, consumption cannot be guaranteed. Indeed, savings is the underlying mechanism connecting risk preferences with food security/insecurity.

4.4 Methodology

4.4.1 Data and Summary Statistics

The current study used the household socioeconomic characteristics data, risk aversion data, and the household food insecurity data from the Socioeconomic Studies (SES) arm of the International Lipid-Based Nutrient Supplement Project in Ghana (iLiNS DYAD-G SES). Details of these data are explained below:

1. ***Household[38] socioeconomic characteristics data****:* Data on household socioeconomic characteristics were collected at various intervals four times (enrolment, 9 months, 15 months and 27 months) and contain information on household socio-demographics, assets, water and sanitation, housing, social capital, agriculture, et cetera. .
2. ***Household food insecurity data:*** Data on household food insecurity were also collected four times (enrolment, 9 months, 15 months and 21 months), based on a modified version of the Household Food Insecurity Access Scale (HFIAS) measures developed and tested by USAID's Food and Nutrition Technical Assistance (FANTA) project (Coates et al. 2007; Deitchler et al. 2011), and food insecurity coping strategies based on households' self-identified behavioural responses to food insecurity (Maxwell 1996 and Maxwell et al. 1999). The HFIAS, a nine-item questionnaire, was developed for use in developing country settings, and focuses on three domains of food insecurity, including anxiety/uncertainty about the household food supply, insufficient quality of food (including variety and food preferences), and insufficient food intake and its

[38] A household is defined as the group of people who have been regularly sleeping in the same dwelling and sharing food from the same cooking pots for at least the past three months.

physical consequences (Coates et al. 2007). In Ghana, women are primarily responsible for food purchases and meals preparation in the household, and hence, women were the respondents to the food insecurity questionnaire. Respondents were asked to think back four weeks prior to the survey, and try to remember how often their household experienced food insecurity, based on the nine items below:

1. Worry that their household would not have enough food.
2. Not able to eat the kinds of foods preferred because of lack of resources.
3. Eat a limited variety of foods due to a lack of resources.
4. Eat some foods that they really did not want to eat because of lack of resources to obtain other types of food.
5. Eat a smaller meal at breakfast, lunch, or dinner than they felt they needed because there was not enough food.
6. Eat less than three meals in a day because there was not enough food.
7. No food to eat of any kind and no way to get more through purchases, your garden, or farm, or from storage.
8. Go to sleep at night hungry because there was not enough food.
9. Go a whole day and night without eating anything because there was not enough food.

Prior to the main data collection, context specific questions related to food insecurity coping strategies were identified via focus group discussions, by gathering answers to the general question, "What do people do when they do not have enough food or enough money to buy food?" The responses were summarized in a variety of single, household-specific coping strategies[39]. Consequently, in terms of coping strategies data, respondents were again asked to think back the past four weeks and try to remember how often their household took actions when faced with insufficient food, based on the five items below:

1. Borrowed food (or money to buy food) from people outside the household, such as relatives or friends, to feed household members.
2. Purchase food on credit to feed the members of your household.
3. Eat elsewhere at another household because there was not enough food.
4. Beg for food from people outside the household.

[39] The number of coping strategies is also used to quantify food insecurity.

5. Limit food intake themselves to feed children because there was not enough food or enough money to buy food.

3. ***Risk aversion data*:** To learn about women's risk taken propensity in the face of uncertainties, data on individual risk behaviour were collected using a field economic experiment with real monetary pay-offs. The participants in the risk aversion game were the study woman, who is the 'mother of the household' and the main person responsible for food purchase and meals preparation. The detailed explanation of the experimental procedure is captured in Chapter One of this thesis.

Summary Statistics

Table 4.1 shows the summary statistics of the data. Average age and years of education of the study women are 27 years and 7 years, respectively. On average, women receive a monthly income of GH¢79 from their main livelihood activities; there are five people in a household with an average net household income of approximately GH¢213. Around 20percent of households own farms and as much as 77 percent own household enterprises/businesses. Also, 73 percent of household heads are males, and the number of completed years of schooling for household heads (15 years) is twice as much as that of the women. Most women (96 percent) are willing to bet in the risk taking propensity game, implying that generally the study women are willing to engage in risk.

Table 4.1 Summary Statistics

	Variable	Definition	Obs.	Mean	Std. Dev.	Min	Max
Household Food	HFIAS	Household food insecurity access score	4308	2.036	3.938	0	23
	Copping strategies	=1 if adopted at least one coping strategy, otherwise 0	4217	.2419	.428	0	1
Role of women	Livelihood Activities	=1 No livelihood activity, otherwise 0	4314	.366	.4817	0	1
	No livelihood		4314	.010	.097	0	1
	Farming	=1 farmer, otherwise 0	4314	.426	.495	0	1
	Petty Retailing	=1 petty retailer, otherwise 0	4314	.125	.331	0	1
	Vocation	=1 vocation, otherwise 0	4314	.074	.262	0	1
	Wage Employed	=1 wage employed, otherwise 0					
	Willing to take risk	=1 willing to take risk , otherwise 0	4,217	.962	.191	0	1
	Age in years	Age in years as a continuous variable	4,217	26.825	5.508	18	44
	Education	Completed years of schooling	4314	7.3141	4.477	0	16
	Woman's Income	Total monthly income in Ghana Cedis	4314	78.957	176.59	0	3600
Household characteristics	Household Size	Total number of household members	4314	4.583	2.270	1	18
	Social Capital	Number of groups household members belong to	4314	.791	.775	0	6
	Household head	=1 if male household head, otherwise 0	4302	.727	.445	0	1
	Education of head	Completed years of schooling	4314	14.779	3.486	0	16
	Under 5 years	Total number of children under 5 years	4217	.9182	.751	0	4
	Dependency ratio	Ratio of dependants and non-dependants	4,312	.902	.765	0	8
	Net household income	Continuous measure of total household monthly income less monthly income of the woman	4217	213.153	442.20	0	15555
	Asset index	Continuous measure of household wealth	4308	-.0002	.997	-3.16	2.2206
	Livestock Unit	Total number of small livestock owned	4293	.140	.573	0	12.6
	Household farm	=1 if household owns a farmland, otherwise 0	4314	.1963	.397	0	1
	Household enterprise	=1 if household operates an enterprise, otherwise 0	4314	.774	.418	0	1

4.4.2 Econometric Specifications

Effect of Risk Behaviour of Women on Household Food Insecurity

For i = 1, 2,…, N households and t = 1, 2, 3 and 4 rounds of data collection, this study evaluated the effect of women's risk taking propensity on household food insecurity using the panel data specifications below,

$$HFIAS_{it} = \beta_0 + \beta_1 WTR_{it} + \beta_2 X_{it} + h_i + \varepsilon_{it} \quad [4.12]$$

where $HFIAS_{it}$ is a continuous dependent variable representing household food insecurity access score, for household i at time t ; WTR_{it} is an indicator of a woman's willingness to engage in risk ($WTR_i = 1$ if an individual is willing to engage in risk, otherwise, 0). To improve the precision of the estimates, a vector of covariates, X_{it}, is included, comprising of women's specific variables (livelihood activities, income, education, and age) and household level variables (education of household head, net income, asset index, livestock ownership, household size, gender of household head, dependency ratio, farming ownership, social capital, and enterprise ownership). The parameters h_i and ε_{it} capture unobserved individual heterogeneity and random error terms, respectively.

Equation [4.12] could be estimated by means of pooled OLS. It is worth noting, however, that the pooled model ignores household heterogeneity, and this could lead to wrong conclusions. With the assumption of exogeneity, the error term is assumed to have zero mean conditional on past, current, and future values of the regressors. Strong exogeneity rules out models with lagged dependent variables or with endogenous variables as regressors (Cameron and Trivedi, 2009). Therefore, a fixed or random effect estimation is ideal. If individual heterogeneity term, h_i, is not correlated with the regressors, a random effects model is estimated. On the other hand, where,h_i, is correlated with the regressors, then a fixed effects model is preferable. Consequently, a Hausman test[40] is run to choose between random effect and fixed effects. A rejection of the null hypothesis of "no correlation between regressors and individual effects", favours the fixed effects model.

It is important to note that either the random or the fixed effects may yield biased results in the presence of endogeneity. Household food insecurity may affect income-earning capabilities, which may intend

[40] H0: Regressors and effects (heterogeneity) are not correlated; H1: They are correlated
Under H0 the Hausman test statistic is distributed as a Chi-Square random variable with degrees of freedom equal to the number of regressors. The formula of the Hausman test statistic is $H = (\hat{\beta}_{FEM} - \hat{\beta}_{REM})' V^{-1} (\hat{\beta}_{FEM} - \hat{\beta}_{REM})$; Where $\hat{\beta}_{FEM}$ and $\hat{\beta}_{REM}$ are the fixed and random effects estimators respectively, and $V = Var\ (\hat{\beta}_{FEM}) - Var\ (\hat{\beta}_{REM})$

affect food insecurity. Also, past household food insecurity may influence current and future food insecurity. Hence, there is the possibility of endogeneity arising from reverse causality, and therefore the Generalised Methods of Moment (GMM) instrumental variable approach is a preferable estimation technique in this case. Because household food insecurity is persistent, it is important to include in the estimation past levels of food insecurity (lagged dependent variable), which will then resolve the autocorrelation problem. Therefore, the usual individual-specific effects panel data model is considered, but in this case the regressors include the dependent variable lagged once, resulting in a dynamic model. Consequently, the parameters of the following dynamic GMM model are estimated:

$$HFIAS_{it} = \beta_0 + \alpha HFIAS_{it-1} + \beta_1 WTR_{it} + \beta_2 X_{it} + h_i + \varepsilon_{it} \quad [4.13]$$

Note that even if h_i is a random effect, estimating the models by OLS leads to inconsistent estimation of the parameters, α andβ. This is because the lagged dependent variable, $HFIAS_{it-1}$, is correlated with the unobserved individual-level effect, h_i , and hence, with the composite error term ($h_i + \varepsilon_{it}$). Removing h_i by the within transformation (removing the panel-level means) produces an inconsistent estimator with T fixed, even in the case of random effects model. Therefore, alternative estimators are needed even with random effects. An instrumental variable variant estimator such as the Arellano–Bond Estimator (Arellano and Bond, 1991) that uses lags as instruments leads to consistent estimates.

According to Roodman (2009), the Arellano–Bond Estimator is designed for situations with many individuals (large N) and few time periods (small T); a linear functional relationship and one left-hand-side variable that is dynamic, depending on its own past realizations. Other characteristics of the Arellano–Bond Estimator include, independent variables that are not strictly exogenous (correlated with past and current realizations of the error); fixed individual effects (unobserved heterogeneity); and heteroskedasticity and autocorrelation within individual units errors but not across them.

Both sides of equations [4.13] are first differenced, after which the dynamic panel Arellano–Bond GMM estimator is applied. Following Arellano and Bond (1991), moment conditions are created using lagged levels of the dependent variables with first differences of the errors, as well as first-differences of strictly exogenous covariates. The first difference transformation removes both the constant term and the individual effect:

$$\Delta HFIAS_{it} = \alpha \Delta HFIAS_{it-1} + \beta_1 \Delta WTR_{it} + \beta_2 \Delta X_{it} + \Delta \varepsilon_{it} \quad [4.14]$$

Note that the lagged dependent variable ($HFIAS_{it-1}$) in $\Delta HFIAS_{it-1}$ is a function of the lagged error term (ε_{it-1}), which is also in$\Delta\varepsilon_{it}$. Hence, $\Delta HFIAS_{it-1}$ is correlated with $\Delta\varepsilon_{it}$.

