University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

MOBILE MONEY USE AND HOUSEHOLD VULNERABILITY TO FOOD POVERTY IN GHANA

ABEL GBOGBOLU

UNIVERSITY OF GHANA, LEGON

A THESIS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF A MASTER OF PHILOSOPHY (ECONOMICS) DEGREE

OCTOBER, 2022

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

DECLARATION

I declare that the research that led to the completion of this thesis was conducted by Abel Gbogbolu in order to receive the Master of Philosophy (M.Phil.) in Economics from the University of Ghana's Economics department. By signing this document, I certify that this thesis is entirely mine, except for citations to other authors' works that have been properly acknowledged. It was written with the help of my supervisors, and neither its entirety nor any portion of it has ever been submitted for credit elsewhere.

ABEL GBOGBOLU

(10183132)

PROF. ERIC OSEI- ASSIBEY

(SUPERVISOR)

DR. RICHARD KWABI AYISI

(SUPERVISOR)

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

DEDICATION

To God almighty, the giver of life, I dedicate this work. In addition, I am thankful to my dear mother, siblings, lecturers, and colleagues for their support and encouragement throughout this academic endeavour.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

ABSTRACT

Ever since the Food and Agricultural Organization (FAO) added the (fourth) stability dimension of food security in 2009, vulnerability to food poverty analysis has been preferred to the incidence of food poverty and food insecurity analysis. While food insecurity is static to a point in time, vulnerability to food poverty is prospective and drives the former. Following the FAO stability dimension, this study examined how using mobile money channels to receive remittances for consumption affects household vulnerability to food poverty in Ghana. Using cross-sectional (observational) data – the latest round of the Ghana Living Standards Survey (GLSS 7) – and food poverty thresholds at both national and international levels, household vulnerability to food poverty index was estimated following the vulnerability as expected poverty (VEP) model. The average treatment effect (ATT) of using mobile money to receive remittances for consumption on household vulnerability to food poverty was estimated by applying propensity score to matching techniques on scores and inverse probability weighting.

The study found a differing effect of using mobile money to receive remittances on household vulnerability to food poverty between food-poor and non-food-poor households in Ghana. At the national food poverty line, radius, kernel and IPTW ATTs estimated at 5% significance level, respectively show that household vulnerability to food poverty is significantly lower for food-poor households that significantly used mobile money to receive remittances by 8.8%, 7.3%, and 4.4% index probabilities compared to non-mobile money users. On the other hand, non-food poor households that significantly used less mobile money channels to receive remittances for consumption may slightly experience high vulnerability to food poverty.

The study also discovered that if exogenous factors raise the food poverty line to at least the international food poverty line, using mobile money to receive remittances will no longer

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

significantly mitigate vulnerability to food poverty among food-poor households. The findings imply that we must proceed with caution before concluding that the adoption and use of mobile money reduce food poverty/insecurity. The linkages go beyond remittances and food consumption expenditures. Much depends on the extent of utilization of mobile money compared with non-mobile money channels by food-poor and non-food-poor households and reciprocal altruistic cost-effectiveness.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

TABLES OF CONTENT

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

LIST OF TABLES

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

LIST OF FIGURES

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

LIST OF ABBREVIATIONS

3-FGLS	Three-step feasible generalized least squares
ATT	Average treatment effect
FAO	Food and Agricultural Organisation
FGT	Thorbecke, Greer & Foster
GLSS	Ghana Living Standards Survey
GSS	Ghana Statistical Service
HH	Households
IDT	Diffusion of innovation
IPTW	Inverse probability treatment weighting
LCH	Life cycle hypothesis
MoMo	Mobile money
OLS	Ordinary Least Squares
PEFCE	Per adult equivalent food consumption expenditure
PIH	Permanent income hypothesis
PSM	Propensity score matching
VEP	Vulnerability as expected poverty
VFP/ VtFP	Vulnerability to food poverty
$Z_{INT'L}$	International food poverty line
$Z_{NAT'L}$	National food poverty line

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

CHAPTER ONE

INTRODUCTION

1.1 Background

Food is a basic human right and first among all necessities. However, the travesty of justice is that for many worldwide, ensuring even a regular two (2) square meal is a luxury (Kakwani and Son, 2016a). According to the Food and Agriculture Organisation (FAO), nearly 1 billion people suffer from chronic hunger, with over 300 million food-poor people in Africa (FAO, 2020). This preamble communicates the idea of food poverty and the vulnerability of many individuals and households worldwide. In Ghana, data from the Ghana Statistical Service (2016-2020) have shown that 47.7% to 49.5% of the population were either moderately or severely food insecure, with Upper West Region recording the highest of 60.6% in 2020. FAO has consistently projected that two (2) million people in Ghana are vulnerable to food poverty annually (FAO, 2020). This projection coincides with a total of 2.32 million Ghanaians that were found to suffer extreme food insecurity in Ghana among 126 countries studied by Kakwani and Son (2016b).

In the 2001 State of Food Insecurity, FAO adopted a revised definition of food security, progressing from a limited definitional focus since 1974. According to FAO (2002), *"Food security [is] a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life."* The foundational research by Sen (1981) is most strongly associated with this new focus on consumption, the demand side, and the difficulties of vulnerable people's access to food. He rejects the idea of food security and instead concentrates on individual/household vulnerabilities and entitlements. Until 2009, this new definition was based

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

on three dimensions of food security. These are food availability (food production), economic and physical access, and food utilization (food consumption and nutritional value) at all times. However, following Sen's (1981) research, FAO added the food stability dimension (no vulnerability) in 2009 (FAO, 2009), which has since inspired recent studies of vulnerability to food poverty.

FAO's dimensional definitions emphasize "at all times" and reflect the non-failure of the other three dimensions – food availability, utilization, and economic access (FAO, 2009). That is non-vulnerability to food poverty based on a standard satisfaction of the other (three) pillars. However, as Coates (2013) indicated, households are usually vulnerable to food security shocks emanating from price hikes, weather occurrences, conflict, and other factors. Thus, food stability (at all times) is rarely achievable. This introduces the concept of vulnerability analyses, initially used in the context of poverty (Holzmann and Jorgensen, 2000), but now a widely indispensable approach for evaluating food poverty (Løvendal *et al.*, 2005). Even though the term vulnerability in broad academia portends a variety of implications according to the discipline, the food security literature relates vulnerability in relations to future adverse effects on food welfare and the capacity to respond and recover from it (Dercon, 2001; World Bank, 2001; Holzmann and Jørgensen, 2000; Mansuri and Healy, 2001).

Thus, food insecurity and vulnerability to food poverty (VFP) analyses are distinct on time horizons (Sileshi *et al.*, 2019). While the former categorizes households as "food poor" or "non-food poor at a given period (static analysis), VFP is dynamic and considers shocks that may impact households' food welfare in the future, as well as the dependability of coping mechanisms (Sileshi *et al*., 2019). This study thus follows the stability dimension (FAO, 2009) to examine how using

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

mobile money channels to receive remittances for consumption affects household vulnerability to food poverty in Ghana.

The role of using mobile money to receive remittances, household risk-sharing (social insurance), and food consumption smoothing are documented in recent literature (Baffuor *et al.* 2020; Aker and Mbiti 2010; Bulmenstock *et al.* 2016; Morawczynski and Pickens, 2009; Jack & Suri 2014, 2016). According to the Ghana Statistical Service (2017), the share of households' utilization of MoMo channels to non-MoMo channels to receive remittances for daily consumption in Ghana is about 60% to 40%, respectively. Non-poor households use non-MoMo remittance channels more, while the poor utilize MoMo channels predominantly. However, poor and non-poor households used mobile money channels to receive remittances for consumption purposes (GSS, 2017). Thus, it is expected that the use of mobile money channels to receive remittances for consumption should have a differing effect on the vulnerability to food poverty of food-poor and non-food-poor households. The recent static studies on mobile money and food insecurity nexus (Murendo & Wollni, 2016; Lee *et al.*, 2018; Hayford, 2019) could not accommodate these essential transmission elements.

Following a dynamic vulnerability approach, the current study departs from these static studies in examining how using mobile money channels to receive remittances for consumption affects vulnerability to food poverty in Ghana's food-poor and non-food-poor households.

1.2 Problem Statement

Food poverty is a measure of extreme poverty around the world. Among the Millennium Development Goals (MDGs), food poverty/insecurity (MDG 1 and sequel SDG 1&2), mostly in developing countries, remains a significant reason why poverty goals are not well achieved in many countries (UN, 2015; WFP & WHO, 2017). While the goal is to eradicate food poverty

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

(extreme poverty) in line with SDG Goal 2, the real challenge, according to the FAO stability dimension, is mitigating vulnerability to food (extreme) poverty. Vulnerability to food (extreme) poverty is irrespective of food poverty/security status in the current period (Novignon *et al.*, 2012; Koomson *et al.*, 2020). Novignon *et al.* (2012) and Koomson *et al.* (2020), for instance, have indirectly confirmed FAO's position that every time incidence of poverty is measured in Ghana, vulnerability to expected poverty is about twice the incidence. Thus, FAO prefers interventions that address vulnerability rather than the incidence of food poverty (FAO, 2009).

Accordingly, the motivation of this study which followed FAO (1996, 2009) stability emphasis on food security 'at all times' in a Ghanaian context, uniquely sets this study apart in several ways. Following Zang *et al*. (2018), a possible scenario of household incidence of food poverty and vulnerability to food poverty is presented in figure 1.1. According to Novignon *et al.* (2012) and Zang *et al*. (2018), vulnerability to food poverty, unlike the incidence of food poverty, is a more prospective concept that considers potential changes in household food welfare. As shown in figure 1.1, hitherto non-food-poor households based on incidence analysis could be vulnerable to food poverty just as food-poor households. A proof that vulnerability to food poverty is irrespective of incidence in the current period; thus, studies static to a point in time may not be complete (Lee *et al.*, 2018; Gyasi *et al*., 2021; Murendo and Wollni, 2016, Hayford, 2020).

In a unique conceptualization, the study found relevance from FAO's 'at all times' stability dimensional emphasis seamlessly connecting with Friedman (1957)/Modigliani (1966) permanent income/life cycle hypothesis (PIH/LCH). The FAO stability dimension recognizes that the food pillars – availability, utilization, and economic access – cannot be stable 'at all times' (Coates, 2013) and emphasizes reliable household coping mechanisms to flatten shocks in food consumption and reduce vulnerability (FAO, 2015). This phenomenon is in line with Friedman

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

(1957)/Modigliani (1966) PHI/LCH. The common postulation of PIH attributes current (food) consumption effects to permanent income and no correlation with transitory incomes like remittances (World Bank, 2006). According to Friedman (1957), transitory incomes are "windfall gains," usually unanticipated, and should not be factored into the budget consumption function of the household. Therefore, per the extended LCH arguments of Modigliani (1966), as followed by the World Bank (2006), remittances as transitory income should be saved for consumption smoothing purposes over time rather than spent in the current period.

Figure 1.1: Possible categorisation of incidence and vulnerability to food poverty

Vulnerability to food poverty (V_i)		Current food expenditure (E_i)		Expected food expenditure E(E_i)
		$E_i < Z$ (food poor)	$E_i \geq Z$ (non-food poor)	
$V_i \geq 0.5$ (Vulnerable)		A	B	E(E_i) < Z (Expected food poor)
		C	D	E(E_i) ≥ Z (Expected non-food poor)
$Vi < 0.5$ *(Non-vulnerable)*		E	F	

(Note: E_i is the current food expenditure, E(E_i) is the expected food expenditure, V_i represents the vulnerability to food poverty pegged at 0.5 probability, and Z is the food poverty line).

Source: Author's construct following Zang et al. (2018).

No wonder many studies on the impact of remittances on food poverty/insecurity abound with contradictory and inconclusive findings. This is because, following Friedman (1957)/Modigliani (1966), whether remittance will affect current (food) consumption and the extent of the effect on food poverty/security depends on the 'confidence' of anticipation that remittances will not fail. Thus, while UNICEF (2017), Burchi *et al.* (2016), Buller *et al.* (2016), Abadi *et al.* (2018), among others, found that remittances improve household food insecurity, Duda *et al.* (2018), Rao and Hassan (2012), Ahmed (2013) found a negative effect of remittances on household food security.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Atouye *et al.* (2017) particularly demonstrated that remittances studied alone are insufficient to improve household food poverty.