As suggested by Arellano and Bond (1991), equation (4.14) is estimated using the instrumental variables estimator with the lagged dependent variable, $HFIAS_{it-2}$, as an instrument either in the form of differences or lagged levels ($HFIAS_{it-1} - HFIAS_{it-2}$), respectively. $HFIAS_{it-2}$ is a good instrument because it is correlated with $HFIAS_{it-1} - HFIAS_{it-2}$, but uncorrelated with $\varepsilon_{it} - \varepsilon_{it-1}$, assuming the errors (ε_{it}) are serially uncorrelated. The instruments include suitable lags of the levels of endogenous variables, which enter the equation in differenced form, as well as the strictly exogenous regressors, and others that may be specified (Baum, 2006).

The overall appropriateness of the instruments can be verified by a Difference in Hansen test for over-identifying restrictions (Kollamparambil 2017). If the Hansen (1982) J test statistic for over-identifying restrictions holds (the null hypothesis that the model and over-identifying conditions are correctly specified), then the statistic is $\chi 2$ with degrees of freedom equal to the degree of over-identification, j − k. Also, aside from the Hansen test, the Arellano– Bond (1991) autocorrelation test of no serial correlation in the first-differenced disturbances also needs to be carried out.

Effect of Risk Behaviour on Household Food Insecurity Coping Strategies

It is assumed that coping strategies will need to be adopted if the household is not able to smooth consumption in any other way. Hence, this section looks at the econometric specifications for the effect of risk behaviour on household food insecurity coping strategies.

a) Likelihood of Adopting Food Insecurity Coping Strategy (HFICS)

The decision to adopt a particular coping strategy is mostly determined by the person responsible for purchasing, preparing, distributing, and managing food in the household, and this happens to be the mother (woman) of the household. The study assumes that adoption of a food insecurity coping strategy or otherwise, depends on the risk behaviour (WTR) of the woman mainly responsible for food purchases and meals preparation in the household, as well as individual and household characteristics X. Because the decision to adopt coping strategies or otherwise is binary, the basic econometric estimation framework to model the effect of risk-seeking behaviour on the decision to adopt food insecurity coping strategy is indicated in equation [4.15] below:

$$HFICS_{it}^{*} = \alpha + \beta WTR_{it} + \gamma X_{it}^{'} + u_{it} \quad ; \quad u \approx N[0, \sigma^2], \sigma^2 = 1 \qquad [4.15]$$

Where; $HFICS_{ij}^{*}$ is binary dependent variable, with 1 indicating the decision to adopt food insecurity coping strategy, 0 otherwise. WTR_{it} is a dummy variable indicating risk-seeking behaviour of the woman (WTR_{it}=1 if willing to engage in risk, otherwise, 0). The coefficient β measures the effect of risk taking propensity on food insecurity coping strategy. This study assumes that savings is a latent variable and is the mechanism through which risk behaviour influences the decision to adopt a coping strategy. X', represents a vector of control variables - individual, household and other characteristics believed to influence food insecurity coping strategies. The parameter γ signifies the strength of the impact of the control variables; α and u_i are the intercept and error term, respectively. The error term is normally distributed and is independent of the covariates, summarising all unobserved factors that affect risk-taking propensity with mean zero and a unity variance.

Now, in modelling, the probability that a woman's risk propensity influences her households' adoption of coping strategies, a consistent estimation technique is the Probit regression estimation, because it is a Maximum Likelihood Estimator (MLE). Hence, for i = 1, 2,…, N households and t = 1, 2, 3 and 4 rounds of data collection, and with the assumption of a standard normal distribution function (Φ) of the error term, ε_i , a panel Probit regression is used to estimate the effect of women's risk behaviour on the likelihood that a household adopts food insecurity coping strategies:

$$\Pr(HFICS_{it} = 1 \mid WTR_{it}) = \phi(\alpha + \beta WTR_{it}) \qquad [4.16]$$

The log likelihood for each observation, i, is a function of the k x 1 vector of parameters, which may be written as:

$$l_i(\theta) = HFICS_{it} \log[\phi(\alpha + \beta WTR_{it})] + [1 - HFICS_{it}] \log[1 - \phi(\alpha + \beta WTR_{it})] \qquad [4.17]$$

The aim here is to determine the effect on the response probability, $\Pr(HFICS_{it} = 1 \mid WTR_{it})$, resulting from a change in risk propensity of women. In the Probit model, the coefficient of *WTR* has a qualitative effect on *HFICS*. Therefore, quantitative predictions are made only based on the marginal effects of the regressors, which are not equal to the coefficient. The marginal effects is given by

$$\frac{\partial \Pr(HFICS_{it} = 1 \mid WTR_{it})}{\partial WTR_{it}} = \phi(WTR_{it})\beta \qquad [4.18]$$

Where, ϕ, is the Cumulative Distribution Function (CDF) of the normal distribution.

b) Number of Household Food Insecurity Coping Strategies Adopted (NHFICS)

The decision to resort to coping strategies during food insecurity episodes may result in more than one possible multinomial outcomes, which are not mutually exclusive. Therefore, households can adopt as many coping strategies as they wish, out of the five mentioned previously. Hence, in this case the outcome of interest (dependent variable) is a non-negative integer or count: the total number of coping strategies adopted by a household. The effect of risk propensity of women on the number of food insecurity coping strategies adopted for i = 1, 2,…, N households and t = 1, 2, 3 and 4 rounds of data collection is captured in equation [4.19]

$$NHFICS_{it}^{*} = \beta WTR_{it} + \gamma X_{it}^{'} + \varepsilon_{it} \quad ; \quad \varepsilon \approx N[0, \sigma^2], \sigma^2 = 1 \qquad [4.19]$$

Where, $NHFISC_{it}^{*}$ is the number of coping strategies adopted. All the other variables (β , WTR, γ $X^{'}$ and ε_i) are as explained earlier.

Because the depend variable (the number of coping strategies) is a count variable, the parameters of the model are estimated using a Poisson regression.

c) Type of Household Food Insecurity Coping Strategies Adopted (THFICS)

Some coping strategies are more drastic than others are. Therefore, the coping strategies adopted by households are ranked based on how drastic that strategy is relative to other strategies. Hence, an ordered measure of coping strategy type is used as a dependent variable to investigate the effect of risk behaviour on the type of coping strategies. As before, the effect of risk behaviour on the type of food insecurity coping strategies adopted could be expressed in terms of a latent response, for i = 1, 2,…, N households and t = 1, 2, 3 and 4 rounds of data collection as captured in equation [4.23]

$$THFICS_{it}^{*} = \beta WTR_{it} + \gamma X_{it}^{'} + \varepsilon_{it} \quad ; \quad \varepsilon \approx N[0, \sigma^2], \sigma^2 = 1 \qquad [4.23]$$

where , $THFISC_{it}^{*}$ is unobserved or latent ordered type of coping strategies adopted, ranging from 0 to 3, where 0 means, non-adoption of coping strategy, 1 means least drastic coping strategy (all strategies other than limiting adult food intake to feed children) and 2 indicates most drastic strategy (on assumption that limiting adult food intake to feed children is the most drastic form). Hence, the higher

the rank the more drastic the coping strategy is. All the other variables (β , WTR, γ , X' and ε_i are as explained earlier.

Because $THFISC_{it}^{*}$ is not directly observed, but only the range in which it falls, observed ordinal responses are generated from the latent response such that:

$$THFICS_{it} = \begin{cases} 0 \text{ if } THFICS_{it}^{*} \le \mu_0 & \text{No coping strategy} \\ 1 \text{ if } \mu_0 < THFICS_{it}^{*} \le \mu_1 & \text{Less drastic coping strategy} \\ 2 \text{ if } THFICS_{it}^{*} \ge \mu_1 & \text{More drastic strategy} \end{cases} \quad [4.24]$$

Two (2) threshold points (μ 's) to be estimated with β, because there are three (3) ordered measure of the type of coping strategies. Therefore, the range of values of $THFICS_{it}*$ are divided into intervals of 0, 1 and 2, analogous to a household moving from adopting no coping strategy to the most preferred coping strategy. The probability of observing outcome μ_{it} for $THFICS_{it}*$ is generally given by

$$\Pr(THFICS_{it} = j \mid WTR_{it}) = 1 - \phi(\mu_{j-1} - \beta WTR_{it}) \quad [4.275$$

Where, all variables (*THFICS, WTR, j and Φ)* are as defined earlier.

The parameters of the model will be estimated using a Panel Ordered Probit regression, and quantitative predictions reported based on the marginal effects given as:

$$\frac{\partial \Pr(THFICS_{it} = j \mid WTR_{it})}{\partial WTR_{it}} = -\phi(\beta WTR_{it})\beta \quad [4.26]$$

4.4.3 Definition of Variables and Expected Signs

Dependent Variables.

Household Food Insecurity Access Score (HFIAS): Following Maxwell et al. (1996) and Coates et al. (2007), this study measured food insecurity using the Household Food Insecurity Access Score (HFIAS). HFIAS is a continuous measure of the degree of food insecurity in the household, and is based on a set of nine questions that encompass three domains of food insecurity: (1) anxiety and uncertainty about the household food supply; (2) insufficient quality; and (3) insufficient food intake and its physical consequences (Coates et al., 2007). For each of the nine questions, the survey respondent indicated whether her household experienced the food insecurity symptom in the previous four weeks (one month). If yes, the respondent indicated how frequently the specific symptom was experienced, where 'rarely'= 1-2 times in the past four weeks, 'sometimes'= 3-10 times in the past

four weeks, and 'often' = more than 10 times in the past four weeks. Each household receives a score from 0-27 based on a simple sum of the frequency of occurrence of each food insecurity symptom, where 'never'= 0 points, 'rarely'=1 point, 'sometimes'=2 points, and 'often'= 3 points. The higher the HFIAS, the higher the degree of household food insecurity and vice versa.

Household Food Insecurity Coping Strategies (HFICS): Food insecure households adopt at least one coping strategy or the other. To assess strategies used to cope with insufficient food, households were asked how often, in the past four weeks preceding the survey they resorted to any of the five coping strategies identified earlier. The respondent indicated how frequently each strategy was relied upon four weeks preceding the survey, where 'rarely' = 1-2 times, 'sometimes' = 3-10 times, 'often' = more than 10. For the purposes of this study, a binary measure of coping strategy adoption is used, where, 1 means a household resorted to at least one of the food insecurity coping strategies and 0 implies the household never resorted to any coping strategy (by implication food secure).

Number of Household Food Insecurity Coping Strategies (NHFICS): As indicated earlier, an individual household may decide to resort to more than one coping strategies that are not mutually exclusive. For instance, whereas one household may resort to one coping strategy, another may adopt three strategies to cope with food insecurity. Hence, the number of food insecurity coping strategies is a simple sum of the total number of coping strategies adopted by the household. If a household resort to no strategy (in this case food secure), then the household is assigned a value of zero (0). But when the household adopts a coping strategy, say, 1, 2,…., N then a value of 1 is assigned for each of those 'N' coping strategies. Hence, the dependent variable (the number of coping strategies) ranges from 0 to 5, where 0 means non-adoption of coping strategy, 1 indicates resorting to just one strategy, 2 means adopting two strategies, 3 for three strategies in that order. Thus, the higher the rank the more coping strategies adopted by a household.

Type of Household Food Insecurity Coping Strategy (THFICS): Usually, households choose among a set of options for coping during food insecurity situations. As shown earlier, in this study households adopt 5 main coping strategies, namely borrowing food or money to buy food, buying food on credit, eating elsewhere, begging for food or money to buy food and lastly, limiting adult food intake to feed children. Indeed, some coping strategies may be more drastic than others may be, and in making the choices of which coping strategy to adopt, households do take into consideration the extent of severity of a particular coping strategy. The coping strategies are ranked with the assumption that limiting adult food intake for children is the most drastic form of coping strategy, relative to the other coping

strategies. This is because in very sever or worse situations, if all the other options fail, the elderly in the households would forgo or limit their regular meals in other to ensure children are adequately fed. For the purposes of this study, an ordered measure of coping strategy is used, where; 0 implies no coping strategy, 1 for all strategies other than limiting adult food intake to feed children and 2 means limiting adult food intake to feed children (on assumption that limiting food is the most drastic form).

Main Explanatory Variables: Risk Behaviour of Women

Risk Behaviour: a woman's risk behaviour is measured as her willingness to engage in risk (WTR) in the risk aversion game with real monetary pay-offs. As explained earlier, an individual's decision to bet or not to bet in the risk behaviour game in itself could be seen as evidence of risk behaviour. Hence, in this study, risk behaviour is a binary or dichotomous variable, where; WTR=1 if the subject is willing to engage in risk, otherwise WTR=0. It is believed that risk averse people save to guard against uncertainty and to ensure consumption smoothening. Hence, in order to moderate the uncertainty and unpredictability in access to food, individuals, and or households may choose to give up some consumption today and rather choose to save to avert future food insecurity. However, because risk-loving women are less likely to have precautionary savings, they are expected to have poor consumption smoothing. Thus, the study hypothesised that if a woman is willing to engage in risk she is more likely to contribute positively to her household's food insecurity. Therefore, a positive effect of risk taking propensity on food insecurity and coping strategies is expected.

Control Variables

The control variables used in this study include women's specific variables (livelihood activities, age and age-squared, monthly income, and education) household level characteristics (gender of head, education of head, household size, net income, dependency ratio, asset index, children under 5 years, total livestock unit, ownership of farm and ownership of enterprise) and other (past food insecurity/hunger). Unless otherwise specified, these variables are included in both the food insecurity and coping strategy estimations.

Livelihood Activities: As explained in Chapter Three of this thesis, this study identified and grouped livelihoods activities into five namely, farming, petty retailing, vocation, paid employment and no livelihood activity (unemployed). Farming involves subsistence food crop cultivation; Petty retailers are those whose livelihood activities are mainly into buying and selling of small consumable and non-durable items. Vocation primarily involve self-employed professional or vocational work such as seamstress and beauticians (hairdressing, pedicure and manicure); and wage employed are those in

either formal or informal livelihoods (nurses, teachers, labourers, factory hand etc.). Lastly, no livelihood constitutes unemployed women who do not engage in any livelihood activity. Livelihood activities are defined as dummies, with 1 indicating if the woman engages in a particular livelihood activity, otherwise 0. Because the unemployed do not engage in any livelihood activity, they lack the means to contribute to the food needs of the household. Hence, a positive association between having no livelihood (unemployment) and household food insecurity is expected. If a woman engages in farming it is expected that she would contribute directly to household food needs by bringing home the food produced from her farm or by selling some of the farm produce to earn income to buy food. Similarly, if a woman is engaged in other livelihoods, it is expected that she would earn income and then use the money to purchase food for her household. Consequently, any of the livelihood activities a woman engages in are expected to influence household food insecurity negatively, i.e. lead to a greater food security. The concept of livelihood activities is not included in the coping strategies model.

Income: This is a continuous variable measuring the total monthly income of the woman. All things being equal, a woman's income is expected to contribute to reducing household food insecurity. This is because having more income means she could purchase prepared food or buy ingredients to prepare the food to feed her household. A negative effect is therefore expected.

Education: Education is measured as a continuous variable indicating the number of completed years of schooling. As a form of human capital, education empowers women to gain employment and for that matter get money to contribute to household food needs. It also provides women with knowledge in food planning and management. Consequently, a negative effect of a women's education on household food insecurity, as well as on food insecurity coping strategies is expected.

Age and Age-squared: The older a woman, the more experience she has in planning and managing food resources in the household. Besides, as an individual ages, she accumulates wealth through time that would enable her to make significant contributions to household food needs. In this regard, age is expected to have a negative effect on food insecurity and coping strategies. However, as women age, they may not be able to participate very actively in different income generating activities, which hitherto could bring in more income and in turn help the household to access food. Therefore, a positive relationship is expected between age-squared and the dependent variables. Hence, a u-shaped relationship for age/age-squared is hypothesised.

Gender of household head: A dummy variable is used to represent gender of the household head (=1 if male household head, 0 otherwise). Mixed result (either positive or negative) is expected for gender of household head.

Household Head's Education: The household head's education is measured as a continuous variable indicating the number of completed years of schooling. A negative relationship is expected for household heads education and food insecurity.

Household size: This refers to the number of people living in a household. An increase in the number of household members means more mouth to feed, and therefore more pressure on food. Hence, a positive relationship between household size and food insecurity and coping strategy adoption is hypothesized.

Dependency ratio: The dependency ratio is defined as the number of household members who are 15 years old and younger plus the number of members aged 65 and over (the inactive group) divided by the number of household members aged between 16 and 64(the active). A high dependency ratio implies more burden on the few working members of the household who provide for the food needs of the household. Thus, dependency ratio is a measure of pressure on productive household members, and hence, a positive effect is expected.

Children under 5: This refers to the number of household members under the age of 5. One of the food insecurity coping strategies specifically focuses on children. Hence, this variable (children under 5) is used only in the coping strategies model. The more children under the age of 5 years a household has, the more the pressure on the few adult who are working to provide for the food needs of the household. Therefore, the more likely the household will adopt child specific coping strategies. A positive sign for children under 5 years is expected.

Asset Index: Asset index is constructed for each household based on the ownership of a set of assets including radio, television, refrigerator, cell phone, and stove, lighting source, drinking water supply, sanitation facilities, and flooring materials. Household ownership of these assets is combined into an index (with a mean of zero and standard deviation of one) using principal components analysis (Vyas and Kumaranayake 2006). Asset indicates wealth; therefore, a negative effect is predicted.

Small total livestock unit: A composite measure of household livestock ownership is constructed by converting 'small' livestock owned by a household to livestock units. Livestock units are calculated by generating a weighted sum (determined by feeding requirement) of the number of animals owned (FAO 2003). The 'small' livestock includes sheep, goats, pigs, chickens, and rabbits; the following weights identified by the FAO as relevant for Sub-Saharan Africa are used in the calculation of the total livestock units: sheep (0.1), goats (0.1), pigs (0.2), chickens (0.01), and rabbits (0.02). A household's livestock ownership contributes to the household source of supplementary food and income, and in some instances a means of coping strategy during crop failure and other shocks. Thus, households with a greater number of livestock are less prone to food insecurity. Therefore, a negative effect of livestock unit on household food insecurity and coping strategies is predicted.

Household net income: This is a continuous variable measured as total household monthly income less monthly income of the woman. Household net income is also expected to reduce food insecurity, as well as adoption of coping strategy.

Household Social capital: In this study, social capital is measured as a continuous variable, indicating the total number of groups or associations household members belong to. Social capital serves as a form of support network because people can fall back on their network for support in times of food insecurity. Therefore, a negative sign is expected.

Household Farm: This is a dummy variable for household ownership of a farm, where 1 indicates the household owns a farm, otherwise 0. Farm ownership is hypothesised to have a negative effect on food insecurity and coping strategies. This is because households owning a farm would cultivate various crops and hence, produce food to feed the members, compared with those with no farm.

Household Enterprise: A dummy variable is used to represent household ownership of an enterprise (1 if the respondent's household owns an enterprise, 0 otherwise). The study also would expect household enterprise ownership to have a negative effect on food insecurity, because the money accrued from the enterprise could be used to purchase food to feed the household.

Past food insecurity: This is a lagged dependent variable of household food insecurity. Hence, this variable is only in the GMM model. A positive sign is predicted for past food insecurity, because it is expected that previous episodes of food insecurity will influence current status.

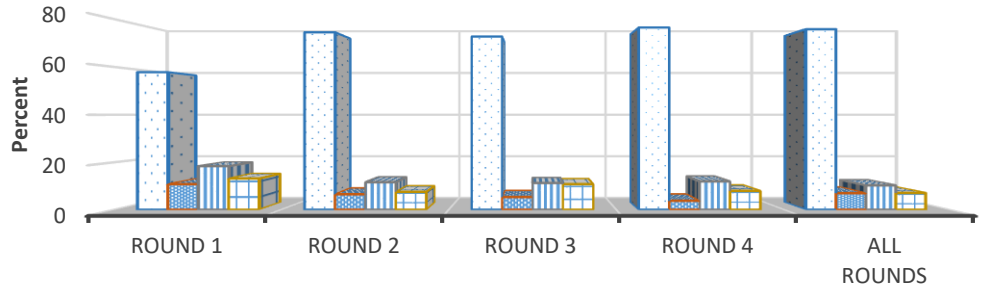
4.5 Results and Discussion

4.5.1 Distribution of Household Food Insecurity and Coping Strategies

Household Food Insecurity Access Prevalence (HFIAP)

One key indicator of household food insecurity is the Household Food Insecurity Access Prevalence (HFIAP), which is a categorical indicator of Food Insecurity Status (Coates et al., 2007). Following Coates et al (2007)[41], households are categorized into four levels of food insecurity using the HFIAP indicator: (1) food secure, (2) mildly food insecure, (3) moderately food insecure, and (4) severely food insecure. Severely food insecure households respond affirmatively to more severe conditions and/or experience those conditions more frequently. On the whole and across rounds of data collection, it is evident from Figure 4.1 that around 24 percent of sampled households were food insecure, with approximately 7 percent severely food insecure.

Figure 4.1 Household Food Insecurity Access Prevalence (HFIAP)



	Round 1	Round 2	Round 3	Round 4	All rounds
% Food secure	57,82	74,52	72,75	76,52	75,81
% Mildly food insecure	10,74	6,46	5,31	3,71	6,91
% Moderately food insecure	18,33	11,54	11,21	11,91	10,24
% Severely food insecure	13,11	7,48	10,72	7,87	7,04

Household Food Insecurity Access Score (HFIAS)

[41] According to Caotes et al (2007) *food secure household*s experience none of the food insecurity conditions, or just experiences worry, but rarely. *Mildly food insecure households* worry about not having enough food sometimes or often, and/or are unable to eat preferred foods, and/or eat a more monotonous diet than desired and/or some foods considered undesirable, but only rarely. But they do not cut back on quantity nor experience any of three most severe conditions (running out of food, going to bed hungry, or going a whole day and night without eating). *Moderately food insecure households* sacrifice quality more frequently, by eating a monotonous diet or undesirable foods sometimes or often, and/or have started to cut back on quantity by reducing the size of meals or number of meals, rarely or sometimes. But they do not experience any of the three most severe conditions. *Severely food insecure households* have graduated to cutting back on meal size or number of meals often, and/or experience any of the three most severe conditions (running out of food, going to bed hungry, or going a whole day and night without eating).

As indicated earlier, HFIAS is a continuous measure of the degree of food insecurity in the household, with a higher score indicating higher degree of household food insecurity. Because the average HFIAS is a continuous variable, it is more sensitive to capturing smaller increments of changes over time than the HFIAP indicator (Coates et al. 2007). Table 4.2 summarizes the HFIAS by round of data collection. Across all rounds, the HFIAS ranged from 0 to 23, with the highest occurring in the 3rd round. Although some households had high scores, generally, households experienced low food insecurity, with an overall average score of 2.04.

Table 4.2 Household Food Insecurity Access Score (HFIAS)

Round	Obs.	Mean	Std. Dev.	Min	Max
1	1,304	2.611196	4.249498	0	22
2	1,083	1.635272	3.522955	0	20
3	1,033	2.008712	4.085677	0	23
4	888	1.713964	3.666378	0	18
All	4,308	2.036444	3.938442	0	23

Household Food Insecurity Coping Strategies

Another way to measure food insecurity is by assessing household responses to insufficient food supplies (Maxwell et al. 1999). In order to lessen the burden of food insecurity, households often adopt as many coping strategies as possible, because the coping strategies are not mutually exclusive. It is evident from Figure 4.2 below that approximately 24 percent of households adopted at least one coping strategy. This is in accord with Figure 4.1, which shows that 24 percent of households are food insecure. It is evident from Figure 4.2 that households resorted to diversified coping strategies; however, the proportion of households adopting more coping strategies decreases as you move from one (1) to five (5) strategies. Precisely, whereas approximately 13.8 percent of household resorted to one coping strategy, around 3.0 percent and 0.2 percent adopted three and five coping strategies, respectively. It is assumed that the number of coping strategies adopted is indicative of the degree of household food insecurity, implying that severely food insecure households are more likely to adopt more coping strategies to lessen the burden of food insecurity.