This study uniquely conceptualized that households' significant use of MoMo channels to receive remittances for consumption instead of non-MoMo channels could defy the theoretical expectations of Friedman (1957)/Modigliani (1966) PIH/LCH but meet FAO's stability expectations. Departing from the static studies that could not accommodate food poverty thresholds, this study also conceptualized that using MoMo remittance channels affect the vulnerability to food poverty of food-poor and non-food-poor households differently in Ghana.

Beyond the conceptualization, this study also provides enough robustness beyond the few static studies. First is using national and international food poverty lines to compare results in a way never considered in any previous research. In fact, in the individual studies of Lee *et al.* (2018), Aker *et al.* (2016), Murendo and Wollni (2016), and Hayford (2020), food poverty thresholds were not utilized as the basis of analyses. Secondly, to resolve some econometric challenges, these incidence studies used single econometric models like instrumental variable estimation and probit/logit estimation procedures. However, employing a single model has the drawback of making estimations that may not be sufficiently reliable. Each model contains unique flaws that cannot be individually fixed—for instance, choosing the appropriate instruments for estimating instrumental variables. Unlike these incidence studies, this study uniquely fills this gap by applying propensity score to matching techniques on scores and inverse probability weighting. Propensity score-based approaches are a significant class of bias-reduction techniques that eliminates selection biases in observational studies (Rosenbaum and Rubin, 1983).

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

1.3 Study Objectives

This study generally investigated how using mobile money to receive remittances for consumption affects households' vulnerability to food poverty in Ghana in line with the FAO stability dimension of food security. More specifically, the study

i. Estimated the vulnerability to food poverty index by the vulnerability to expected poverty model,

ii. Examined how using mobile money channels to receive remittances for consumption affects the vulnerability to food poverty in Ghana's food-poor and non-food-poor households.

1.4 Research Questions

Based on the above objectives, the following research questions were answered;

i. What proportion of food-poor and non-food-poor households are vulnerable to food poverty in Ghana?

ii. How does using mobile money channels to receive remittances for consumption affect the vulnerability to food poverty of food-poor and non-food-poor households in Ghana?

1.5 Significance of the Study

The findings of this study are expected to provide an understanding that households that use MoMo channels to receive remittances cope differently with vulnerability to food poverty compared to non-MoMo users. The findings of this study are also expected to show that there may be significant differences in the utilization of mobile money channels to receive remittances for consumption between food-poor and non-food-poor households. Thus, this study provides information on how

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

using mobile money to receive remittances affects the vulnerability to food poverty of food-poor and non-food-poor households.

Therefore, the findings of this study should inform policymakers on how to promote the active usage of MoMo channels, particularly among the predominant 77% of Ghanaians without a traditional bank account (GSS, 2017). More important is how the findings of this study provide information to the government on the food welfare implications of the new electronic levy on MoMo and non-MoMo channels on food-poor households. The new electronic levy without particular exemptions has consequences on the net remittance income of particularly food-poor households that utilize MoMo remittance for daily consumption. The findings of this study may inform the government on providing further exemptions or reductions in the levy on remittance transfers among the extremely poor in Ghana.

At the household level, the study provides information on household consumption and savings patterns through MoMo channels. This information may also help the government and the Telcos to educate households on the responsible and sustainable use of MoMo channels. Thus, the findings and suggestions from this study may significantly help promote the needed stakeholder discussions on mobile money in Ghana that may result in reforming the laws that could benefit users of mobile money technology. Moreover, mobile money is still developing, and academic members and students are researching a wide range of topics related to this innovation. The focus area considered for this study inspires further research into vulnerability to food poverty analysis using other coping mechanisms in line with the FAO stability dimension.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

1.6 Scope of the Study

This study examined how using mobile money to receive remittance for consumption affects the vulnerability to food poverty of food-poor and non-food-poor households in Ghana. Beyond remittances and per adult equivalent food consumption expenditure, the study examined the following essential transmission elements. First, the extent of utilization of MoMo channels versus non-MoMo channels for receiving remittances among the food-poor and non-food-poor households. Second, how remittance channel utilization affects vulnerability to food poverty of food-poor and non-food-poor households. The study also examined the efficacy of using mobile money to receive remittances on households' vulnerability to food poverty at national and international food poverty lines.

Data availability limited the study. The current study utilizes typical observational data from the national cross-sectional GLSS7 survey conducted in 2017. The study is thus limited to the use of the dynamic vulnerability to expected poverty (VEP) model approach for only a two-year time horizon, which is good enough for the resultant conclusions. However, to a large extent, the findings are limited to that year.

1.7 Organisation of the Study

The study is organized into five chapters. The first chapter presents the introduction, which includes the study's background, the problem's presentation, research objectives, as well as the research questions, relevance, and scope of the study. The second chapter reviews the extant literature on the subject of research, both theoretical and empirical. The chapter also presents the conceptual framework of the study. The third chapter discusses the research methods used for conducting the study. The fourth chapter presents a full analysis, interpretation, and discussion of

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

the study's findings. The final chapter outlines a summary of the major findings together with the conclusion and policy recommendations made by the researcher.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of the literature relevant to the objectives of this study. The chapter begins with thoughts on food poverty, vulnerability to food poverty, channels of receiving remittance, and the use of mobile money for remittance as a coping tool against vulnerability to food poverty. The chapter also discussed three key theoretical frameworks for the study; Singh *et al*. (1986) household general utility model, Friedman (1957)/Modigliani (1966) permanent income/life cycle hypothesis, and reciprocal altruism of Lévi-Strauss (1969) and Trivers (1971). The chapter finally presented a conceptual framework for the study.

2.2 Theoretical review

This section places the study's argument in a theoretical perspective. The academic reviews focus on the ideas and propositions that underpin vulnerability to food poverty and the mobile money remittance channel. This section explores relevant literature as follows;

2.2.1 The concept of food poverty

Despite slight differences in methodological applications, food poverty has been synonymous with food insecurity in the literature. As a strategy for achieving sustainable development goals (SDGs), food poverty/insecurity has become more critical during the past two decades (FAO *et al*., 2017). Concerns have been expressed about the post-2015 development agenda's need to emphasize policies that encourage nations to reduce hunger and food poverty due to the growing number of food-insecure people worldwide. According to reviews, food poverty/security is multifaceted, spanning the global to the individual levels, making the idea a complicated phenomenon,

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

especially considering its varied drivers and results (McGuire, 2015). A thorough description that included all the components of food poverty was necessary to properly conceptualize vulnerability to food poverty.

According to the 1996 World Food Summit (WFS), the term "food poverty" refers to the situation in which people lack access to enough food to satisfy their hunger or experience anxiety about not having enough food as a result of economic and social hardship; it does not refer to voluntary fasting or dieting or other reasons for not eating. Following this cardinal definition, FAO (2009) defined food poverty/security as concentrating on four unique but connected dimensions as its core pillars for conceptualizing linked issues and creating actions to address the phenomena. These dimensions are food availability (food production) at all times, economic and physical access (channels of income and purchasing power for food) at the time needed, food utilization (food consumption and nutritional value), and stability (vulnerability and shocks) (FAO, 2009). Following FAO (2009), deficiencies in one or more of the four pillars could threaten an individual or household's level of food security.

Availability

The availability pillar depends on having enough food, whether from domestic production, regional output, imports, or food aid. The production of agricultural products, national policy, the operation of international markets, and the condition of the socioeconomic infrastructure are just a few examples of the factors that go into the availability component (McGuire, 2015). According to McGuire (2015), agricultural production throughout the world has significantly increased over time, increasing access to food. Following this insight, FAO may claim that food availability no longer poses a danger to food security, which calls for a substantial revision of the explanation of food poverty to consider resource distribution. Additionally, it suggests focusing on a household's

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

capacity to get food rather than food production and enough food storage. Without a doubt, availability is meaningless if households lack the financial means to purchase the food for their households' use. As a result, food poverty would persist since the food is not efficiently distributed throughout the population.

Economic and Physical Access

The discussion of food poverty has expanded beyond the production of food for households to consider how well-equipped households are to acquire and distribute resources and food. This development emphasizes the determinants of economic and physical access to food security. Swindale & Bilinsky (2006a) discussed the economic access component as having enough resources to find appropriate foods for a healthful diet. Food prices, social assistance accessible to people, and household income are all included when defining access to food. Barrett (2002) asserts that access to food is limited by the resources that are accessible at all times, including channels of access, which are influenced by social and economic statuses. This is described by Sen (1981) as the effects of poverty.

The idea of poverty and food insecurity creates a vicious cycle. Though oddly centered on rural settings, literature has expressed the contradictory phenomena of poverty and food insecurity (Frayne *et al.,* 2010; Crush & Caesar, 2017). However, in addition to being financially feasible, physical access to food, facilitated by the availability of functional market chains and infrastructure, is essential to support food distribution and pricing (Barrett, 2010; Coates, 2013). The capacity of a household to receive food is therefore influenced by economic, physical, and social elements, which make up the access dimension.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Food Utilization

As worries about unequal access to and distribution of food among people arose, food poverty advanced. FAO increased the utilization dimension after discovering that simply increasing food access and availability was insufficient to guarantee personal food security. Utilization scales a person's capacity to get and consume nutritious food for a specific time. Imagine that despite individuals eating enough to feel content, their diets may not contain enough micronutrients (Swindale & Bilinsky, 2006a). Food utilization has both a socio-economic and a biological component. The socio-economic component revolves around intra-household dynamics with food sharing among household members, depending on who eats what. While the biological component concentrates on the human body's capacity to take in food, convert it into daily energy, or store it for use in the future, depending on the individual's genetic makeup. Utilization has also been described as concerns with eating habits and food preparation, which, according to Sassi (2015), can help households consume enough nutrients. Utilization is explicitly regarded as a third component since acquiring food is necessary but insufficient to ensure family food security (Capone *et al.*, 2014).

Stability (Non-vulnerability)

In acknowledgment that shocks in the other three pillars must be considered to achieve food security, the FAO included stability as the fourth dimension of food poverty. The degree of dependability with which the standards of the other three pillars are satisfied is thus reflected in stability (FAO, 2015). In the FAO definition of food poverty/security, the word "at all times" emphasizes the stability aspect of the concept. Coates (2013) found that households may suffer food insecurity shocks as a result of irregular shocks such as weather occurrences, conflict, and other factors that often cause food security status to change over time. The stability pillar strongly

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

emphasizes how households continually stockpile enough food and their ability to cope with adversity.

The emphasis on "at all times" following the stability dimension of FAO (2009) suggests firstly that household food poverty/insecurity status is examined at both the current and expected periods. Secondly, gains in food security remain constant 'at all times', and vulnerability to food poverty is reduced significantly. Thirdly, the potency of the coping tool/mechanism available to households to flatten food consumption shock should the dimensions fail, and households become vulnerable to food poverty (FAO, 2015). Therefore, following Coates (2013) that stability is rarely achieved, this study stemmed from the stability (failure) dimension of FAO (1996, 2009) cardinal definition of food poverty/security. The study assessed household food poverty not just in the current period like other previous studies proceeded, but vulnerability to food poverty expected in a prospective sense. The vulnerability analysis is hedged against using mobile money for remittances as the coping tool/mechanism available to households.

2.2.2 Vulnerability to food poverty

In recent years, there has been a growing understanding that analyzing food poverty requires a dynamic framework. Identifying the most vulnerable people, households, or communities is crucial while looking at the existing occurrence of poor nutritional outcomes. Vulnerability analysis is the primary analytical idea that has been created to address the problem of the potential occurrence of food poverty. Although the concept of vulnerability was initially used in the context of poverty (Holzmann and Jorgensen, 2000), it is now widely recognized as a crucial method for evaluating food poverty (Lvendal *et al.*, 2005).

Following Scaramozzino's (2006) arguments, the vulnerability approach has two key advantages. The method is deliberately dynamic and perspective in that it considers future occurrences and

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

current outcomes rather than focusing just on the present. As a result, it examines food poverty ex-ante rather than an ex-post result. Second, because the analysis is grounded in a stochastic framework, it can take into account all of the unknowns related to future food poverty, including the impact of external shocks and the coping mechanisms that households and communities can use to lessen the likelihood of unfavourable outcomes (Scaramozzino, 2006).