Figure 4.2 The Number of Coping Strategies Adopted

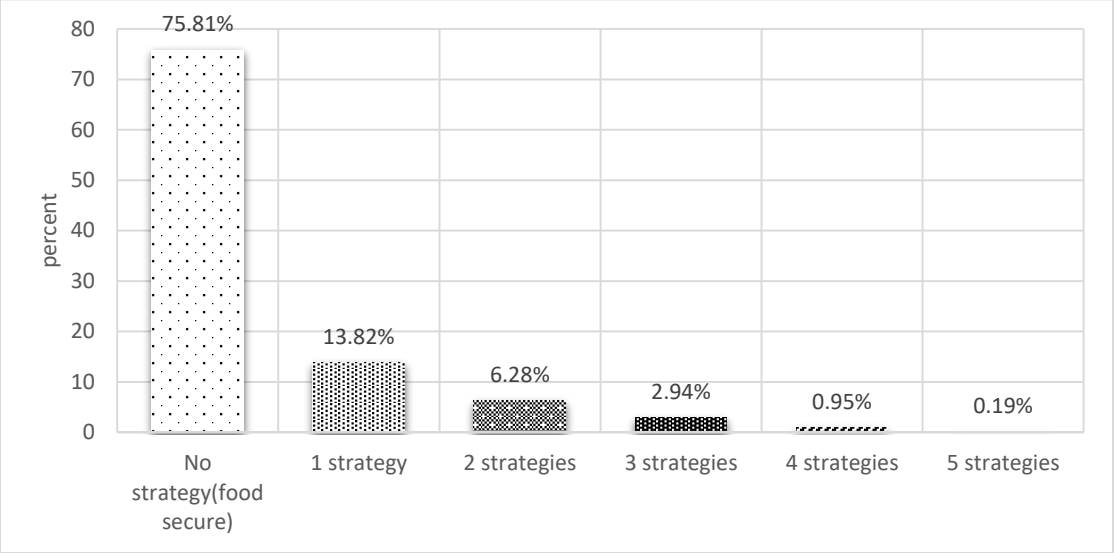
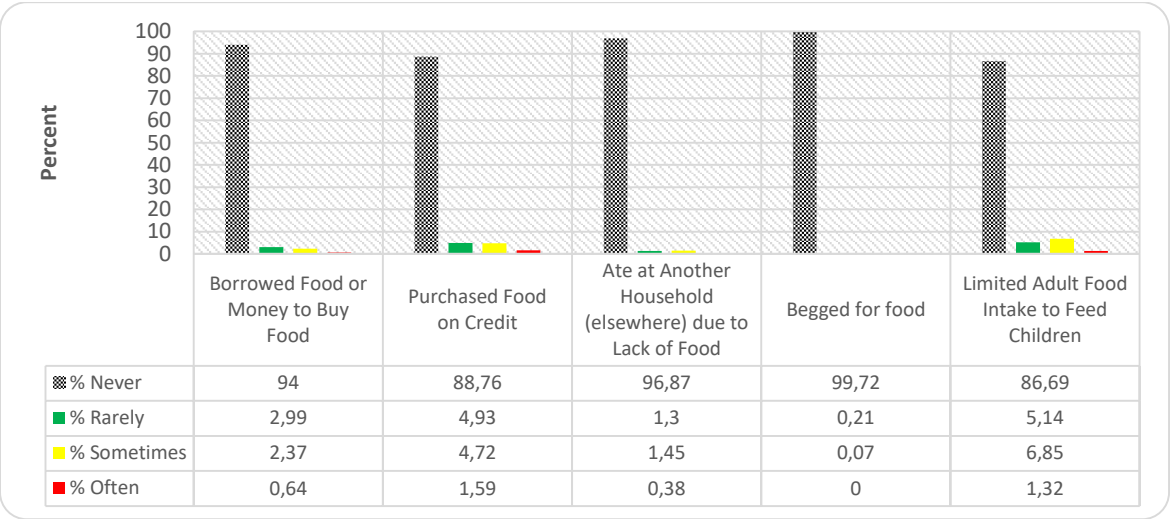


Figure 4.3 below shows the percentage of households that relied on each specific coping strategy identified in the study. Overall, few households indicated relying on any of the strategies to cope with insufficient food supplies. This is not surprising because household food insecurity episodes are generally low among the sampled households. The most common coping strategy adopted is limiting adult food intake to feed children in the household (13 percent). This points to the value households place on taken care of children's food needs. This is followed by purchasing food on credit (11 percent), borrowing food or money to buy food (6percent) and eating at another household (3percent). With less than 1percent, the least common strategy households rely on is begging for food (0.28 percent). Earlier studies (Maxwell et al 2000; Quaye 2008; Kuwornu et al 2012 and Chagoma et al 2016) also reported similar coping strategies. Table 4.9 in the appendix shows the percentage of households who relied on each of the five coping strategies at each round of data collection.

Figure 4.3 Household Food Insecurity Coping strategies



	Borrowed Food or Money to Buy Food	Purchased Food on Credit	Ate at Another Household (elsewhere) due to Lack of Food	Begged for food	Limited Adult Food Intake to Feed Children
% Never	94	88,76	96,87	99,72	86,69
% Rarely	2,99	4,93	1,3	0,21	5,14
% Sometimes	2,37	4,72	1,45	0,07	6,85
% Often	0,64	1,59	0,38	0	1,32

*Note: sample for limit adult food intake to feed children, is composed of households with at least one child under age 18.

4.5.2 Estimation Issues

Before presenting the regression results, it is worth highlighting some key estimations issues. The details are outlined below.

Assumption of constant risk behaviour: Chuang and Schechter (2015) note that, theoretically, individual preferences are assumed constant; and if preferences do vary over time, then it is because of shocks faced by the individual. Empirically, a number of studies report stable risk preferences (Andersen et al. 2008; Chuang and Schechter 2015; Drichoutis and Vassilopoulos 2016). For instance, in a field experiment to examine temporal stability of risk preferences, Andersen et al. (2008) reported that generally risk attitudes did not change over a 17-month span after a repeated risk aversion elicitation task. Also, in a panel of subjects over a three-year period, Drichoutis and Vassilopoulos (2016) found aggregate stability of six measures of risk over time, and also showed remarkably high individual stability over the examined period. Thus, in concert with the theoretical assumptions and earlier studies, this current study assumes that a woman's risk-taking propensity is the same across the entire period of data collection. Again, the assumption of constant risk over time could be seen in the light of the relationship between risk behaviour and religious affiliation. It is worth noting that religious affiliation, which is typically constant over time, is a relevant instrument for risk-taking propensity. Individuals are born into various religious groups, and most often do not change such affiliations. Indeed, the effect of religious conditioning is strong and lifelong; hence, individuals are forever bound and influenced by religious teachings and tenets. Results from Chapter Two of this thesis show that generally religion influences risk behaviour. Therefore, to the extent that religion is lifelong, and

individuals generally do not change their religion of birth, it is reasonable to assume that risk behaviour would be constant over time. By design, the Willingness to Take Risk data was collected once, but all the other data were collected over time (4 periods). Therefore, assuming stability of individual risk preference[42] in this study will allow for exploring the panel structure of the data, and hence, the dynamics in household food insecurity.

Estimation techniques: Table 4.3 presents multivariate regression results for the effect of risk behaviour of women on household food insecurity. Columns 1, 2, and 3 of Table 4.3 show the OLS, random effects, and dynamic GMM results, respectively. The pooled OLS ignores household heterogeneity, and problems of heteroscedasticity, as well as autocorrelation, and this might lead to wrong conclusions and biased estimates. Hence, the random effects (Model 2) can be considered as an improvement over the OLS (Model 1). The Breusch and Pagan Lagrangian Multiplier test indicates the random effects model (Model 2) is chosen over the pooled OLS regression (Model 1). It is, however, worth noting that the OLS and Random Effect Models yield very similar estimates. Because the main variable of interest is risk-taking propensity, which is time- invariant, and because in transforming the data, fixed effect wipes out all time-invariant variables, it is not possible to estimate fixed effects. Therefore, in this study, the Random Effect Model is reported instead. It is worth acknowledging that the Random Effect Model may yield biased results in the presence of endogeneity arising from reverse causality. Household food insecurity may affect income-earning capabilities, which may intend affect food insecurity. Additionally, past household food insecurity may influence current and future food insecurity. Consequently, the Generalised Methods of Moment (GMM) instrumental variable approach (Column 4) is considered a better estimate. The Hansen J test statistic is not significant, indicating the overall validity of the instruments, and also validates the use of system GMM estimation over difference GMM. Besides, the significant and positive coefficient of the lagged dependent variables of household food insecurity validates the persistent nature of household food insecurity.

Isolating causal effect: The relationship between risk behaviour and food insecurity as well as coping strategies is believed to be causal. As stated earlier, the first paper (Chapter 2) of this thesis, which used the same sample as in this current study, examined the effect of religion on risk behaviour, and established that religious affiliation strongly ($p<0.01$) influences a woman's willingness to take risk.

[42] Stability of risk preferences implies that one should observe the same willingness to take risks when measuring an individual's risk preferences repeatedly over time (Golsteyn and Schildberg-Hörisch 2017).

Hence, in attempting to isolate the causal effect of risk behaviour of women on food insecurity and coping strategies, *religion* is used as an instrument for *WTR*. Hence, to check for endogeneity, instrumental variable regression (ivregress) for the food insecurity and the instrumental variable Probit (ivProbit) for the coping strategies are estimated. The Durbin (score) and the Wu-Hausman indicator test for exogeneity of risk- taking propensity in the instrumental variable regression (ivregress) as presented in Table 4.8 in the appendix are not significant for food insecurity (Durbin score : p = 0.9974 ; Wu-Hausman F(1,3954) = .00001 , p = 0.9974). Additionally, the Wald test of rho (p)=0) show that Athrho is insignificant for decision to adopt a coping strategy (Table 4.9 in appendix: [chi2(1) = 2.16 , Prob > chi2 = 0.1418]) and the type of coping strategies (Table 4.10 in appendix : [chi2(1) = 2.32 , Prob > chi2 = 0.1279 ; chi2(1) = 1.10 , Prob > chi2 = 0.2948 ; chi2(1) = 1.52 Prob > chi2 = 0.2179]). Consequently, the study failed to reject the null hypothesis of exogeneity of risk- taking propensity.

4.5.3 Regression Results

Effect of Risk Behaviour of Women on Household Food Insecurity

It is interesting to note from Table 4.3 that although the system GMM yields better estimates because it takes into account endogeneity, all the regression estimations (OLS, RE and GMM) show a positive and statistically significant effect of risk behaviour on household food insecurity. The system GMM results (Column 3) indicate that if a woman is willing to engage in risk, she contributes to increasing her household's food insecurity by around 72 percentage points, *ceteris paribus*. This result is not surprising because, as explained earlier, women with high-risk propensity would take the riskier option of not saving to smooth consumption and thus, face food insecurity. It is also interesting to note from Table 4.3 that risk propensity has the greatest impact on food insecurity, compared with all the other variables in the model.

To improve the precision of the estimates, women-specific variables (livelihood activities, income, education, and age/age-squared) and household level variables (education of household head, net income, asset index, total livestock unit, household size, gender of household head, dependency ratio, ownership of farm, social capital and enterprise ownership) were controlled for. It is evident from Table 4.3 that relative to the unemployed, only the choice of vocation as a livelihood activity is statistically significant ($p<0.1$) in explaining household food insecurity. The result indicates that relative to no livelihood activity, if a woman is engaged in a vocation, her household food insecurity access score reduces by approximately 72.5 percentage points (Column 4). This result is expected

because compared with women with no livelihood (unemployed), those engaged in some form of vocation do earn income from their vocational activities, and thus, are able to contribute to household food needs. As indicated earlier, no specific study has precisely looked at the effect of livelihood activities of women on household food insecurity in Ghana. However, some earlier studies (Kuwornu et al. 2012; Owusu et al 2011 and Osarfo et al. 2016) are to some extent similar to the current study. Much related to the current result, Owusu et al (2011) and Osarfo et al.(2016) also reported statistically significant positive (negative) effect of participation in non-farm employment on household food security (food insecurity). However, Kuwornu et al (2012) established a non-significant effect of non-farm activities on household food security. However, it is worth noting that the current study is a bit different from the earlier studies; because, whereas the current study focused on livelihood activities of individual women, the earlier studies focused on household non-farm activities. Also, non-farm income activities are broad, and encompass activities such as trading, vocation, paid employment, et cetera. Adepoju et al. (2015) also found no significant result for women whose main economic activity is farming on household food insecurity in Nigeria.

Income is used as a proxy for wealth that gives an individual purchasing power, and hence influences demand for food and for that matter access to food. Therefore, a woman's income is expected to reduce household food insecurity significantly. In concert with expectations, the result showed that a woman's monthly income has a negative and statistically significant effect on household food insecurity, although the effect size is very small (approximately 0.020 percentage point's reduction). This finding on income corroborates an earlier study in Ghana by Boakye-Akyeampong et al. (2012). However, in Nigeria, Adepoju et al. (2015) reported no significant effect of women's income on household food insecurity.

Education, as a form of human capital, provides women with knowledge in food planning and management and also empowers them to gain employment and earn an income to help feed their households. As expected, an additional year of a woman's schooling significantly ($p<0.01$) reduces her household food insecurity access score by approximately eight percentage points (Table 4.3). To explain the education result, this study agrees with Nkegbe et al. (2017) who suggest that higher levels of education may lead to better awareness and ability to diversify streams of income. Hesselberg and Yaro (2006) in a study of three villages (Kajelo, Chiana and Korania) in northern Ghana, however, found mixed results. Whereas they showed a positive statistically significant effect of the educational level on food insecurity in both Kajelo and Korania, education was not statistically significant in Chiana. The current finding, however, is not consistent with Uzma and Muhammad (2004) and

Adepoju et al. (2015), who found the opposite. Shone et al. (2017), however, found no effect of education on food insecurity.

The last women specific variable is age. Though age and age-squared variables are statistically significant in the pooled OLS and random effect regressions, the system GMM regression estimations show no statistically significant effect of both variables on food insecurity. By implication, a woman's age does not matter in explaining household food insecurity when endogeneity is taken into account. A quick explanation that comes to mind is that though age could be a proxy variable for experience, as far as food availability in the house is concerned, it is really not about a woman's age, rather, what she can contribute directly to make food available in the home by way of purchasing or preparation or both. Whereas the current finding is in line with Adepoju et al. (2015) who also reported no effect of age on food insecurity in Nigeria, Uzma and Muhammad (2004) in Pakistan, found that a woman's age influences her household's food insecurity positively.

Looking next at household control variables, there is no significant effect on food insecurity if the household head is a male, when endogeneity is accounted for (GMM regression), though the variable is significant in the pooled OLS and random effects models. The GMM result means there is no significant difference between male- headed and female-headed households as far as food insecurity is concerned. This finding corroborates other studies (Bogale and Shimelis 2009; Beyene and Muche 2010 and Kuwornu et al. 2012). However, an earlier study by Zakari et al. (2014) and a more recent study by Shone et al. (2017) found a significant effect of gender of household head on food insecurity. Table 4.3 also reveals that a household head's education is not relevant in explaining household food insecurity; corroborating findings in earlier studies (Kuwornu et al. 2012, Bogale and Shimelis 2009, Zakari et al. 2014). However, other studies found significant effect (Beyene and Muche 2010, Abafita and Kim 2014, Muche et al. 2014). Again, household size and dependency ratio are not statistically significant. Similarly, the current finding is consistent with, Zakari et al. (2014) who also found no significant effect of household size on food insecurity in Niger. In contrast, previous studies in Ghana (Hesselberg and Yaro, 2006); Nigeria (Adepoju et al. 2015); Ethiopia (Muche et al. 2014, Shone et al. 2017) and in Malaysia (Shariff and Khor 2008) established a significant effect of household size on food insecurity.

It is also evident from the system GMM results (Column 3, Table 4.3) that household asset index, a measure of household wealth, significantly decrease household food insecurity access score by 59 percentage points ($p<0.01$). The current finding is expected and the reason is not farfetched. As

explained earlier, household asset index a wealth variable, and hence, any increase in a household's assets is expected to lead to increase in purchasing power, and consequently access to food. This result corroborates Kuwornu et al. (2012) and Uzma and Muhammad's (2004) findings. Some studies (e.g. Beyene and Muche 2010), however, report no significant effect of asset index on food insecurity. This study finds no statistically significant effect of total livestock unit on food insecurity. Very few households in the sample have livestock and hence, total livestock unit is very small, with an average of less than one livestock in a household (Table 3.1). This potentially could be the reason why there is no significant effect of livestock ownership on food insecurity. Whereas this current result of no statistically significant effect is in line with Shone et al. (2017), other studies (Bogale and Shimelis 2009, Beyene and Muche 2010, Abafita and Kim 2014, Muche et al. 2014) report a statistically significant effect.

As hypothesized, household net income is also negative and statistically significant. However, the effect size is very small (less than 1 percentage point). Similar results were established in earlier studies (Uzma and Muhamma 2004; Bogale and Shimelis 2009). Net household income could be interpreted as a socioeconomic status variable, just like asset index. Hence, as expected, the higher the net income of the household, the more money the members have available to purchase food and other related ingredients. Shone et al. (2017) found no significant association between household income and food security. It is expected that farming would have significant impact on food insecurity, because farming households would harvest food directly from their farm to feed the members. Surprisingly, the study established no significant effect of household farm ownership on food insecurity. A reasonable explanation for this result may be because there are relatively few households owning a farm (19 percent) in the sample. Household enterprise ownership also does not have a significant effect on food insecurity.

Lastly, in line with expectations, the result indicates a positive statistically significant ($p<0.01$) coefficient of the lagged dependent variable for household food insecurity. The result shows about 22 percentage points increase in household food insecurity with respect to past food insecurity. This means that past episodes of food insecurity may lead to increased current food insecurity by approximately 22 percentage points, signalling the persistent nature of household food insecurity. This is because when people are unable to come out of food insecurity situations possibly due to poverty and other obvious reasons, they do not have adequate nutrition, which adversely affects their health. Over time, it stifles their ability to work to enable them either produce or purchase food; thus, trapping them into a vicious cycle of food insecurity.

Table 4.3 Effect of Risk Behaviour of Women on Household Food Insecurity

	VARIABLES	(1) Pooled OLS HFIAS	(2) Random Effects HFIAS	(3) GMM HFIAS
Risk Behaviour	WTR	0.913***	0.893***	0.721**
		(0.269)	(0.297)	(0.365)
Individual characteristics	Livelihood Activities			
	Farming	0.356*	0.465***	-0.370
		(0.190)	(0.165)	(1.405)
	Petty Retailing	0.282	0.301	-0.384
		(0.667)	(0.774)	(0.393)
	Vocation	-0.361	-0.0981	-0.725*
		(0.232)	(0.217)	(0.386)
	Paid employment	0.605**	0.649**	0.222
		(0.280)	(0.280)	(0.508)
	Income	-0.00135***	-0.00102***	-0.00197**
		(0.000329)	(0.000287)	(0.000961)
	Years of schooling	-0.0695***	-0.100***	-0.0779***
		(0.0198)	(0.0203)	(0.0236)
	Age	-1.3061**	-0.3243*	-0.12407
		(0.1253)	(0.1208)	(0.11817)
	Age squared	0.0061**	0.0062*	0.00298
		(0.0022)	(0.0021)	(0.00206)
Household Characteristics	Male head	-0.434*	-0.586**	-0.153
		(0.222)	(0.230)	(0.256)
	Head schooling years	-0.00166	-0.00550	0.0137
		(0.0355)	(0.0368)	(0.0401)
	Household size	0.0177	-0.0319	-0.0174
		(0.0406)	(0.0383)	(0.0524)
	Dependency ratio	0.162	0.0500	0.126
		(0.127)	(0.111)	(0.159)
	Asset index	-0.954***	-0.609***	-0.589***
		(0.0820)	(0.0751)	(0.114)
	Total Livestock Unit	-0.125	-0.0573	-0.0191
		(0.105)	(0.110)	(0.109)
	Net Income	-0.000318***	-0.000309***	-0.000326***
		(0.000112)	(6.99e-05)	(6.21e-05)

	Social capital	-0.164*	-0.175**	-0.111
		(0.0850)	(0.0757)	(0.126)
	Farm ownership	0.397*	0.313*	0.0797
		(0.204)	(0.179)	(0.244)
	Enterprise ownership	-0.207	-0.141	0.145
		(0.197)	(0.174)	(0.370)
	Past Food Insecurity			0.224***
				(0.0691)
	Constant	0.683	1.868**	0.0883
		(0.755)	(0.779)	(0.909)
	Observations	4,172	4,172	1,623
	R-squared	0.109		
	F/Wald chi2	13.49***	200.17***	159.11***
	P-value Breusch and Pagan Lagrangian		0.000	
	No. of instruments			51
	P-value Hansen test			0.279
	P-value Diff Hansen			0.387

Robust standard errors in parentheses , *** p<0.01, ** p<0.05, * p<0.1

Notes: (i) The GMM estimates reported are all two step. (ii) The Hansen and the difference-Hansen statistics are all two-step versions of these tests. (iii) The instrument set used: L2.bet L2.iLiNSW_edu L2.farming L2.trading L2.vocation L2.paidemp m_age m_age2 head_male hhead_edu hhsize dependency_ratio asset_index small_TLU nethhincome hh_socapt hhfarm hhent L2.m_mincome L2.unemployed L2.hfias)

Effect of Risk Behaviour of Women on Household Food Insecurity Coping Strategies

Decision to adopt coping strategies

Table 4.4 presents marginal effect results for the effect of risk behaviour of women on their household's adoption of food insecurity coping strategies, whilst controlling for individual and household characteristics. Risk behaviour is significant ($p<0.01$) and has a positive effect on adoption of coping strategies as hypothesized. Precisely, if a woman is willing to take risk, her household is around 8.4 percentage points more likely to adopt a coping strategy. It is worth noting that the relationship between risk behaviour and coping strategy adoption is consistent with the relationship between risk behaviour and food insecurity as established earlier in Table 4.3 (risk propensity increases household food insecurity). Therefore, the current results are plausible, because, it is common knowledge that households resort to one strategy or the other to cope with food insecurity episodes. It is also interesting to note from Table 4.4 that, compared with other variables, risk propensity has the largest impact on the likelihood of adopting a food insecurity coping strategy.

Now, to the control variables, the results show significant effect of both a woman's age (negative) and age squared (positive) variables on a household's coping strategy adoption. An additional year of a woman's age decreases the likelihood of her household adopting a coping strategy by around 3.8 percentage points. Though the magnitude of age-squared is very small (less than 1 percentage point), it shows a u-shaped relationship between a woman's age and adoption of coping strategies. This also points to the effect of experience on adoption of food insecurity coping strategies. The age and age-squared results is an indication that at early stages of a woman's life, she is likely to reduce the probability of her household adopting a coping strategy when food insecure, but as she ages, the opposite occurs. This is expected because women are mainly responsible for household food management/planning, preparation and distribution. Hence, as women age, they are exposed to household food shortages, and therefore, gain a lot of experience and knowledge with respect to how and what strategies they could adopt to cope with food insecurity, all things being equal.