Regarding the best method for analyzing vulnerability, there is no clear consensus in the literature; additionally, rather than food insecurity, most vulnerability evaluations concentrate on (food) poverty (Scaramozzino, 2006). The influential entitlement theory of Sen (1988) connects vulnerability to limited access to assets, even intangible ones like social capital. Access to resources does not, however, ensure that they will be utilized wisely to lessen risk. For instance, the UK Department for International Development (DFID) builds its vulnerability analysis in terms of the personal assets and activities necessary to maintain or sustain livelihoods (Department for International Development, 2003). In contrast, the World Bank assesses household vulnerability using a risk-based methodology (World Bank, 2005). The Bank's "Social Risk Management" concept considers the community's capacity to handle related risks and the causes of vulnerability. The focus is primarily on reducing risk exposure; however, the strategy suffers greatly from not considering issues related to inadequate asset ownership or access.

Numerous organizations that work in developing countries, including the FAO, analyze vulnerability using methods for sustainable livelihoods (Devereux *et al*., 2003). Geographically speaking, the FAO identifies populations that are currently vulnerable and strives to understand the reasons why (Scaramozzino, 2006).

Thus, while there are several definitions of vulnerability, the major challenge has been in developing a robust vulnerability measurement compatible with the fundamental concepts of

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

dynamic analysis. Following Scaramozzino (2006), there are two major approaches to measuring vulnerability. The *outcome approach* assesses vulnerability based on the likelihood of (expected) poverty (Chaudhuri, 2001; Chaudhuri *et al.*, 2002). The *utility-based approach* estimates vulnerability as the difference between the utility a household would receive with certainty from consuming a certain bundle and the predicted utility of consumption (Ligon and Schecter, 2003, 2004).

The utility-based metrics of vulnerability contrast the predicted utility obtained from consumption versus the utility derived from the consumption of a specific bundle with certainty. The utility function may be broken down into several elements evaluating risk and poverty (Scaramozzino 2006). The benefit of the risk metric is that it may account for both overall and unique risks. This method may, in theory, determine if vulnerability affects people with low asset levels, unfavourable environments, or low returns on assets (Ligon and Schecter, 2003, 2004).

The metrics of vulnerability in the outcome approach differ depending on the conception of expected poverty. The expected headcount measure of poverty is used by Chaudhuri (2001), Chaudhuri *et al.* (2002), and Christiaensen and Boisvert (2000); Ravallion (1988) use the expected squared poverty gap to measure vulnerability, and Kamanou and Morduch (2002) consider expected changes in poverty rather than expected poverty. The outcome approach to vulnerability offers a quantitative assessment of the incidence of vulnerability, which is valuable in determining where households fall with the reference threshold since policy can be targeted at specific groups.

An alternative perspective on vulnerability is taken by Glewwe and Hall (1998) and Dercon and Krishnan (2000) by taking into account the household's capacity to smooth consumption through observed variations in consumption over time in response to shocks. The method employs an

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

internal rather than a socially established poverty threshold, although it is fundamentally comparable to the expected poverty approach.

Thus, following Løvendal and Knowles (2005), Løvendal *et al.* (2004), and Capeldo *et al.* (2010), a vulnerability in the context of food poverty refers to the probability of a household staying or falling below the food poverty line over time. By distinction, food insecurity analysis considers food insecurity as a lack of food at a given time and, thus, a static measure of welfare that categorizes households as "food poor" or "non-food poor"(Sileshi, 2019). Vulnerability to food poverty (VFP) analysis, on the other hand, considers the many shocks and hazards that may impact households in the future, such as price hikes, drought, unpredictable rainfall, etc., in measuring whether food consumption will fall below a specified threshold level. Households will be classified as "chronically food poor," "transitory food poor," "permanently non-food poor," or "transitory non-food poor" based on further vulnerability analyses (Scaramozzino 2006; Bogale 2012).

2.2.2.1 Determinants of household vulnerability to food poverty

Previous researchers have examined how vulnerable households are to food poverty as well as its causes using a range of econometric approaches (Bayudan-Dacuycuy and Lim 2014; Demeke *et al.* 2011; Chaudhuri 2003; Ogundari 2017; Bogale 2012; Mutabazi *et al.* 2015; Proag, 2014; World Bank 2000; Ellis 2003; Sen 1981; Gelaw and Sileshi, 2013; Sharaunga *et al.* 2015; Chaudhuri *et al.* 2002).

According to these researches, several variables contribute to vulnerability to (food) poverty. Sen (1981), for instance, used the entitlement theory to link household food vulnerability to a variety of present or anticipated variables of production, such as the household's output, assets, and reciprocal agreements. The most crucial elements for lifting impoverished households out of food

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

poverty are available production resources and coping mechanisms against shocks and hazards (Proag, 2014; Ellis, 2003). Sharaunga *et al*. (2015) suggested that reducing food poverty among rural households in developing nations requires empowering women in economic and physical capital capacities.

In the Morogoro area of Tanzania, Mutabazi *et al.* (2015) evaluated smallholder farmers' vulnerability using a three-stage FGLS. They discovered that farmers who believed humans were responsible for climate change were less likely to be at risk of (food) poverty. Additionally, households with consistent earnings were less likely to be exposed to outside shocks (Mutabazi *et al.* 2015; Alwang *et al.* 2001). The investigations by Devicienti (2002), Finnie & Sweetman (2003), and Jenkins *et al.* (2003) are among more empirical studies that have quantified vulnerability using income patterns and sources. Much research has also demonstrated how climate-related factors influence food poverty and vulnerability. For instance, Demeke *et al.* (2011) utilized panel data to determine the impact of rainfall shocks on the food vulnerability of smallholders in rural Ethiopia. They discovered that the rainy season's timing significantly impacted how secure a household's food supply was.

Chaudhuri (2003) and Chaudhuri *et al.* (2002) in Indonesia examined vulnerability to food poverty based on cross-sectional data from the nation. They concluded that the real cost of risk associated with food poverty was more than the outcome observed. Moreover, there was a disparity between the prevalence of food poverty present and vulnerability through various population features. Gelaw and Sileshi (2013) discovered that increases in the price of grain in Ethiopia substantially impacted households moving into and out of food poverty. Similar findings were made by Kimani-Murage *et al.* (2014) in the urban slums of Kenya, where they discovered that unemployment and the cost of staple commodities such as maize flour were important determinants impacting

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

vulnerability to food poverty. Other elements that have been linked to vulnerability to poverty and food insecurity include the source of the household's food (whether it comes from outside purchases or homegrown food), income, gender of the household head, household size, as well as access to remittances, geographic location, economic stability, educational attainment and occupational risk (Bayudan-Dacuycuy and Lim, 2014; Ogundari 2017; Bogale 2012; Azeem *et al.* 2017; Mutabazi *et al.* 2015).

2.2.3 The mobile money remittance channel

Prior to the 2008 and 2009 MoMo summits, which were held back-to-back, there was no agreement on the definitional concept of mobile money. The summits essentially described mobile money as any payment scheme carried out using mobile devices (Maurer, 2012). The International Telecommunication Union (ITU) (2013) defined mobile money as "services that enable customers to use their mobile devices to send and receive money or to transfer money electronically from one person to another using a mobile phone, and such transfers can either be a domestic transfer or an international remittance transaction." According to the ITU (2013), the private nature of the transfers makes MoMo transfer services unique. Consequently, moving money from one person to person (P2P).

A broader definition, according to Dolan (2009), is "a package of financial services made available through mobile phones and other portable mobile devices." (Dolan, 2009, p.5). Among these services are (i) person-to-person money transfers, such as domestic and international remittances, (ii) person-to-business payments for a variety of products and services, and (iii) mobile banking, which enables users to access their bank accounts, make deposits and withdrawals and pay bills (Dolan, 2009; Jenkins, 2008). The ACP Observatory on Migration (2014) divided MoMo services into three categories, namely "mobile banking, mobile payments, and mobile transfers," based on

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

the categorization provided above (p.6). Although mobile banking is one type of MoMo service, several studies incorrectly use the term to apply to all MoMo service types. People who already have accounts with traditional financial organizations (often banks) have access to mobile banking services, which allow them to conduct transactions in their accounts using their mobile devices. As a result, only those with established bank accounts are eligible for mobile banking, which gives them the ease of accessing their bank account(s) whenever it is convenient for them through a mobile device rather than going to the bank's physical location. In industrialized nations, mobile banking is quite popular (ACP Observatory on Migration, 2014).

Mobile payments and transfer services are the MoMo services frequently accessible in many developing nations. Bank accounts are not required for mobile transfers or mobile payment services. Practically, these services enable users to conduct transactions using an electronic account they construct for themselves and attach to their SIM cards. This account is referred to as a mobile wallet. The only way to access the account is with a personal identification number (PIN). Through a MoMo agent or another user, users may add or remove money from their wallets (ACP Observatory on Migration, 2014).

The ACP Observatory on Migration (2014) delineated that "mobile payment is a technology that enables unbanked persons to buy or sell products and services at a merchant shop/store (or remotely) using their mobile wallet through their mobile phone, instead of cash. Users of unbanked mobile devices can pay their utility bills with their mobile wallet." (p.7). However, "mobile transfer (also known as P2P or mobile remittances) is a service that enables unbanked people to send or receive small amounts of money to or from any other mobile phone user (even if they are subscribed to different telephone service providers) across the nation, from urban to remote rural areas, and across international borders" (ACP Observatory on Migration, 2014, p.7).

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

In Ghana, the banks provide customers who have an account with their mobile banking services. These people already have financial inclusion in the established financial system since they are bank customers. Mobile transfers and payments are the two remaining services that aim to offer financial services to the unbanked population. With the assistance of the banks, Ghana's telecommunications companies offer these services, which are governed by the Bank of Ghana. Using a mobile phone device to access financial services is the point of agreement across all definitions of the term "MoMo." In this study, MoMo services of relevance omitted mobile banking. In the context of this study, following ITU's (2013) definition, MoMo thus refers to mobile money transfer services, both of which are offered by Ghana's telecommunications sectors.

2.2.3.1 The economics of Mobile Money channel for stabilizing food security

Due to the novelty of mobile money and its recent adoption in many countries, some researchers have looked at its economics (Osei-Assibey, 2015; Baffuor *et al*., 2020; Mas and Klein, 2012; Jack, Suri, and Townsend, 2010; Jack and Suri, 2011; Weil *et al*., 2012) for various welfare implications. According to Karlan *et al.* (2016), the mobile money storage and payment system, as well as its additional links to formal bank savings accounts, credit, and micro-insurance, might enhance financial inclusion. More importantly, the mobile money channel for remittance transfers presents much lower reciprocal altruistic costs than other channels (Jack and Suri, 2014). Thus, mobile money can alleviate many welfare challenges, like stabilizing food security.

Lower costs of transactions

Mobile money is affirmed to lower the cost of transferring money, which is especially important given the insufficient and expensive transportation infrastructure. According to Jack and Suri (2014), remittances travel 200 kilometres on average in Kenya, where internal migration has widely dispersed families and social networks. Transportation costs for going to a bank, utility

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

company, or government office are an example of transaction costs. Other transaction costs include travel time and waiting in long lines as well as coordination costs between people, businesses, and the government that can result in significant time and financial losses as well as delays and "leakages" caused by corruption or middlemen, or total loss due to theft via unsecured payment methods (Morawczynski, 2009).

Moreover, Aron (2018) noted that missed money and time have an opportunity cost. The money and the time might have been better utilized if they had been invested, used, or preserved. The automated electronic transmission of cash transfers, salaries, social security benefits, and private remittances enhances the predictability of the time of financial receipts, which facilitates planning. By doing so, the costs associated with coordination, delays, and opportunity costs are further reduced.

According to Whitlock *et al.* (2007), these direct and indirect reciprocal altruistic costs advantages of mobile money present lower costs to both senders and receivers of remittances. This encourages more remittance transfers to the households and high net remittance income received. This will likely increase food consumption (Jack & Suri, 2016), better smooth food consumption and stabilize the household's food security.

Reduced information asymmetry and increased micro-credits

Radcliffe and Voorhies (2012), Aron (2018) acknowledge how mobile money ensures that financial transactions are recorded, increasing financial transparency and reducing information asymmetry. The failure of traditional banking to extend credit to the underprivileged and underserved, who lack collateral and credit histories, can be attributed to asymmetric information and the fixed expenses of maintaining an account. Cash becomes recorded when it is moved from

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

under the mattress to a mobile money account. Each deposit, withdrawal, transfer, or payment generates a documented financial history through mobile money. Aker *et al.* (2015) noted the connection between automated credit scores and the provision of modest loans through mobile money. Thus, mobile money provides a digital credit market where households can borrow to smoothen food consumption which can stabilize their food security.

Digital savings and changing the way people save/invest

There are various reasons to save. Dupas and Robinson (2013) indicated life-cycle incentives, such as making up for discrepancies in timing between incomes and spending streams, saving for school, consumer durables, house purchases, retirement, and funeral costs. Savings for precautionary reasons, such as unemployment, sickness, accidents, natural catastrophes, and old age risks, reflect the uncertainty of future income and expenses. Savings contribute to risk mitigation and consumption planning over time (Dupas and Robinson, 2013).

According to Radcliffe and Voorhies (2012), the absorption of the underserved and unbanked poor in real currency "generates significant frictions in their financial life." Cash-based households have various informal saving choices, including cash under the mattress, stockpiling assets like jewellery or cattle, and depositing funds with informal savings clubs, all of which involve risks of theft or "liquidation." Savings losses in this way are frequent. Electronic accounts with mobile money provide secure cash storage. The platform is also evolving with various interest-paying savings/investment opportunities that households may utilize for food consumption purposes 'at all times'. Dupas and Robinson (2013) argued that mobile money accounts provide a useful model in economic psychology research on how the poor should be encouraged to accumulate savings, such as using "commitment" savings accounts.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Risk and social insurance

The poor are particularly vulnerable to a variety of societal shocks, such as floods, droughts, plagues, other natural catastrophes, occasionally conflict, and medical epidemics, as well as individualized shocks like theft, damage to the homestead, illness, and family deaths. De Weerdt and Dercon (2006) noted that there are not many options for getting insurance against these shocks. Typically, there is no official insurance, but, family, clan, and network linkages can develop informal insurance networks that monitor and mitigate such risks through periodic transfers (De Weerdt and Dercon, 2006).

Mobile money promotes risk-sharing in several ways, according to Jack and Suri (2011). For instance, mobile networks' geographic reach might expand, while timely money transfers can stop major decreases that may be difficult or impossible to reverse. Due to the small and frequent money transfers made possible by mobile money technologies, negative shocks may be managed more flexibly (Jack and Suri, 2011). Thus, unofficial insurance networks could operate more successfully by preventing adverse effects on food consumption and increasing vulnerability to food poverty.

2.2.4 Review of the empirical literature

The current literature on mobile money is borrowed from similar innovative digital finance studies in the past because mobile money payment systems are still relatively new. This is generally divided into three categories: (a) studies that explain or predict the adoption of mobile money systems (e.g., Osei-Assibey, 2015; Manyegera & Matsumoto, 2016; Weil *et al.*, 2012); (b) studies that evaluate the systems' impact on people and economies (e.g., Baffuor *et al.*, 2020; Suri and Jack, 2016); and (c) a small number of studies that attempt to comprehend the use of such systems

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

in social, economic, and cultural contexts (Orlikowski & Iacono, 2001; Sein & Harindranath, 2004).

This study adds to the group of grossly inadequate impact studies both in scope and interests of mobile money. The focus of most impact studies in developing countries ended in financial inclusion for the underserved (Porteous, 2007; Ahmad *et al*., 2020). A few other studies extended the work beyond financial inclusion and deployed some single variable proxies for welfare impact analysis (for example, consumption expenditure, remittances, and savings, among others) (Morawczynski and Pickens, 2009; Jack and Suri, 2014; Shaikh *et al.*, 2019; Baffuor *et al*., 2020). Thus, the direct impact studies of mobile money on the incidence of food poverty and vulnerability to food poverty are new. The closest are a few recent studies on mobile money and the food security nexus, which are reviewed in a section. Largely, this section's empirical review on the subject under investigation is considered indirectly through transmissions such as reduced transaction costs and increased remittances, risk-sharing, and consumption smoothing. A few reviews on the potential hazards of using mobile money are also presented.

Reduced transaction costs and increased remittances

Baffour *et al.* (2020) recently looked at the effects of mobile money access on Ghanaian internal remittances, consumer spending, and household welfare. They employed the seventh round GLSS in their work. In their study, consumer spending and internal remittance were the main mechanisms via which mobile money adoption affected welfare. Using propensity score matching and dualizing findings for poor and non-poor households, they demonstrated that MoMo adopters receive noticeably greater remittances than non-MoMo users. Munyegera *et al.* (2016) study on the effect of mobile money and remittances on household well-being included 864 rural households. To determine the impact of mobile money on household welfare in terms of real per capita

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

consumption, the researchers used fixed effects, instrumental variables, and propensity score matching in their analysis. Their study's conclusions demonstrated that mobile money use positively and significantly impacts remittance. Their findings concur with those of Baffour *et al.* (2020). While the study objectives are similar, different estimation procedures were deployed in the two studies, but the effect on remittances was identical. However, the two studies did not draw any particular linkages between food poverty and food security.

Aker *et al.* (2016) examined the effect of payment mechanisms on anti-poverty programs using evidence from a mobile money cash transfer experiment in Niger. Their study was based on the fact that cash transfers have become an increasingly essential component of both wealthy and developing countries. While such programs are electronically administered in developed nations, similar payments are generally delivered manually in many developing countries with poor financial infrastructure, resulting in high economic costs to both program users and the government as the provider. They conducted a randomized controlled experiment using 96 villages as their sample size. The Nigerian government had previously identified these communities as having produced less than 50% of their consumption requirements during the 2009 harvest. The interventions for cash, mobile, or Zap were distributed randomly to these communities after stratification by administrative division. Evidence from their study shows that the Zap intervention had a more significant impact than monetary or mobile interventions. They found that if the required infrastructure is in place, mobile money might be an easy and affordable way to send financial transactions. However, improvements in food security, particularly FAO's food utilization dimension, were recorded for households on the Zap mobile transfer program. Children were recorded to have consumed 1/3 more of a meal each day, and food diversity was 9–16%

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

greater in households receiving Zap mobility transfers. The current study follows FAO's stability dimension for the vulnerability to food poverty analysis.

In rural Northern Uganda, Wiser *et al.* (2019) investigated the impact of introducing mobile money agents. In a random experiment, 168 regions were chosen randomly to receive an agent in 2017, while 163 regions served as the control group. The agent implementation may have enhanced the likelihood of sending and receiving peer-to-peer remittances, according to administrative statistics on mobile money transactions. The agent implementation reduced the cost of remittance transactions of more than 4,500 households. Additionally, it lowered the percentage of households with extremely low food security from 62.9 to 47.2% in locations remote from a bank branch. Their investigation revealed no impact on remittance savings.

Different from the observational studies of Munyegera *et al.* (2016), Baffour *et al.* (2020), the studies by Aker *et al.* (2016) and Wiser *et al.* (2019) are random experiments. However, they all conclude that the mobile money channel significantly increases remittance transfers at lower costs. Mbiti and Weil (2011) employed a difference-in-difference estimation procedure to investigate the usage of M-Pesa (mobile money) and its effects in Kenya. By analyzing data from two waves of individual data on financial access in Kenya, they discovered that M-Pesa lowers the costs of rival money-transfer services like Western Union. In other words, mobile money can even lower the remittance transaction costs of non-mobile money channels.

MoMo use, risk sharing and consumption smoothing

Jack & Suri (2014) utilized panel survey data from more than 2000 households to study the effect of mobile money use on risk sharing in Kenya. Using a difference-in-difference estimation strategy, they show that mobile money users successfully smoothed their consumption after

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

income shocks. For non-users, however, income shocks typically result in a 7% reduction in household consumption per capita. The authors demonstrate that mobile money users have a higher likelihood of receiving remittances following exogenous shocks. Compared to non-users, they have an average 13 percentage points higher likelihood of receiving money from others. These remittances come from a wider network, happen more frequently on average, and are worth more overall.

As a follow-up to their work in 2014, Jack & Suri (2016) compared the 2014 results of households who had relatively significant gains in access to mobile money agents with outcomes of households that did not by performing five survey rounds of a household panel beginning in 2008. Again using a difference-in-difference estimation strategy, they found that using mobile money helped 2% of all Kenyan households escape poverty. Jack & Suri (2016) particularly found that mobile money use provided short-term economic benefits of consumption smoothing raised per capita consumption significantly and can lift individuals out of extreme poverty (food poverty). They concluded that using mobile money in Kenya has long-term implications that generally lead to higher per capita consumption. Earlier works of Suri and Jack (2011, 2012, 2013, and 2014) using similar methodology showed that using mobile money allowed individuals to protect themselves against income shocks. They suggested that individuals drew on a wider network of social support and received more remittances quickly from different sources in response to negative shocks. Thus, mobile money users documented greater remittance transactions in response to unexpected adverse events (Suri and Jack, 2014) and overall shocks (Suri and Jack, 2013) that disrupt consumption.

Riley (2018) also studied consumption smoothing and spillover effects as she built on previous research in this area. She also utilized panel data from the Tanzania National Panel Survey to

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

examine self-reported shocks, remittances, wealth, and consumption among mobile money users and non-users. Using a difference-in-differences methodology, she also discovered that only mobile money users could avoid a significant decline in consumption following severe downpours. Two-thirds of the negative impact of the shock is accounted for by the fact that they receive, on average greater remittances – specifically, 4% of per capita income. Her research confirms the work of Jack & Suri (2014; 2016) that exogenous shock protection is a function of mobile money. Additionally, she provides evidence that non-users in the same communities cannot regulate their intake and do not appear to share risks as efficiently.

In rural Bangladesh, Lee *et al*. (2018) examined how mobile money transfers reduced inequality by experimentally providing mobile banking to people in Bangladesh's cities and rural areas. The sample comprised extremely low-income rural households with household members who have moved to the city. They found that the technology modernized antiquated, ineffective transfer procedures, and remittances from cities to rural areas rose 30% more than they did in the control group a year later. Rural consumption grew by 7.5%, and extreme poverty decreased for those who actively used mobile money. Rural households tend to borrow less, save more, and spend more during financial hardship. Urban migrants, however, paid the price, claiming noticeably lower physical and mental health.

In Mozambique, Batista and Vicente (2020), following a randomized control trial, provided evidence on whether mobile money is changing rural Africa. They worked with work with a sample of 1819 households from 102 rural areas in Southern Mozambique. They found that mobile money increased migration in villages with lower agricultural and investment activity. They particularly showed that mobile money increased consumption expenditure by 44% when rural households experienced a flood shock. Beyond the preceding experimental studies, an

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

observational study by Baffour *et al.* (2020) concluded that households that utilize mobile money often spend more on consumption than those that do not. This is because they received much more remittances.

Mobile money and food security

Compared to the objective of this study, the few previous studies on mobile money and the food security nexus are mainly partial, focusing only on the current period – and ignoring the 'at all times' stability emphasis of food security (FAO, 2009). Nonetheless, they provide a reference for comparing vulnerability to food poverty effect in this study.

In their research of panel data, Kikulwe *et al.* (2014), following FAO (2009) food production dimension, discovered that using mobile money increased household income, investments in agricultural inputs, and agricultural production. Aker *et al.* (2013) found evidence that children in households that received Zap mobile transfers consumed healthier and highly diversified meals every day in a randomized experiment that delivered cash transfers to households in Niger. Thus, mobile money enhances the first (food production) and, to some extent, the second (food utilization) definitional dimensions of food poverty/security, according to FAO (2009).

In the study by Murendo & Wollni (2016), household survey data was employed to analyze the effect mobile money has on household food security in Uganda. Their study analyzed food security using a static binary food insecurity measure and 7-day or 30-day recall period to elicit food expenditures. Their results showed that using mobile money reduced food insecurity among households. Beyond the static analysis, their study did not engage food poverty thresholds and followed FAO (2009) food utilization dimension. The current study pertains to FAO stability of food security as a result of using mobile money for receiving remittances for consumption.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

In that study in rural Uganda where Wiser *et al.* (2019) investigated the effects of adding mobile money agents in 168 regions while 163 regions acted as the control, they found that in areas far from a bank branch, mobile money use reduced households in severely low food security from 62.9% to 47.2%. In that study by Lee *et al.* (2018), many rural households in Bangladesh could not sign up for mobile money services because of their lack of English language competence. The treatment group was trained in the northwest district of the research by Lee *et al.* (2018), which used a randomized controlled trial design. Consequently, the trained households' usage of mobile money increased significantly from 20% to 70%. They found that extreme poverty (measured in food poverty) decreased as well, and the households that received treatment had an average 7% rise in consumption.