Table 4.4 also shows a negative and significant effect of women's education on adoption of coping strategies. Precisely, an additional year of a woman's schooling decreases the probability of her household adopting food insecurity coping strategy by around 0.6 percentage points. A possible explanation is that as a form of human capital, higher education endows individuals with employable skills, and they are therefore able to get higher and more stable income from their work. Therefore, higher educated women contribute more to household food needs, all things being equal; thus, reducing the need for their households to resort to coping strategies. The results also show a negative significant effect of income of women on coping strategy adoption (a 0.02 percentage point decrease). This is not at variance with expectation, because an increase in a woman's income suggests that she has more money to contribute to buying food or ingredients to prepare food or both to feed the household; and hence, it is expected that her household would be food secure. By implication, there would be absolutely no or very little need to resort to coping strategies.

One would expect that increasing household size means pressure on available food in the household, because there will be more mouths to feed. Thus, an increase in household size is expected to increase food insecurity, and hence warrants the adoption of coping strategy. However, this current result is contrary to expectations, as the result indicates an additional household member significantly decreases the likelihood of adopting a coping strategy by 3.4 percentage points. A relevant explanation is that household size could also be considered as a wealth variable, and thus may reduce food insecurity, especially where more household members are in gainful employment and contribute either food or money or both to the household. In this case, there would be no need to adopt any coping strategy,

because the household would be food secure. In contrast, both Regassa (2011) and Ahmed (2015) et al. reported a positive correlation between household size and coping strategies.

All things being equal, an increase in under -five year old children in the household means pressure on few adults working to provide for the household's food needs. Accordingly, the household is likely to be food insecure when there are more children under the age of five years; thus, increasing the likelihood of adopting coping strategies. Contrary to expectations, Table 4.4 indicates that a unit increase in under - five year old children in a household significantly decreases the probability of adopting a coping strategy by approximately 7.9 percentage points. Perhaps, this opposing finding can be explained by the fact that in terms of food consumption, such children consume a lower quantity of food compared to teenagers and adults; implying that children under the age of five years do not exert much pressure on household food.

As expected, asset index, a proxy measure of household wealth, is negative and statistically significant. There is approximately a 5-percentage point decrease in the likelihood of adopting a food insecurity coping strategy with a unit increase in the household asset index. This conforms to expectations because, higher asset index implies higher socioeconomic status, suggesting the household has little problems with access to food, all things being equal. This means that as a household's wealth increases, the household would not need to resort to coping strategies, as it were, since they remain food secure. Related to asset index is household net income. Just like asset index, it is expected that household income would significantly reduce a household's coping strategy adoption. Though the effect size is very small (less than 0.01 percentage points), with a negative and significant effect, the results for household net income are in line with expectations. As income increases, households have the ability to have access to food, therefore are less likely to resort to food insecurity coping strategies.

Surprisingly, household farm ownership is positive and significantly related to adopting coping strategies. Specifically, the result indicates a 5-percentage point increase in the likelihood of adopting a food insecurity coping strategy if a household owns a farm. Indeed, this is counterintuitive and a reasonable explanation could be that farming is an unpredictable line of work with variable income. This may mean that, households that depend mainly on farming are not likely to have enough food, especially during off-farming seasons.

Table 4.4 Effect of Risk Behaviour of Women on Adoption of Food Insecurity Coping Strategy

	VARIABLES	1 Pooled Probit	2 Population Average Probit	3 Random Effects Probit
Risk Behaviour	WTR	.0836836* (.04288)	.082046* (.0422532)	.0836836* (.04288)
Individual characteristics	Age	-.035247*** (.0105019)	-.0352549*** (.0111838)	-.035247*** (.0105019)
	Age squared	.0006037*** (.000184)	.0006091*** (.0001952)	.0006037*** (.000184)
	Years of schooling	-.0067064*** (.0019111)	-.0069415*** (.0018801)	-.0067064*** (.0019111)
	Income	-.0001473*** (.0000475)	-.0001546*** (.0000532)	-.0001473*** (.0000475)
Household characteristics	Household size	-.0343571** (.0156708)	-.0100484** (.004544)	-.0343571** (.0156708)
	Under 5 years children	-.0786522*** (.0114803)	-.0783671*** (.011523)	-.0786522*** (.0114803)
	Dependency ratio	-.0079886 (.0127983)	-.0051266 (.0129125)	-.0079886 (.0127983)
	Male head	-.0181683 (.018475)	-.0184974 (.0187045)	-.0181683 (.018475)
	Asset index	-.0505572*** (.0080893)	-.0502918*** (.0079842)	-.0505572*** (.0080893)
	Net income	-.0000941** (.0000369)	-.0000904** (.0000422)	-.0000941** (.0000369)
	Social capital	-0.0272 (0.0371)	-.0052965 (.008854)	-0.0272 (0.0371)
	Farm ownership	.049027*** (.0173062)	.050361*** (.0171466)	.049027*** (.0173062)
	Enterprise ownership	-.0020545 (.0155385)	-.0021935 (.0158208)	-.0020545 (.0155385)
	Observations	4,198	4,198	4,198
	Wald chi2	232.74***	252.39***	232.74***
	Robust standard errors in parentheses ; *** p<0.01, ** p<0.05, * p<0.1			

Number of Food Insecurity Coping strategies Adopted

The decision to resort to food insecurity coping strategies may result in more than one possible multinomial outcomes, which are not mutually exclusive. Therefore, households can resort to adopting as many coping strategies as they wish. Hence, to some extent, the number of coping strategies adopted could also be considered as a measure of coping strategy diversification. It is important to note that the number of coping strategies adopted is indicative of food insecurity, but it does not reveal the extent

or severity of the situation. It only indicates how many coping strategies food insecure households resort to. For instance, whereas one household may resort to only one coping strategy, another household may adopt 3 strategies, and yet, another all 5 coping strategies.

Table 4.5 presents the results of a Poisson estimation for the effect of risk propensity on the number of food insecurity coping strategies. The results from all three estimations (pooled regression, population average and random effect) show that risk propensity of women has a significant and positive influence on the number of coping strategies adopted (Columns 1-3). In particular, the random effect results show that, if a woman is risk seeking, the number of coping strategies her household adopt to cope with food insecurity increases by 38.8 percentage points. By implication, households with risk-loving women resort to more number coping strategies, all things being equal. This finding confirms the earlier results that risk propensity of women influences the adoption of coping strategies positively (Table 4.4), and is also consistent with the food insecurity access score and risk propensity results (Table 4.3). This current finding can be explained by the fact that, as households become increasingly food insecure, risk-loving women would resort to more coping strategies because they are not afraid of taking on the risk of adopting new coping strategies. It could also be that based on certain outcomes or occurrences after adopting a particular strategy, they resort to different and relatively better or less demanding strategies at later periods. For instance, it could be that households resorted to either borrowing food or money to buy food or buying food on credit and defaulted on repayments. Hence, such households may resort to different strategies in future (e.g. Limiting adult food intake to feed children, eating elsewhere, or obtaining food from friends, neighbours and relatives).

Whereas age-squared of women and household farming ownership are both significant and positively related to the number of coping strategies, the results show a negative significant effect for women's specific variables such as age, education and income, as well as household variables including household size, children under five years, asset index, and net income. Interestingly, all these control variables in Table 4.5 also have similar significant effects (in terms of signs) just as in the case of the effect of risk propensity on adoption of coping strategies (Table 4.4). This again confirms the robustness of the estimations.

Table 4.5 Poisson Regression Results: Effect of Risk Propensity on the Number of Food Insecurity Coping Strategies

	VARIABLES	(1) Pooled	(2) Population Average	(3) Random Effect
Risk Behaviour	WTR	0.388*	0.141*	0.388*
		(0.227)	(0.192)	(0.234)
Individual Characteristics	Age	-0.210***	-0.173***	-0.210***
		(0.0526)	(0.0332)	(0.0529)
	Age squared	0.00360***	0.0012***	0.00360***
		(0.000888)	(0.000574)	(0.000903)
	Years of schooling	-0.0355***	-0.0133***	-0.0355***
		(0.00964)	(0.00723)	(0.00977)
	Income	-0.0009***	-0.0003***	-0.0009***
		(0.000332)	(0.000280)	(0.000328)
Household Characteristics	Household size	-0.0482**	-0.0202***	-0.0482***
		(0.0214)	(0.0160)	(0.0185)
	Under 5 years children	-0.264***	-0.097***	-0.264***
		(0.0567)	(0.0442)	(0.0533)
	Dependency ratio	0.0708	0.0295*	0.0708
		(0.0550)	(0.0421)	(0.0551)
	Male head	-0.0899	-0.0369	-0.0899
		(0.0950)	(0.0698)	(0.0937)
	Asset index	-0.240***	-0.114***	-0.240***
		(0.0432)	(0.0299)	(0.0373)
	Net income	-0.0007***	-0.0003***	-0.0007***
		(0.000282)	(0.000170)	(0.000190)
	Social capital	-0.0414	-0.0169	-0.0414
		(0.0452)	(0.0340)	(0.0393)
	Farm ownership	0.208**	0.0865***	0.208**
		(0.0851)	(0.0668)	(0.0822)
	Enterprise ownership	0.0529	0.0143	0.0529
		(0.0741)	(0.0611)	(0.0720)
	Constant cstrategy	2.398***		2.398***
		(0.797)		(0.785)
	Constant lnalpha	0.0750		0.0750
		(0.323)		(0.0891)
	Constant		1.903***	
			(0.507)	
	Observations	4,001	4,001	4,001
	Robust standard errors in parentheses ; *** p<0.01, ** p<0.05, * p<0.1			

Type of Household Food Insecurity Coping Strategy (THFICS)

Usually, households choose among a set of options for coping during food insecurity situations. In making the choice, it is assumed that a household would select a particular coping strategy if the perceived benefits from choosing that particular coping strategy is greater than the utility from another coping strategy. Indeed, the consequences of some coping strategies may be more drastic than others ar; and in making the choice of which coping strategy to adopt, households do take into consideration the extent of severity of a particular coping strategy. As shown earlier, households in the sample adopt five main coping strategies (borrowing food or money to buy food, buying food on credit, eating elsewhere, begging for food or money to buy food and limiting adult food intake to feed children). The study estimated a panel ordered Probit model for the effect of risk taking propensity of women on the type of food insecurity coping strategy; on the assumption that limiting adult food intake to allow children to have enough food is the most drastic form of coping strategy, relative to the other coping strategies. Generally, children are hit hard during extreme food insecurity situations, and this often leads to malnutrition, low cognitive development and other negative child growth outcomes. As a way of cushioning children from food insecurity and its attendant problems, very often adult household members, women especially, do limit their food intake (portion size and skipping of meals) in order to ensure children are adequately fed, during food insecurity periods. Limiting adult food intake for children is also considered the most drastic strategy because, it is presumed that in the most unlikely situation, if all the other options fail, the elderly in the households would forgo eating their regular meals (intervals and portion sizes) in other to ensure children are adequately fed. It may also happen that even though a household adopts all the coping strategies, they may still not have enough to eat; hence, adults would still need to limit their food intake in order to ensure children are adequately fed.

Table 4.6 presents the marginal effects results of the panel ordered Probit regression. The outcome variable is an ordered coping strategy measure where 0 implies no coping strategy, 1 means all strategies other than limiting food and 2 is limiting food (on the assumption that limiting food is the most drastic form). In accordance with expectations, the results clearly depict that risk-seeking behaviour is statistically significant and negatively associated with no coping strategy (Column 1), but positive and statistically significant with respect to all strategies other than limiting adult food intake (Column 2) and limiting adult food intake for children (Column 3). In particular, risk behaviour significantly decreases the probability of not adopting any coping strategy by around 8.4 percentage points.