On a broader level of financial inclusion, Baborska *et al.* (2017) examined the effects of utilizing one, many, or all three of the formal financial services – savings, credit, and payments – on individuals' experiences with food security in rural regions throughout 88 low- and middle-income countries. The findings show conflicting impacts on food security. Depending on the kind of service provided, the results show a range of implications for food security. The likelihood that a person would experience food insecurity is greatly impacted by their use of savings accounts, significantly impacted by their use of credit, and unaffected by their use of formal payment systems. Their results support the idea that the ultimate experience of food security is determined more by specific characteristics than by the variety of services provided by the formal financial sector, especially when such characteristics might be linked to favourable income impacts.

A recent study by Gyasi *et al.* (2021) also examined the effects of financial inclusion on food insecurity among older Ghanaians and tried to discover the tasks that age and gender play in explaining the connection. A total of 1,200 persons aged 50 and above were included in the study.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Generalized linear models with a logit link function were used for the estimate. The results showed that aging individuals' food insecurity is decreased by financial inclusion.

The preceding studies, thus, were not conceptualized based on FAO stability dimension of food security. For instance, Baborska *et al.* (2017), Wiser *et al.* (2019), Lee *et al.* (2018), and Gyasi *et al.* (2021) all followed the FAO (1996; 2009) economic and physical access dimension of food security. Murendo & Wollni (2016) followed FAO (1966; 2009) food utilization dimension, while Aker *et al.* (2013) followed FAO food production and utilization dimensions. The current study thus contributes immensely to the stability dimension by examining the dependability of using mobile money to receive remittances for consumption as a coping mechanism.

2.3 Theoretical frameworks

The following key theories underline this study. The general households utility theory according to Singh *et al.* (1986), the economics of remittances and consumption according to Friedman (1957)/Modigliani (1976) PIH/LCH and the reciprocal altruistic cost of remittance channels (Trivers 1971; Whitlock *et al.* 2007; Hamilton, 1964a, b).

2.3.1 The General Household's Utility Theory

According to Singh et al. (1986), the general household's utility framework recognizes that households can produce and consume their own food. Therefore, the household maximizes its utility from the consumption of goods, which may be purchased or home-produced, subject to the production function, time and cash constraints (Singh *et al.*, 1986: Sadoulet and de Janvry, 1995).

Theoretically, the *ith* household maximizes its utility

$$U_i = u(C_h, C_m, l_i|x_i) \quad (2.1)$$

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

where U_i is a utility function that is twice differentiable, increasing in its arguments, and strictly quasi-concave; C_h is *i*th household's home-produced food demand, C_m is *i*th household's market-purchased food demand, l_i is the time devoted to leisure and x_i is the vector of household socio-demographic variables included in recognition that household utility is derived from the combination of decisions made by household members according to their preferences .

It is important to note that whether home-produced or market-purchased, household *i* demands both food C_f and non-food C_{nf} commodities.

$$C_i = (C_{hf}, C_{mf}, C_{nf}) \quad (2.2)$$

Substituting Eq. (2.2) in (2.1) yields Eq. (2.3)

$$U_i = u[(C_{hf}, C_{mf}), C_{nf}, l_i|x_i] \quad (2.3)$$

Where $C_f = (C_{hf}, C_{mf})$, $C_h = (C_{hf}, C_{nf})$, $C_m = (C_{mf}, C_{nf})$. C_i being a vector of household *i* consumption demand, C_{hf} is home food demand of household *i*, C_{mf} is market food demand and C_f is a vector of food demanded by household *i*.

If household *i* produces food that it also consumes, which is consequently subject to certain constraints of production, income and time factors, the optimization of Eq. (2.3) requires that the household's production and consumption decisions are made separately on the assumption that they are all relevant to the market. In this case, production decisions are first made and then subsequently used in allocating the income between the consumption of goods and leisure (Strauss, 1983). According to Feleke *et al.* (2005), it is important to make this assumption because household food consumption and food poverty often depend on production variables, but not vice

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

versa. The argument by Feleke *et al.* (2005) supports the cardinal definition dimensions of food insecurity by FAO (1996, 2009) that food must be produced first (availability dimension) before it can be accessed or utilized.

Similar to the work of Singh *et al.* (1986), the production, income, and time constraints imposed in the course of optimizing Eq. (2.3) are specified as follows:

Household ith utility is maximized subject to a production constraint:

$$f(Q_h, L, A, K) = 0 \tag{2.4}$$

Eq. (3.4) is a typical household production function for food Q_h produced at home and assumed to be twice differentiable, increasing in outputs, decreasing in inputs, and strictly convex; A is household's fixed quantity of land, K is the fixed capital stock; L is total labour input.

Cash income constraint:

$$P_{hf}(Q_h - C_{hf}) - P_{mf}C_{mf} - P_{nf}C_{nf} - w(L-l_h) + Y_{nh} = 0 \tag{2.5}$$

Where P_{mf} and P_{hf} are the prices per unit of market-purchased food and home-produced food respectively, Q_h is the household's production of the home food (so that $Q_h - C_{hf}$, is its marketed surplus and $P_{hf}(Q_h - C_{hf})$ is the total household income from sales of surplus foods). $P_{mf}C_{mf}$ is total household expenditure on market-purchased food, $P_{nf}C_{nf}$ is total household expenditure on non-food items, w is the market wage, L is total labour input, and l_h is family labour input (so that $w(L - l_h)$ if positive, is total expenditure on hired labour). Y_{nh} is exogenous income such as remittance.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Time constraint:

$$l_h = T - l_i \tag{2.6}$$

Where T is household *i*'s time endowment received in each time period, which is allocated between leisure l_i and time spent working l_h.

Substituting the right-hand side (RHS) of Eq. 2.6 into 2.5 and expanding gives

$$P_{hf}Q_h - P_{hf}C_{hf} - P_{mf}C_{mf} - P_{nf}C_{nf} - wL + wT - wl_i + Y_{nh} = 0 \tag{2.7}$$

Re-arranging Eq. 2.7 to explicitly account for household income and expenditure gives:

$$P_{hf}Q_h + wT + Y_{nh} - wL = P_{hf}C_{hf} + P_{mf}C_{mf} + P_{nf}C_{nf} + wl_i \tag{2.8}$$

The left-hand side (LHS) of Eq. 2.8 is household *i*th income (HH income). The household income comprises of the value of food-produced food $P_{hf}Q_h$, value of HH's time endowment *w*T, the value of labour used *w*L, and exogenous income Y_{nh}. Likewise, the RHS is equivalent to household *i*th expenditure (HH expenditure). The household expenditure includes the value of home produce food consumed $P_{hf}C_{hf}$; value of market purchase food consumed $P_{mf}C_{mf}$; value of non-food expenditure $P_{nf}C_{nf}$ and purchase of leisure *wl*

The optimization of Eq. 2.3 gives rise to the income and expenditure equation within the separability assumption, which is necessary to have first-order conditions. It is equally possible via optimization of Eq. 2.8 to yield consumption demand and production equations separately as discussed below.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

The demand for inputs and output produced for household i that produces its food at home can be derived by maximizing the first-order condition of the LHS of Eq. 2.8 with respect to labour (L) and output produced (Q) as:

$$L^* = l(P_{hf}, w, A, K) \quad (2.9)$$

$$Q^* = Q_h(P_{hf}, w, A, K) \quad (2.10)$$

Where L* is the optimum labour used and Q* is the optimum output. Substituting Eqs. 2.9 and 2.10 into LHS of Eq. 2.8 gives optimum income/full income Y* under the assumption of maximized profit π^* as:

$$Y^* = P_{hf} Q^* + wT + Y_{nh} - w L^*$$

$$Y^* = wT + \pi^*(P_{hf}, w, A, K) + Y_{nh} \quad (2.11)$$

Where $\pi^*(P_{hf}, w, A, K) = P_{hf} Q^* - w L^*$

So that a variable of interest which is household *i*'s demand for food C_f can be derived by solving the first-order conditions of the RHS of Eq. 2.8. However, recall in Eq. 2.3 that C_f is a vector of C_{hf} and C_{mf}, which depend on their respective prices. This relationship can be specified as:

$$C_f = C_f(P_{hf}, P_{mf}, P_{nf}, w, Y^*) \quad (2.12)$$

Eq. 2.12 suggest that household *i*th optimum demand for food consumption to be food secure is a function of the prices of optimum food and non-food items demanded, wage rate and household income Y^*(the causal effect on consumption discussed through PIH/LCH perspectives). However, the general household utility model has been adopted in various modifications, particularly for

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

modeling household food poverty. For instance, household *i*th demand for food also depends on the preferences of its members as represented by household demographic characteristics conditioned in Eq. 2.1 . Moreover, granted that household *i* food demand is only within the basic framework of Eq. 2.12, then any significant negative changes in any of the variables in Eq. 2.12 could lead to a shock in food consumption. For instance, Sadoulet and de Janvry (1995) found that changes in the prices of market-purchased foods and non-foods can affect household *i* food demand and may cause food consumption shock.

Eq. 2.12 could therefore capture changes in household food consumption if the household experience such common shocks. Thus, Eq. 2.12 is a good basis for measuring adverse changes in the optimal C_f that may predispose the household to food poverty, given the sources of vulnerabilities and coping mechanisms available. C_f is therefore, the reduced form of the utility function in Eq. 2.1(Ogundari, 2017; World Bank, 2002). However, the optimal food demand of each household is unobserved, thus the use of the per adult equivalent food consumption energy required for daily living (Christiaensen and Subbarao, 2005; Chaudhuri *et al.*, 2002). We can therefore write the following relation for C_f, which feeds into empirical modeling in the next chapter.

$$C_f \approx [\text{Per adult equivalent food consumption}]$$

However, the optimum daily per adult equivalent food consumption required by FAO (2009) depends on the optimum satisfaction of the dimensions of food availability, economic and physical access, utilization, and stability. That is

$$C_f \approx [\text{Per adult equivalent food consumption}] = f(\text{food availability, economic/physical access, utilization, stability}) \quad (2.13a)$$

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Following unstable satisfaction of these dimensions at 'all times', FAO recognizes vulnerabilities to food welfare and emphasizes coping mechanisms, which is the focus of this study (Coates, 2013). Thus C_f may well be considered a function of vulnerabilities and coping mechanisms.

$C_f \approx$ [Per adult equivalent food consumption] = f(vulnerabilities, coping mechanisms) (2.13b)

Underlying assumptions and constraints of the theory

The household food demand function C_f is derived from a profit function at equilibrium that obeys the usual constraints from the theory of the firm: homogeneity of degree one in prices and convexity with respect to prices. The household food demand function is a function of commodity prices (full income), possible household level and covariate characteristics. When household income is held at full income (at constant), C_f is assumed to satisfy the usual constraints of demand theory: adding up to total expenditure; zero homogeneity with respect to prices and exogenous income; symmetry and negative semi-definiteness of the Slutsky-substitution matrix (Singh *et al.*, 1986; Pangaribowo *et al.*, 2013). Some of these constraints are used to specify the empirical model for estimation. For instance, zero homogeneity with respect to prices implies that changes in P_{hf}, P_{mf}, P_{nf}, w may have no effect on C_f and the researcher may include or exclude them depending on the quality of data available. Moreover, within this household utility theory, households are considered price takers (Singh *et al.*, 1986), and P_{hf}, P_{mf}, P_{nf}, w are often held unchanging in model specifications (Ogundari, 2017).

Another vital property that C_f is additively separable (Singh *et al.*, 1986) particularly guided a linear empirical specification of the vulnerability index model.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

2.3.2 Permanent Income Hypothesis/Life Cycle Hypothesis

As originally articulated by Friedman (1957), the PIH assumes that consumers; (i) prefer a smooth pattern of consumption, (ii) are farsighted and have a clear vision (no uncertainty) about future income, and (iii) are able to borrow. Based on this set of assumptions, they are able to maximize "lifetime" or permanent consumption. According to the PIH, the observed value of consumer's income (YO) comprises two components, permanent income (YP) and transitory income (YT); YP includes current income plus expected income from various forms of assets, YT is windfall gains measured by (YO - YP). Consumers form an estimate of YP and assign an appropriate fraction for consumption. YT does not affect consumption since its expected value equals zero; also YT and YP are uncorrelated.

The role of transitory income on consumption is crucial to the PIH, which assumes that it is 'windfall gains' (the random variation from average income) and is non-correlated with consumption. In earlier studies, Doenges (1966) and Kreinin (1961) examined the marginal propensity to consume (MPC) between transitory income and permanent income; they arrived at different conclusions. Modigliani (1966) life cycle hypothesis (LCH), which is an extension of PIH suggests that transitory incomes (such as remittances) are saved/invested for lifetime consumption smoothing. The World Bank (2006) notes that households view remittances as transitory income rather than permanent and should be saved rather than spent in the current period. Willassen (1978) argues, on the other hand, that if the "windfall gains" (transitory income according to PIH) are anticipated, they should be incorporated into recipients' budget plans and should not be regarded as a random variable. Therefore, within the PIH/LCH, whether remittance as transitory income could affect consumption is debated based on whether it is regular or can be anticipated not to fail.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Evoking PIH, that there is no correlation between transitory and permanent components of income (Friedman, 1957), the impact of household income Y^*on C_f in Eq. 2.12 depends on whether Y^*(in Eq.2.11) is permanent ($wT + \pi^*$) or transitory (Y_{nh}). Following the World Bank (2006) that remittances are transitory income, the significance of using mobile money for receiving remittances on consumption is evident to the extent that it defies this theory in the current period without jeopardizing consumption smoothing ability. If this is achievable through mobile money, then there are implications for FAO (2009) stability dimension, which also demands stability in the optimal food consumed 'at all times'. Thus, Friedman (1957)/ Modigliani (1966) PIH/LCH connects seamlessly with FAO stability dimension of food security and theoretically provides an economic basis for this study.

2.3.3 Theory of reciprocal altruism

The revolutionary theory of reciprocal altruism stems from the theory of reciprocity (Lévi-Strauss, 1969) and an act of altruism defined by Trivers' (1971). According to Lévi-Strauss (1969), reciprocity has long been a crucial component of African nations' social structures rather than an afterthought to their nation's inability to provide for all their needs. Africans who engage in exchange relationships understand that giving resources confers a right to receive, and obtaining resources obligates one to provide resources in return. These give-and-take exchanges foster relationships, trust, and a sense of belonging in a setting where reciprocity is explicitly encouraged. Frequent interactions between relatives create a strong sense of hope that assistance is always on the way, making it easier to feel secure in the face of risks caused by the cycle of excess and scarcity.

Indeed, in Africa, the extended family has evolved into a "vehicle for sharing the benefits of migration" (Findley, 1997, p. 120). Families typically rely heavily on remittances from distant

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

relatives to meet their necessities, ease cash flow problems and provide mutual insurance (Sander & Maimbo, 2005). Remittances are countercyclical since they grow during economic hardship (Quartey, 2006). Cash transfers from urban to rural or from abroad migrants are extended for household heads to distribute to kin members, giving a special sense of support and solidarity to the extended family.

Tsai and Dzorgbo (2012) used a common saying among the Akans, Ghana's biggest ethnic group, to reflect the normative viewpoint of reciprocity; *"If your parents watched after you to develop your teeth, you must watch over them to lose their teeth."* Thus, Ghanaians generally believe that kinfolks are always willing to help. However, reciprocity may not be the balanced norm in real life, and aberrations are obvious (Tsai and Dzorgbo 2012).

As Whitlock *et al.* (2007) interrogated, reciprocity may have many advantages for African households, but what about the costs? They contend that for cooperation or charity to evolve through reciprocity, an action's benefits must surpass its costs. According to Trivers (1971), an altruistic act provides advantages to the recipient while incurring direct costs to the giver (despite indirect positive effects to the giver). The evolution of altruism is determined by three factors that are relatable to the use of mobile money for transferring remittances; the cost to the giver of the altruistic act, the benefit to the recipient, and some measure of the relative likelihood that the act will eventually lead to a net gain/loss for either the giver or the recipient (Whitlock *et al.*, 2007; Hamilton, 1964a, b).

The evidence from the Ghana Statistical Service (2017) indicated that more than 60% of households receive regular remittances, suggesting that reciprocity works in households in Ghana. However, remittances are transferred at a cost to both the giver and the recipient, suggesting that the altruistic act comes at a cost. Thus, the predominant use of mobile money for receiving

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

remittances by households reduces both the direct and indirect costs of transferring remittances (GSS, 2017). The theory of reciprocal altruism is, therefore, precise for this study.

2.4 Conceptual framework

Based on the depth of the literature reviewed, this study conceptualized a working framework as follows. Three critical theories framed the concept of this study. The reciprocal altruistic cost-effectiveness of using mobile money channels for remittances compared to non-MoMo channels (reciprocal altruism) (Trivers 1971; Whitlock *et al.* 2007; Hamilton, 1964a, b), the economics of remittances and consumption according to Friedman (1957)/Modigliani (1976) PIH/LCH and FAO (2009) stability dimension of food security 'at all times'. The motivation of this study follows FAO (2009, 2015) stability dimension of food security which reflects the degree of dependability with which the standards of the other three pillars – food availability, utilization and economic access – are satisfied. FAO emphasizes that a standard of the pillars that guarantee household food security must be stable 'at all times'. In reality, however, household-level and covariate shocks predispose households to both incidence and vulnerability to food poverty (Coates, 2013). Thus, the FAO stability pillar strongly emphasizes how households mitigate vulnerability to food poverty and the reliability of available coping mechanisms over time (FAO, 2015).

The emphasis on "at all times" following the stability dimension of FAO means that the relevance of a coping tool/mechanism for household food poverty/insecurity is not a case in one-period static analysis. FAO emphasizes how reliable a coping mechanism available to a household is to flatten food consumption shocks that occur and predisposes households to food poverty over time. This study assessed the relevance and dependability of using a digital finance innovation – mobile money – for receiving remittances by some households as a coping mechanism vis-à-vis households that used other channels.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Following the reciprocal altruism of Hamilton (1964), this study conceptualizes that the reciprocal act of remittance support among households is not without altruistic costs– direct (transaction costs) and indirect costs (Whitlock *et al.* 2007; Hamilton, 1964a, b). Based on several adoption studies (Suri and Jack, 2011, 2014; Kirui *et al.*, 2013; Kikulwe *et al.*, 2014), using mobile money channels for remittances was found to present lower altruistic costs compared to non-MoMo remittances channels. This presents lower costs to the sender and the receiver, thus encouraging more remittance transfers to the household. Low altruistic (e.g. transaction) costs at the household level also reflect higher net disposal remittances received. Following the few impact studies (Aker *et al.*, 2013; Lee *et al.*, 2018; Murendo and Wollni, 2016), this is expected to increase food consumption in the current period, contrary to PIH/LCH postulates of Friedman (1957)/Modigliani (1976).

As theorized by Friedman (1957) and Modigliani (1976) PIH/LCH, remittances are 'windfall gains' which, according to the World Bank (2006), must be saved/invested in the current period for consumption smoothing rather than consumed. Given that remittances may or may not come to the households, the implications of using remittances received mainly for consumption rather than savings in the current period borders on food consumption smoothing ability, all other things being equal. Contrary to PIH/LCH, if households use MoMo to receive remittances for only consumption purposes in the current period instead of savings, food consumption smoothing ability may suffer (Friedman, 1957; Modigliani, 1976); all other income sources constant. This is particularly true for food-poor households who are also the extreme poor with minimal sources of income.

Thus, this study conceptualized that the significance of using mobile money for receiving remittances is found if it defies Friedman (1957)/Modigliani (1976) PIH/LCH but meets FAO

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

(2009) stability expectations by lowering household vulnerability to food poverty. The study further conceptualized that whether this will occur depends on the extent of utilization of MoMo channels to receive remittances for consumption among food-poor and non-food-poor households.

2.5 Conclusion

The literature reviewed in this chapter makes the case that the effect of using mobile money to receive remittances for consumption on vulnerability to food poverty is not straightforward. The previous empirical literature may have oversimplified the transmission mechanisms for remittances and food consumption. Mobile money use may raise remittance levels and increase food consumption in the current period. However, if remittance savings is jeopardized, food consumption smoothing ability may suffer, and food security stability may be affected. Thus, if using mobile money for receiving remittances will defy this status quo and stabilize food security, other transmission conditions, as reviewed, are imperative.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter discusses and presents the research method, data sources, and variables utilized in the study. The chapter also discusses and explains the empirical model and estimation procedure for the analyses.

3.2 Research design

This study's delineation of the research design follows Almalki (2016). The study's objectives are such that it necessitated following a complete research process, from conceptualizing the research problem and following relevant theories through to the results. The study is thus necessarily quantitative in design and used secondary cross-sectional data.

3.3 Data Source

This study used data from the seventh wave of the GLSS to examine the relative effects of using mobile money to receive remittances on households' vulnerability to food poverty in Ghana. For this study and in line with its objectives, the relevant data captured in the GLSS7 include data on household per adult equivalent food consumption expenditure, channels of receiving remittance receipts (MoMo or non-MoMo), use of received remittances by remittance channel, household level socio-demography characteristics and other community covariates.

The Ghana Statistical Service conducted the seventh edition of the GLSS in 2016–2017, and it is the most current national household survey for which data have been gathered. The Ghana Statistical Service has conducted the GLSS, a periodic national cross-sectional household survey, since 1989. The GLSS round 7 is a nationally representative survey of about 14,009 households

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

and over 59,000 individuals from regions and locations for households chosen at random from enumeration areas (EAs). The overall sample for the study was arrived at after matching the relevant datasets from the GLSS round 7. After merging and cleaning the datasets, the final sample size used in this study totalled 5,435 households.

The main limitation of the GLSS7 dataset is the potential effects of bias due to missing data. The bias would serve not only to distort results, but also to reduce the capacity of estimation procedures employed in the analyses to detect effects. In this study variables with large missing data were excluded from the study. Minor missing data some variables were cleaned in arriving at the final sample of 5,435 households.

Another limitation is the failure to have underlying normal distributions for some continuous variables. The failure to have underlying normal distributions would not only be likely to influence the use of significance tests, but could also influence the use of certain maximum likelihood estimation procedures. However, appropriate transformations were used under careful considerations to normalize these variables where necessary in this study.

3.4 Overview and operationalization of variables

Theoretical and empirical literature influenced the conceptualization, choice, and operationalization of the variables used in this study. The study's objectives and the data availability also serve as guidelines for selecting variables. The inclusion criteria of variables for the empirical model specification were also subjected to best fit and multicollinearity tests (VIF), such that variables that passed the goodness of fit were finally used for the study (Appendix B; tables B1/2). Tables 3.1, 3.2 provides an operational overview of the variables used in the study.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

3.4.1 Measuring household incidence of food poverty

A headcount food poverty approach based on the FGT (1984) index was used to estimate the incidence of food-poor and non-food households in the current period. Despite the fact that several poverty measures have been acknowledged in the literature, the Foster-Greer-Thorbecke (FGT) family of poverty indices are still the most often used, providing a distributive sensitive measure through the selection of a 'poverty aversion' parameter (Tassew *et al.*, 2008).

Thorbecke *et al.* (1984) developed the FGT multidimensional poverty index based on the seminal works of Sen (1981, 1999) that the measurement of poverty is beyond a unidimensional phenomenon. Kimalu *et al*. (2002) pointed out that one poverty measure that has been found to dominate the literature on poverty analysis and is manageable in presenting information on the poor in an operationally convenient manner is the FGT measure developed by Foster *et al*. (1984).

Following Foster *et al*. (1984), this measure is used to quantify the three well-known elements of food poverty; the headcount food poverty index, the food poverty-gap index, and the severity of the food poverty index (WBI, 2005; Tassew *et al.*, 2008).

The FGT (P_α) is given by the formula;

$$P\alpha_i = \frac{1}{N}\sum_{i=1}^{q}\left[\frac{Z-Ci}{Z}\right]\alpha \qquad (3.0)$$

Where $P\alpha_i$ is headcount food poverty (for $\alpha = 0$)

Z is the set food poverty line (section 4.6)

C_i is the annual per adult equivalent food consumption expenditure for household (HH) i.

N is the total sample size for the study

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

q is the total number of food-poor households

α is the poverty aversion parameter.