It is striking to note that in terms of specific coping strategies, the impact of risk behaviour is relatively larger for the more drastic coping strategy (limiting adult food intake to feed children) than all the other strategies put together. Whereas risk-seeking behaviour increases the likelihood of adopting all coping strategies other than limiting food by approximately 3.6 percentage points, it does increase the probability of limiting adult food intake to feed children in the household by around 4.9 percentage points. This presumably points to the importance risk-loving women place on taking care of children's food needs, when the household is faced with food insecurity and also in adopting more drastic ways of coping with food insecurity. Consistent with the results in Tables 4.4 and 4.5, this current finding (Table 4.6) suggests that risk-loving individuals do not only have to adopt more increased number of coping strategies, but also more drastic/extreme coping strategies.

It is also evident from Table 4.6 that the significant control variables are not different from the previous results (Tables 4.4 and 4.5), confirming the robustness of the results. Whereas the likelihood of adopting no coping strategy is influenced by women's age (age-squared) positively (negatively), the opposite result is true for adopting all strategies other than limiting adult food intake (Column 2) and limiting adult food intake to ensure children are sufficiently fed (Column 3). Both education and income of women increase the likelihood of non-adoption of coping strategies and also decrease the probability of having to resort to all coping strategies other than limiting food, as well as limiting adult food intake to feed children. Household variables including household size, asset index and net income are all positive and significantly related to the probability of either resorting to all coping strategies other than limiting adult food intake, and in limiting adult food intake to feed children. However, farm ownership shows the opposite significant effect. Similar to what is observed with respect to risk behaviour, it is again clear from Table 4.6 that, the effect size of all the significant control variables are larger for limiting adult food intake to feed children (Column 3)Column), compared with adopting all other coping strategies combined. Again, this probably suggests the value households place on caring for their food needs during food insecurity episodes.

Table 4.6 Panel Ordered Probit Marginal Effects Results: Effects of Risk Behaviour on the Type/Specific Food Insecurity Coping Strategies

		1	2	3
	VARIABLES	**No coping Strategy**	**All strategies other than limiting adult food intake**	**Limit adult food intake**
Risk propensity	WTR	-.0848736**	.0362198**	.0486537**
		(.0420052)	(.0179577)	(.0241533)
Individual characteristics	Age	.0324578***	-.0138514***	-.0186064***
		(.0094718)	(.0041227)	(.0054169)
	Age squared	-.0005419***	.0002312***	.0003106***
		(.0001657)	(.000072)	(.0000948)
	Years of schooling	.0005419***	-.0023516***	-.0031589***
		(.0001657)	(.0007629)	(.0010222)
	Income	.0001343***	-.0000573***	-.000077***
		(.0000476)	(.0000204)	(.0000275)
Household characteristics	Household size	.0106939**	-.0045636**	-.0061303**
		(.0041997)	(.0018061)	(.0024104)
	Under 5 years children	.0830127***	-.0354257***	-.047587***
		(.0109032)	(.0046515)	(.0066304)
	Dependency ratio	.0175263	-.0074793	-.0100469
		(.0121268)	(.0051612)	(.0069812)
	Male head	.0076236	-.0032534	-.0043702
		(.0170123)	(.0072653)	(.0097491)
	Asset index	.0383403***	-.0163617***	-.0219786***
		(.0076306)	(.0034307)	(.0043138)
	Net income	.0000844**	-.000036**	-.0000484**
		(.000035)	(.0000151)	(.0000201)
	Social capital	.0093578	-.0039935	-.0053644
		(.0081781)	(.0034897)	(.0046951)
	Farm ownership	-.0446555**	.0190568**	.0255987**
		(.0159249)	(.006842)	(.00916)
	Enterprise ownership	0.00988	-.0010536	-.0014153
		(0.0589)	(.0062911)	(.0084452)
	Cut1	-1.519***	-1.519***	-1.519***
		(0.555)	(0.555)	(0.555)
	Cut2	-0.811	-0.811	-0.811
		(0.553)	(0.553)	(0.553)
	sigma2_u	.0024688	.0024688	.0024688
		(.014736)	(.014736)	(.014736)
	Observations	4,198	4,198	4,198
	Robust standard errors in parentheses ; *** p<0.01, ** p<0.05, * p<0.1			

4.4.4 Study Limitations

Before concluding, it is necessary to acknowledge and highlight some limitations of the study. While acknowledging the uniqueness of the data, it is also worth emphasizing the potential for respondent bias in the measures of household food insecurity and coping strategies. Because the food insecurity data relied on women reported experiences and not an objective indicator, it is likely for respondents either to understate their food insecurity experiences, or over- state them. However, this concern is partly mitigated by the fact that the data were collected several times over the span of more than a year; and hence, it is less likely that respondents may overstate or understate their experiences all the time.

4.5 Conclusions and Recommendations

From the regression results, it is apparent that risk-seeking behaviour of women increases household food insecurity. Additionally, the probability of adopting coping strategies as well as the number and form of coping strategies adopted increases with risk-seeking behaviour, all things being equal. Consequently, risk-loving individuals do not only have to adopt more coping strategies, but also more drastic coping strategies.

Given that in the current study, risk behaviour of women influences household food insecurity and food insecurity coping strategies, policies and programmes aimed at improving access to food (reducing food insecurity) in the study area and elsewhere, should take into consideration women's propensity for risk. This is particularly important in this current era where various forms of agricultural insurance are been rolled out as a way of improving food security.

The results established that if a woman is engaged in a vocation it contributes significantly to reducing her household's food insecurity. To this end, various policies to ensure female labour force participation, especially in the area of vocational activities, would be crucial in helping to reduce food insecurity in the household. It is also recommended that steps should be taken to encourage more women to acquire vocational skills through training and apprenticeship. In this regard, government and local authorities should provide the needed support to women to allow them to set up self-employed vocations by removing the bottlenecks related to access to finance. It is again suggested that the government's flagship programme on technical and vocational training should consider involving more women.

Women's years of schooling and income significantly reduce household food insecurity. Therefore, it is recommended that more women should be encouraged to seek higher education, because higher education could help them secure well-paid jobs and hence increase their ability to provide for their household food needs. Investing in education and increasing access to higher education for women may therefor help indirectly to reduce food insecurity. In line with this, the study sees the government of Ghana's new policy of free Secondary High School (SHS) education as a welcoming undertaking. The free SHS policy would go a long way to ensure more women attain more years of schooling. Thus, in the medium to long term, the policy will contribute positively to reducing food insecurity at the household level. Also, adult literacy programmes should be intensified for older women who cannot enrol in formal institutions to allow them to benefit from the free basic and secondary education policy.

4.6 Appendix

Table 4.7 Household Food Insecurity Coping Strategies

HOUSEHOLD FOOD INSECURITY COPING STRATEGIES					
Borrowed Food or Money to Buy Food					
Round	**Obs**	**% Never**	**% Rarely**	**% Sometimes**	**% Often**
1	1,266	92.10	4.19	2.76	0.95
2	1,064	95.21	2.16	1.97	0.66
3	1,014	94.87	2.56	2.07	0.49
4	872	94.27	2.75	2.64	0.34
All	4,216	94.00	2.99	2.37	0.64
Purchased Food on Credit					
1	1,266	85.70	6.16	6.32	1.82
2	1,064	91.82	3.20	3.76	1.22
3	1,014	88.86	4.44	4.83	1.87
4	872	89.33	5.85	3.44	1.38
All	4,216	88.76	4.93	4.72	1.59
Ate at Another Household (elsewhere) due to Lack of Food					
1	1,266	95.66	1.82	2.05	0.47
2	1,064	97.27	1.03	1.32	0.38
3	1,014	96.94	1.38	1.28	0.39
4	872	98.05	0.80	0.92	0.23
All	4,216	96.87	1.30	1.45	0.38
Begged for Food					
1	1,266	99.76	0.24	0.00	0.00
2	1,064	99.53	0.28	0.19	0.00
3	1,014	99.90	0.10	0.00	0.00
4	872	99.66	0.34	0.00	0.00
All	4,216	99.72	0.21	0.07	0.00
Limited Adult Food Intake to Feed Children*					
1	998	81.36	7.72	8.72	2.20
2	1,046	90.92	3.15	5.16	0.76
3	1,013	87.76	4.54	6.32	1.38
4	872	86.47	5.28	7.34	0.92
All	3,929	86.69	5.14	6.85	1.32

*Note: The sample is composed of those households with at least one child under age 18 years.

Table 4.8 Instrumental Variable Regression Results for Household Food insecurity

	(1)
VARIABLES	**HFIA**
WTR	1.017
	(8.302)
Trading	0.403**
	(0.171)
Farming	0.330
	(0.617)
Vocation	-0.432*
	(0.232)
Paid employment	0.687**
	(0.281)
Income	-0.00141***
	(0.000396)
Years of schooling	-0.0735***
	(0.0218)
Age	-0.287*
	(0.169)
Age2	0.00588*
	(0.00325)
Male head	-0.434**
	(0.201)
Head schooling years	-0.00204
	(0.0413)
Household size	0.00948
	(0.0383)
Dependency ratio	0.224
	(0.139)
Asset index	-0.913***
	(0.0734)
Total Livestock Unit	-0.107
	(0.118)
Net income	-0.000306**
	(0.000140)
Social capital	-0.188**
	(0.0775)
Farm ownership	0.405**
	(0.180)
Enterprise ownership	-0.200
	(0.176)
Constant	5.202

	(6.980)
Observations	3,975
	Durbin (score)
	(p = 0.9974)
Endogeneity test	Wu-Hausman
(Ho: variables are exogenous)	F(1,3954) = .00001 (p = 0.9974)

Table 4.9 Instrumental Variable Probit Results for Coping Strategy Adoption

VARIABLES	**Coping strategy**
WTR	-1.617***
	(0.278)
Age	-0.0378
	(0.102)
Age squared	0.000461
	(0.00176)
Years of schooling	0.00325
	(0.00795)
Income	8.25e-05
	(0.000401)
Household size	-0.0167
	(0.0400)
Children under 5 years	0.00163
	(0.0891)
Dependency ratio	-0.0839
	(0.0846)
Male head	-0.142*
	(0.0737)
Asset index	0.0142
	(0.0503)
Net income	2.74e-05
	(0.000188)
Social capital	0.0217
	(0.0399)
Ownership of farm	0.134
	(0.138)
Ownership of enterprise	-0.177**
	(0.0890)
Constant	2.162
	(1.413)
Observations	1,202
	chi2(1)=2.16;
Wald test of exogeneity(corr = 0)	Prob>chi2=0.1418

Instruments: Pentcharis, Catholic Muslim other religion Protestant

Table 4.10 Instrumental Variable Regression Results for Type of Coping Strategies

VARIABLES	(1) **No strategy**	(2) **All strategies other than limiting adult food intake**	(3) **Limiting adult food intake**
WTR	1.177004**	-1.098151	-1.484098***
	(.5195518)	(.7704214)	(.4821277)
Age	.08472**	-.0745487*	-.0327151
	(.0410228)	(.0447278)	(.0356585)
Age squared	-.0014138*	.0013539*	.0003961
	(.0007409)	(.000865)	(.0006001)
Years of schooling	.0093807	-.0113732	.0011129
	(.0086824)	(.0119825)	(.0070007)
Income	.0003106	-.0006641	.0000428
	(.0003057)	(.0005703)	(.000241)
Household size	.0066231	.0133462	-.0125497
	(.0131046)	(.0112263)	(.0230179)
Children under 5 years	.1096255	.002191	-.1028779
	(.0924277)	(.0665374)	(.166511)
Dependency ratio	.0262821	.0432219	-.1160103
	(.0354067)	(.0619299)	(.0735954)
Male head	.1068936**	-.1289351**	-.0776244
	(.050717)	(.0553227)	(.0642305)
Asset index	.1136083	-.1770187	.040888
	(.0833937)	(.1405241)	(.0358546)
Net income	.0002731	-.0003082	-.0000918
	(.0001685)	(.0002397)	(.0001449)
Social capital	.0248967	.0072082	-.040804
	(.0263232)	(.0293615)	(.0397472)
Ownership of farm	-.1096618	.0960737	.0320733
	(.0842914)	(.0987312)	(.0871467)
Ownership of enterprise	.1034377**	-.0990418*	-.0715825
	(.0480234)	(.0551766)	(.0559588)
Constant	-2.082373***	1.219306	1.456006**
	(.4243493)	(.763102)	(.5640343)
Observations	4,198	4,198	4,198
	chi2(1) = 2.32 Prob > chi2 = 0.1279	chi2(1) = 1.10 Prob > chi2 = 0.2948	chi2(1) = 1.52 Prob > chi2 = 0.2179

Wald test of exogeneity (corr = 0):
Instruments: pentcharis Catholic Muslim other religion Protestant
Robust standard errors in parentheses;*** p<0.01, ** p<0.05, * p<0.1

Table 4.11 Panel Ordered Probit regression coefficient: Effect of Risk Behaviour on the Type of Coping Strategies.