Per the FGT headcount approach, all households with $C_i < Z$ are food poor in the current period, while those with $C_i \geq Z$ are non-food-poor (WBI, 2005; Tassew *et al*., 2008).

3.4.2 Measuring household vulnerability to food poverty (VtFP)

The probability of a household becoming food poor over a time horizon was estimated following vulnerability as expected poverty (VEP), a model approach following Chaudhuri *et al.* (2002), Christiaensen and Subbarao (2005), utilizing per adult food consumption expenditure (PEFCE). VEP accounts for risks to the household and coping mechanisms that may plunge a household below a minimum threshold of food poverty. Vulnerability as expected food poverty is the likelihood of a household (h) at time (t) being food consumption poor in time j. Households' vulnerability from the current period is expressed as

$$V_{ht} = P(C_{ht+1} < Z) \quad (3.1)$$

A household's vulnerability (V_{ht}) or likelihood of expected food poverty is determined by the probability that the expected household optimal food consumption (C_{ht+1}) will be below the food poverty line (Z), and $j=t+1$. Estimating vulnerability thus involves determining the probability distribution of expected food consumption. Assuming the probability distribution is log-normal, estimating the mean and variances of expected food consumption will effectually determine that distribution (Sileshi *et al*., 2019).

The VEP method estimates have always been a function of the predicted mean and variation of household PEFCE. The predicted mean of PEFCE is defined by community and household variables, whereas the volatility in household consumption reflects the idiosyncratic shocks that

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

add to the variation in PEFCE levels for households with common traits (Échevin, 2013; Bogale, 2012; Gunther and Harttgen, 2009). In line with Chaudhuri (2003) and considering Eq. 2.12/13, the household food poverty vulnerability index was estimated by the VEP approach following the probabilistic process;

$$lnC_f = X_i\delta' + \varepsilon_i \quad (3.2)$$

where C_f in this study follows Eq. 2.13 above, the optimum household demand for food consumption is usually unobservable and measured by household per adult equivalent food consumption. Following Chaudhuri (2003) and Sileshi *et al.* (2019), household per adult equivalent food consumption expenditure was used as a proxy. Since the expected food poverty reflects the possibility of expected household food consumption expenditure falling below the food poverty line (that is a possible unfavourable change in C_f), this study used the real household per adult equivalent food consumption expenditure (PEFCE) as a proxy for C_f unobserved. X_i is a vector of household-level characteristics and covariates defined in table 3.1 below. δ is a vector of parameters, and ε_i is a mean-zero disturbance factor that takes idiosyncratic shocks into account. The variance of the disturbance term is taken as a function of the household variables to examine the probability of a household with low per-adult equivalent food consumption experiencing high food consumption volatility compared to a household with high mean food consumption:

$$\sigma_{\varepsilon i}^2 = X_i\rho' + \mu_i \quad (3.3)$$

Following Chaudhuri (2003), Amemiya (1977), Christiaensen and Subbarao (2005), the estimations of δ and ρ were determined using the three-step feasible generalized least squares method (3-FGLS). In the first stage, ordinary least squares was used to estimate Eq. (3.1). The predicted residuals from Eq. (3.1) were used to run the following model:

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

$$\hat{\varepsilon}^2_{OLS,i} = X_i\rho' + \mu_i \quad (3.4)$$

The estimates determined from Eq. (3.3) were used to transform Eq. (3.4) as follows:

$$\frac{\hat{\varepsilon}^2_{OLS,i}}{X_i\hat{\rho}_{OLS}} = \frac{X_i}{X_i\hat{\rho}_{OLS}}\rho' + \frac{\mu_i}{X_i\hat{\rho}_{OLS}} \quad (3.5)$$

The OLS estimate of $\hat{\rho}$ in Eq. (3.3) produced an asymptotically FGLS estimate of ρ, that is, $\hat{X}\rho_{FGLS}$ being a consistent estimator of $\sigma^2_{\varepsilon i}$. Equation (1) was transformed as follows:

$$\frac{lnC_f}{\widehat{\sigma_\varepsilon}} = \frac{X}{\widehat{\sigma_\varepsilon}}\delta' + \frac{\varepsilon}{\widehat{\sigma_\varepsilon}} \quad (3.6)$$

Where $\widehat{\sigma_\varepsilon} = \sqrt{X\hat{\rho}_{FGLS}}$. The asymptotically FGLS estimator $\hat{\delta}_{FGLS}$was obtained from the OLS estimation of Eq. (3.6), allowing the study to estimate the expected log food consumption expenditure and its variation as;

$$E\left[lnC_f|X_i\right] = X\hat{\delta}_{FGLS}$$

$$Var\left[lnC_f|X_i\right] = X\hat{\rho}_{FGLS}$$

At time t + 1, the probability that a household would be food insecure or each household's vulnerability to food index (VFI) can be written as follows, assuming food consumption is distributed log-normally.

$$\hat{V} = \hat{P}\left(lnC_f < lnZ|X_i\right) = \emptyset\left(\frac{X\hat{\delta}_{FGLS} - lnZ}{\sqrt{X\hat{\rho}_{FGLS}}}\right) \quad (3.7)$$

Where $\emptyset$ is the cumulative density function of the standard normal distribution. $X\hat{\delta}_{FGLS}$ and $X\hat{\rho}_{FGLS}$ are the expected household food consumption expenditure and the standard error of the

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

regression, respectively, Z is the food poverty line, and $\hat{V}$ is the probability that each household's vulnerability to the food poverty index ranges between zero and one.

3.4.2.1 Choosing the vulnerability threshold and time horizon

Following other studies, the vulnerability threshold is determined using the popular benchmark poverty rate of 0.5 and a time horizon (j) of two years (Zhang and Wan, 2008; Azeem *et al*., 2018; Novignon *et al.*, 2012; Chaudhuri *et al*., 2002). Any household with a 50% chance of becoming poor in the following period is considered susceptible to poverty, according to the benchmark poverty rate. Based on a benchmark poverty rate of 0.5, the vulnerability threshold (v^*) for the next year, two years, three years and so on can be determined using the v^*relation below (Chaudhuri *et al.*, 2002; Koomson *et al*, 2020). For this study, the thresholds for the next three years are correspondingly determined as 0.50, 0.29, and 0.11.

$$v^* = 1 - \sqrt[n]{1 - v_n}$$

Since this study utilized cross-sectional data, vulnerability analyses are meaningful for *j*=2 years (Koomson *et al*, 2020). Thus, following (Chaudhuri *et al*., 2002; Azeem *et al*., 2018; Koomson *et al*, 2020; Novignon *et al.*, 2012), this study defined households with a probability greater than or equal to 0.50 as vulnerable to food poverty, while households with probabilities less than 0.50 are non-vulnerable.

3.4.2.2 Expected sign of the nexus between MoMo use and VtFP

Following the conceptual framework above, the expected sign of the effect of using MoMo for receiving remittances on VtFP is not straightforward. If using mobile money for receiving remittances also promoted the depletion of remittances (both received and saved) in the current period, then we expect a positive relationship between the use of MoMo for receiving remittances

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

and vulnerability to food poverty. However, as conceptualized, the significant utilization of MoMo channels to receive remittances by households compared to non-MoMo channels could override this expectation and negatively affect VtFP.

On the other hand, if using mobile money for receiving remittances also promoted savings or asset accumulation in the current period following PIH/LCH (World Bank 2006; Friedman 1957; Modigliani 1976), we expect a negative relationship between using MoMo to receive remittances and vulnerability to food poverty.

For estimating the vulnerability to food poverty index $\hat{V}$, the household level and covariate variables X_i used that are theoretically fitting are operationally defined below.

Table 3. 1: Operationalization of variables for estimating $\hat{V}$

Variable name	Operationalization
Vulnerability to food poverty Index	
V	1 if V greater than or equal to 0.50, vulnerable to food poverty 1 if V less than 0.50, non-vulnerable to food poverty
Dependent consumption variable	
PEFCE	Household per adult equivalent food consumption expenditure
HH level & covariate Characteristics	
Age(yrs)	Age of an individual (years)
Employment status	1 if household head is employed; 0 otherwise
Educational status	1 if household head is educated; 0 otherwise
Gender	1 if individual is female; 0 otherwise
HH location	1 if household is located in rural area; 0 urban
Marital status of HH head	1 married, 0 unmarried
Food remittance	Total food remittance received
Regularity of remittance	1 if household receive regular remittance; 0 otherwise
Household size	Number of household members
Participation in comm. cooperative	1 household belong to community cooperative, 0 otherwise
Buy/sell farm land in comm.	1 land is bought/sold in community, 0 otherwise
Community irrigation	1 irrigation is practiced in community, 0 otherwise
Religion	Religious background/affiliation
Real total HH expenditure	Real total household expenditure
Risk preference	1 HH head is risk averse, 0 risk lover
Time preference	1 HH head prefer immediate reward, 0 prefer delay reward
Fertilizer(yes)	1 farmers in community access fertilizer, 0 otherwise
Rice/maize husking machine	1 husking machine in community, 0 otherwise
Access to comm. market	1 community have market, 0 otherwise

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Poverty status	1 poor household; 0 non-poor household
Food CPI	Food price index
Non-food CPI	Non-food price index

3.4.3 Choosing the food poverty line

In order to analyze food poverty, a cut-off point known as the food poverty line has to be identified. Over the years, the formulation of a food poverty line was mostly subjective and dependent on data availability. Four methodologies were used to determine the food poverty line in different contexts; direct calorie intake (DCI), food energy intake (FEI), cost of basic necessities (CBN), and arbitrary choice of index (ACI) (Novignon *et al*., 2012). Each of these methodologies has its strengths and weaknesses, but their adoption is largely dependent on data availability in developing countries (Ozughalu, 2016).

For robustness, food poverty in this study was determined at national and international food poverty lines. This is because even though calorie requirements vary slightly across countries, FAO (2009; 2013) suggests that a food basket that delivers a minimum of 2100 kilocalories per day is good enough for a healthy adult life.

3.4.3.1 National food poverty line

The food poverty line for Ghana derived by the Ghana Statistical Service (2018) based on per adult calorie equivalent is set at GH¢982.2 per adult equivalent per year for a minimum food basket that delivers 2900 kilo calories per day. This line is the extreme poverty line for Ghana which is derived from the GSS (2018) by concentrating only on food consumption expenditure. The approach by the GSS (2018) followed the conversion of the 2016–17 GLSS data into annual adult equivalents and employed the FGT model to categorize the extreme (severely) poor from the non-poor. The extremely poor households based on this poverty line are the food-poor households whose per

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

adult equivalent food consumption expenditure is insufficient to fulfil the minimum calorie requirement of 2900 kilo calories per day (GSS, 2018).

3.4.3.2 International food poverty line

The FAO, in partnership with the WFP/World Bank since 1996, has constructed standard international food poverty lines and provided avenues for updates and conversions at national levels through purchasing power parities (PPP).

In 1996, the FAO suggested daily calorie intake is roughly 1,800 kilocalories per person and constructed a food poverty line at $0.25 per calorie of a food basket that delivers 1,800 kilocalories per capita per day (FAO, 1996; Kakwani and Son, 2016a). This daily calorie intake has been proven insufficient for a healthy adult life, and the FAO has since raised the level to 2,100 kilocalories per day based on data from over 100 countries, including Ghana (FAO, 2013; Kakwani and Son, 2016b). Following (FAO, 2013; Kakwani and Son, 2016a), the international price of a food basket that delivers this energy level can be converted at the national level at the 2005 PPP.