VARIABLES	oProbit coefficient
WTR	0.340**
	(0.168)
Age	-0.130***
	(0.0382)
Age squared	0.00217***
	(0.000667)
Years of schooling	-0.0220***
	(0.00712)
Income	-0.000537***
	(0.000190)
Household size	-0.0428**
	(0.0169)
Children under 5 years	-0.332***
	(0.0451)
Dependency ratio	-0.0701
	(0.0485)
Male head	-0.0305
	(0.0681)
Asset index	-0.153***
	(0.0302)
Net income	-0.000337**
	(0.000140)
Social capital	-0.0374
	(0.0328)
Ownership of farm	0.179***
	(0.0639)
Ownership of enterprise	-0.00988
	(0.0589)
	-1.519***
Cut1	(0.555)
	-0.811
Cut2	(0.553)
	0.363***
sigma2_u	(0.0544)
Observations	4,198

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

CHAPTER FIVE

Summary, Conclusions and Suggestions for Further Research

5.1 Introduction

This thesis broadly examined risk behaviour of women, livelihood activities and household food insecurity. In particular, it sought to answer three key research questions: (1) What is the effect of religion on risk behaviour? (2) What is the relationship between risk behaviour and livelihood activities of women? (3) Does risk behaviour matter in explaining household food insecurity and coping strategies? To answer these research questions, the study used field data on 1320 women and their households in the Yilo and Manya Krobo Districts in the Eastern Region of Ghana. The thesis was structured into three core papers, with each paper forming a key chapter, and addressing a specific research question. This concluding chapter summarises the key findings and provides some suggestions for further research.

5.2 Summary and Conclusions

Religious doctrines may guide individual attitudes and preferences, including risk behaviour among others. The first paper (Chapter 2) sought to estimate the effect of religion on individual risk behaviour among 1,209 women. The paper used socioeconomic characteristics data and risk data on women from a field experiment with real monetary payoffs. To learn something about individual risk behaviour in the face of uncertainties, women were asked to make decisions about how much money they would like to bet in a risk behaviour game. Three different individual risk behaviour measures were generated. First, a binary measure of risk behaviour (1='Willing to Take Risk', women who chose to play/bet in the risk game; 0 otherwise). Second, an ordered multinomial measure of risk behaviour categories including 'Not Willing to Take Risk' (participants who chose not to play the risk aversion game at all), 'Willing to Take Moderate Risk' (did play the game, but did bet below the mean amount bet) and 'Willing to Take High Risk' (did play the game and bet either exactly the mean amount or higher). Last, risk behaviour was measured using the amount bet by participants: the higher the amount bet the more a woman was willing to take risk, and vice versa.

Religion was measured based on six religious affiliation dummies, representing Pentecostals, Protestants, Catholics, Muslims, Traditional religion and no religion. The effect of religion on risk behaviour was estimated using a binary Probit, ordered Probit, OLS, Tobit and Heckman regression models, with non-religious as the reference category. A binary Probit model was estimated to examine the effect of religion on whether a woman is willing to take risk or not. The other regressions (ordered Probit , OLS, Tobit and Heckman) were estimated to investigate the effect of religion on the degree or

level of risk behaviour. Generally, the study found that whereas religious affiliation influences the decision to engage in risk, it does not in any way influence the level or degree of individual risk- taking thereafter. Specifically, the study established that relative to a non-religious person, religious affiliation of a woman influences her willingness to engage in risk negatively. However there is very little difference in such willingness to engage in risk between the different religious groups.

Using field experimental risk behaviour data matched with data on livelihood activities, the second page (Chapter 3) examined the relationship between risk behaviour and livelihood activities among a sample of 1,209 women in Ghana. Livelihood activities of women were grouped into five, including farming (subsistence food crop cultivation), petty retailing (buying and selling of small consumable, and non-durable items), and vocation (seamstress, hairdressing, giving pedicures and manicures), paid employment (formal or informal) and no livelihood activity (unemployed, and do not engage in any livelihood activity). Risk behaviour was measured as a binary of a woman's willingness to take risk. In order to isolate the causal effect of risk behaviour of women' on their choice of livelihood, a Seemingly Unrelated Bivariate Probit (SUR bi-Probit) was first estimated using *Religion* as an instrument. Following from the fact that the Wald test of rho in the SUR bi-Probit estimation showed an exogenous relationship between willingness to take risk and livelihood activities, a standard multinomial logit model was then estimated. Again using Religion as instrument, a Generalized Structural Equation Model for multinomial logit (GSEM Mlogit) with endogenous variable was also estimated to check the robustness of the results. Women who are willing to take risk were less likely to be in paid employment than to be unemployed (have no livelihood activity). While risk-loving women were more likely to be farmers than to be unemployed, such women were indifferent between having a vocation or being involved in petty retailing and being unemployed. Other individual and household characteristics that influenced livelihood activity choice of women in the sample included age, education, household headship, dependency ratio, per-capita income, household farm ownership, and household enterprise ownership.

The third and last paper (Chapter 4) used panel data on 1320 women and their households to investigate the effect of risk behaviour of women on household food insecurity and food insecurity coping strategies. The paper was divided into two parts; with the first part focusing on the effect of risk behaviour on household food insecurity by using three different regression estimation techniques (Pooled regression, Random Effect and GMM). The second part examined the effect of risk behaviour on food insecurity coping strategies by looking at three key outcomes. First, the effect of risk behaviour

on the decision to adopt a coping strategy was estimated using panel Probit estimation. Secondly, a Poisson regression was used to estimate the effect of risk behaviour on the number of coping strategies adopted. Lastly, the effect of risk behaviour on the form/type of coping strategy adopted by households was estimated using panel ordered Probit regression.

Household food insecurity was measured using the Household Food Insecurity Access Score (HFIAS). A set of nine questions encompassing three domains of food insecurity (anxiety and uncertainty about the household food supply, insufficient quality and insufficient food intake and its physical consequences) was used to construct the HFIAS. HFIAS is a simple sum of the frequency of occurrence of each of the nine food insecurity indicator questions; and is a continuous measure of the degree of food insecurity in the household. It ranges from 0-27, where, a high score implies a higher degree of household food insecurity, and vice versa.

In this study 5 food insecurity coping strategies were identified, namely borrowing food or money to buy food, buying food on credit, eating elsewhere, begging for food or money to buy food and lastly, limiting adult food intake to feed children. The decision to adopt a coping strategy by a household was measured as a dichotomous dependent variable; where, 1 indicates a household resorted to food insecurity coping strategies and 0 otherwise. The second coping strategy outcome variable in the current study looked at the number of coping strategies adopted by a household, out of a total of 5 coping strategies. The form/type of coping strategy is the last coping strategy outcome variable. By assuming that limiting adult food intake to feed children in the household is a more drastic form of coping strategy, relative to other strategies, the form/type of coping strategies adopted was measured as an ordered measure; where 0 implied no coping strategy, 1 for all strategies other than limiting adult food intake to feed children and 2 referred to limiting adult food intake to feed children. Concerning the key explanatory variable of interest, risk behaviour was again measured as a binary variable (1='Willing to Take Risk' by the mother of the house, who is the person mainly responsible for food preparations, purchases and distribution in the household; 0 otherwise).

Results from a Dynamic Generalised Methods of Moments (GMM) estimation established that the propensity of women to take risk significantly increased household food insecurity. In terms of control variables, women's specific variables such as engaging in a vocation, women's income and years of schooling reduced household food insecurity. Additionally, household variables including asset index, net income and past/previous food insecurity episodes were significantly associated with food insecurity. Also, a random effects and Poisson regression estimations respectively also showed that

the propensity to take risk increases both the likelihood of adopting coping strategies and the number of coping strategies adopted by households. Again, the ordered Probit panel estimation of the type of coping strategies confirmed that, risk behaviour impacts on adopting more drastic coping strategies (limiting adult food intake to feed children) compared with the other coping strategies.

5.3 Study Limitations

Aside from the limitations identified in previous chapters of this thesis, it is important to highlight one major limitation with respect to the data, which have implications for external validity. The study population comprised of women (and their households) who were recruited as part of the iLiNS- Dyad-Ghana nutritional intervention trial. Once a woman was recruited into the study, her household automatically became part of the study. One of the main inclusion criteria for a woman and her household to be part of the iLiNS Dyad Ghana study was that the woman should be in her reproductive years (18 years and above) and also resident in the Yilo and Lower Manya Krobo districts of Ghana. Thus, the study population was certainly not a random sample of women and households in Ghana as a whole. Hence, to the extent that the women and their households were exclusively recruited from just two districts out of the 216 districts in Ghana, caution must be exercised in attempting to generalize these results to the entire population of Ghana. Consequently, this study does not seek to make generalizations of the findings, as external validity is not possible, since the sample is not representative of all women in Ghana.

5.4 Suggestions for Further Research

Notwithstanding, the external validity concerns and other limitations, the results from this study provide valuable insights to conduct future research. Nevertheless, it is unclear whether beyond the study area, similar results would be established, because there may be heterogeneity in individual characteristics in other contexts. For example, the eastern region of Ghana, where the study was carried out is largely Christian and differs from the northern region, where generally the Islamic faith predominates. Thus, the results may differ in other regions merely because one religious group has a dominant position over others. Further studies could therefore look at a much broader geographic scope.

Also, as indicated earlier, in this study religion is measured as religious affiliation. It is worth noting however that, religion is not only about being affiliated to one denomination or the other. Hence, future studies could explore religiosity variables such as frequency of prayer, specific beliefs, religious organizational membership, commitment, and participation in religious activities among others. Owing to data limitations, the current study could not explore these religiosity variables.

Again, considering the fact that risk-seeking behaviour is fundamental in explaining individual decisions and predicting policy responses, future studies should show how religious induced heterogeneity in risk preferences influence individual economic behaviour and actual decision-making. This could be looked at in response to various policy initiatives or interventions such as national/public health insurance enrolment, employment schemes and preventative health products, among others.

It is also recommended that future studies should explore further the evidence that social capital and previous luck influences risk behaviour to ascertain the veracity of the current results. Clearly, these are challenging avenues for future research because very little empirical data exist.

A comprehensive livelihood activity involves a wide range of activities and is not limited to the five main activities considered in the current study. Also, a better understanding of the relationship between risk behaviour and livelihood activities will be appreciated with a more dynamic analysis using panel data, rather than the static analysis with the use of cross- sectional data utilised in the current study. It is therefore recommended that future studies should include more livelihood activities and should explore the dynamic relationship between risk behaviour and livelihood activities, using longitudinal data.

Lastly, future research should investigate factors that influence each specific food insecurity coping strategy, such as the ones identified in this current study (borrowing food or money to buy food, purchasing food on credit, eating elsewhere or in another household, begging for food, and limiting adult food intake to feed children in the household). Particular focus could be on the risk propensity effect of each specific coping strategy. This is an unexplored area as far as the food insecurity literature is concerned.

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