However, the World Bank has updated its PPP estimates from 2005 to 2011; a currency conversion used to compare economies' size and price levels. In terms of country coverage and estimation based on more precise prices obtained from individual nations, the 2011 PPPs are rated superior to the 2005 PPPs. With the most recent conversion rates available, it is reasonable to speculate on the food poverty line in 2011 PPP, which corresponds to the value in 2005 PPP. In 2016, a novel work by Kakwani and Son (2016a) for the World Bank based on World Bank data from 101 countries, including Ghana, employed a novel approach of equivalency poverty liens to estimate a single threshold of $1.59 in 2011 PPP. Therefore, this study chose an international food poverty line of $1.59 in 2011 PPP for 2,100 kilocalories per day for a healthy adult life.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Justification for adding the international food poverty line for robustness

Individual countries committed to the FAO usually follow the methodology of the organization to set their own national daily calorie requirement per adult health and the minimum cost/price of the food basket that delivers that energy requirement. However, in developing countries like Ghana, data challenges have impaired the accuracy of estimations (Ecker and Fang, 2016). Coulombe and Wodon (2012) observed that during the 5th round of the GLSS in 2005–2006, the GSS projected calorie availability of roughly 2,700 kcal per day in Ghana could not be supported by the GLSS5 data. Given that 30% of the population was estimated to have consumed less than 1,800 kcal per day in 2005-2006 using the GLSS data, this value seems to overstate the actual average per capita calorie consumption (Coulombe and Wodon, 2012). In contrast is the estimate of a daily calorie requirement from the International Food Policy Research Institute (IFPRI) of 2,900 kcal for Ghana in 2000 (IFPRI, 2000) which is quoted for GLSS7 food poverty estimates. Even more critical is the fact that the minimum cost of a food basket that could deliver such recommended calorie levels is left to the subjective convenience of researchers, except for the GLSS7 survey.

Following the dimensional definition of food availability by the WHO (2009) and arguments of Ecker and Fang (2015); Gabbert and Weikard (2001); Nube (2001); Smith (2002), the main challenge in the determination of a national food poverty line is the determination of the per capita food supply in a country. The standard method begins by estimating the residual total quantity of foods produced in the home country, plus the total food imported, minus the amount that is exported; then subtracting the amount of food that is used for livestock feed and seed, allocated for manufacturing for food and non-food, adjusting for changes in stocks and food that is lost during storage and transportation (Ecker and Fang 2015; Gabbert and Weikard 2001). As a result, the correctness of this residual food quantity depends on the completeness and quality of the data

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

for all other food-related variables, which are often gathered by various national organizations and ministries using a variety of techniques and certainly with differing degrees of rigour (Ecker and Fang, 2015). Therefore, the data completeness and synergy efficiency required across organizations in Ghana pose methodological hindrances. Hence, the decision to use both national and international food poverty lines for this study.

Converting the food poverty line at the national level

Following Cassel (1921) PPP definition based on the law of one price, the study engaged the following standard conversion formula in international trade economics;

$$P^{gh} = \frac{P^{usd}}{S} \tag{3.8}$$

Where P^{gh} and P^{usd} are the respective prices in Ghana and on the international market for a food basket that delivers the food energy of 2100 kcal per day for a healthy adult life. S is the PPP exchange rate which, according to data from GLSS7 is \$0.4626 in 2011. P^{usd} is \$1.59 per capita per day in 2011 PPP according to (FAO, 2013; Kakwani and Son, 2016a). Using Eq. 3.8, the converted food poverty line in Ghana in 2011 PPPs per capita per anum (results from Eq 3.8 multiplied by 365 days) is GH¢1,254.54. The food poverty lines used in this study are summarized in table 3.2.

Table 3.2: Converted food poverty lines annual per capita

Food Poverty Lines	$Z_{NAT'L}$ (GH¢)	$Z_{INT'L}$ (GH¢)
	982.20	1254.54

Source: Author's conversion based on GLSS7, FAO, 2013

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

3.4.4 Mobile Money use

Following Baffuor *et al.* (2020), Aker *et al.* (2016), Munyegera and Matsumoto (2014), Murendo and Wollni (2016), mobile money use is simply defined as a household head being a registered mobile money user who uses MoMo for receiving remittances. Therefore, household use of a remittance channel to receive remittances is measured as a dummy variable which takes 1 if a household used MoMo channel for that purpose and 0 if non-MoMo channel was used.

Thus, using MoMo/non-MoMo to receive remittances at the household level is a household decision influenced by household-level characteristics and covariates. The relevant variables that passed the goodness of fit and therefore used as determinants of this household decision are defined operationally below.

Table 3.2: Variables for HHs decision to use mobile money

Variable	Operationalization
Dependent variable	
Remittance medium/channel	1 used MoMo for remittances; 0 used non-MoMo channel
Determinant variables	
Age(years)	Age of household head
Household size	Number of household members
Household location	1 if household is located in rural area; 0 urban
Phone expenditure	Total expenditure on mobile phone
Regularity of internal remittance	1 if household receive regular remittance; 0 otherwise
Community access to electricity	1 have electricity; 0 no electricity
HH head own mobile phone	1 household head own mobile phone, 0 otherwise
Risk preference of HH head	1 household head risk averse, 0 risk loving
Time preference of HH head	1 HH prefers immediate rewards, 0 delayed rewards
Education status of HH Head	1 if household head is educated; 0 uneducated
Marital status of HH head	1 household head is married, 0 unmarried
Expenditure on financial services	Total expenditure on financial services
Employment status	1 if household head is employed; 0 otherwise
Experienced stealing incident	1 HH member experienced stealing incident; 0 otherwise
HH member prefers phone number private	1 important that it is private; 0 unimportant
HH member prefers financial history private	1 important that it is private; 0 unimportant
HH member prefers phone usage records private	1 important that it is private; 0 unimportant
Ownership of bank account	1 household head own bank account, 0 otherwise
Community access to mobile network	1 Community access to mobile network, 0 otherwise
Community access to financial institution	1 Community access to financial institutions, 0 otherwise

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

If HH receive internal remittances	1 received remittance; 0 otherwise
Religion	Dominant religious background of household
Migration status	1 household have a migrant; 0 otherwise
Transaction cost	Remittance transaction cost

3.5 Empirical model specification

To specify empirically the impact of the household remittance medium used on vulnerability to food poverty, the study followed Phillips and Taylor (1990) application of optimal control problem – a function of time $f(t)$ – in the empirical model specification of food poverty. In general, optimal control problems require the specification of an initial and terminal time (Phillips and Taylor, 1990). We specify the initial time $f(t_0)$, which corresponds to household food poverty status at j=1 (current period), and the terminal time $f(t_1)$, which corresponds to the time when the household experiences expected food poverty.

Since household vulnerability to food poverty (V) ranges from 0 to 1, with V≥0.5 being vulnerable to expected food poverty and V<0.5, not vulnerable (Chaudhuri *et al.* (2002), then $k(t)$ in the relation below is the vulnerability to food poverty status of the household;

$$0 \leq k(t) \leq 1 \tag{3.9}$$

Eq. (3.9) according to Phillips and Taylor (1990), is the equation of motion that describes the rate of time in a state of the risk of food poverty and the coping mechanisms available for households to smooth consumption over time, given household current (optimal) food consumption and level/covariate characteristics.

Following Phillips and Taylor (1990)'s optimal control, the reduced form relationship from Eqs. 2.12&2.13b for the current optimum household food consumption demand (C_f), Chaudhuri et al.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

(2002)'s estimate of food poverty vulnerability index ($\hat{V}$), and MoMo use for remittance as a coping mechanism, we specify the following empirical models;

Expected household food poverty (FP_1) = f{(current optimal food consumption of household i (C_i), Vulnerability (due to household level & covariate characteristics), coping mechanism available (remittance medium)}

That is

$$FP_1 = C_i + V(X_i) + Rem\_medium(MoMo\ use) \tag{3.10}$$

Evoking FAO (2009) 'at all times' stability dimension over the short time horizon ($j=2$) considered for this study, household food security status is expected to be unchanging over time, such that, $\Delta C_i = 0 \gg \Delta FP_1 = 0$. Eq. 3.10 thus reduces to

$$0 = \Delta V(X_i) + \Delta Rem_{med(MoMo)}$$

$$\equiv\gg\ \Delta V(X_i) = \Delta Rem_{med(Momo)} \tag{3.11}$$

Where Rem_{med} is medium of remittance receipt which is MoMo channel. Eq. 3.11 says that utilizing MoMo channels more to receive remittances for consumption could provide enough cushion for households as they become vulnerable to food poverty.

In simple econometric expression, Eq. 3.11 becomes

$$V_i = X_i\beta' + \omega' Rem_{med(MoMo),i} + \epsilon_i \tag{3.12}$$

V_i is food vulnerability index for household i estimable from relation (3.7). X_i is a vector of household-level characteristics and covariates. β and ω are vectors of parameters to be estimated and ϵ_i is the random error term. $Rem_{med(MoMo)}$ is medium of remittance receipt which is 1 if the household used MoMo to receive remittance and 0 otherwise.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

3.6 Estimation technique and procedure

Following the relation in Eq. 3.11 above, households that use mobile money to receive remittances are expected to cope differently with vulnerability to food poverty, such that mobile money is expected to provide a cushion for those that use it. This analytical problem mimics scenarios of research experiments where the treated households are those that used MoMo channels to receive remittances, and the control group is non-MoMo user households. However, this study relied on data from a non-experimental (observational) cross-sectional survey.

Observational studies are being utilized more often to determine the impact of treatments and interventions on outcomes. As treated households frequently are likely to differ consistently from control households in terms of baseline variables that are crucial for prognosis, confounding is a significant problem in observational data. To properly infer treatment effects using observational data, confounding caused by measurable variables must be eliminated or reduced using statistical approaches (Austin, 2016).

The propensity score-based approaches are a significant class of bias-reduction techniques (Rosenbaum and Rubin, 1983). In observational studies, there are four ways of applying the propensity score to decrease confounding; inverse probability of treatment weighting (IPTW), stratification on the propensity score, matching on the propensity score, and covariate adjustment using the propensity score (Austin, 2011a,b). For robustness, this study applied the propensity score to estimate the average treatment effect on the treated (ATT) by matching on the propensity score (PSM) and inverse probability of treatment weighting (IPTW). PSM estimates treatment effects by matching MoMo households with non-MoMo households on similar characteristics or propensity score (Rubin, 1974; Caliendo and Kopeinig, 2005). In other words, more similar MoMo and non-MoMo households are assigned higher propensity score in the estimation process. On the

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

other hand, IPTW estimates treatment effects by creating the counterfactual which assigns more weight to non-MoMo households with higher predicted likelihood (propensity score) of using MoMo. Thus, robustness is achieved by estimating treatments effect via PSM and IPTW.

3.6.1 Propensity score matching (PSM)

By accounting for the factors that predict a treatment, Rosenbaum and Rubin (1983)'s PSM seeks to assess the effect of treatment among a group. It may be used in any case where two groups are present; the treatment and the control group. In most cases of non-experimental surveys, even in the absence of treatment, participation and non-participation groups can suffer selection bias (Mensah *et al.*, 2010). PSM aids in solving the selection bias problem.

Rubin (1974), Rosenbaum and Rubin (1983), Caliendo and Kopeinig (2005) argue that PSM's potency is to locate households in a large population of non-participating subjects who are comparable to participants in all characteristics. This is done by using a balancing score $b(x)$ which according to Rosenbaum and Rubin (1983), is a function of observed variables x such that the treatment and control groups have the same conditional distribution of x given $b(x)$. Therefore, PSM is a balancing score such that the distribution of observed baseline variables is similar between treated and untreated participants based on the propensity score. Furthermore, according to Rosenbaum and Rubin (1983), the propensity score is the probability of assigning treatment given the baseline variables observed.

Formal treatment of the PSM model

The formal treatment follows the Roy-Rubin Model (Rubin 1974) approach to potential outcome. In this study, the potential outcome is vulnerability to food poverty, while the treatment is the channel/medium of remittance receipt. The key pillars of the model are households, medium of remittance receipt, and vulnerability to food poverty. Assume a binary medium of remittance

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

receipt (MoMo or non-MoMo use) T_i, vulnerability to food poverty outcome Y_i, and household level and covariate characteristics, X_is as defined in tables 3.1/2. The propensity score is defined as the conditional probability of the medium of remittance receipt given household level and covariate characteristics, X_is.

That is the propensity score $e_i = P_r(T_i = 1|X_i)$ in the case of the binary treatment estimator (medium of remittance receipt indicator), T_i is equal to 1 if the household uses MoMo to receive remittances and 0 if otherwise. The potential outcome (vulnerability to food poverty) is then given as Y_i (T_i) for the *i*th household. Following (Rubin 1974), the effect of the remittance medium (treatment effect) is then given as;

$$\tau_i = Y_i(1) - Y_i(0) \tag{3.14}$$

Since the presence of counterfactual outcomes makes it impossible to estimate individual effects, this study focuses on the average effect on households that used MoMo for receiving remittances on vulnerability to food poverty. Therefore, the average treatment effect on the treated (ATT) is given as;

$$\tau_{ATT} = E(\tau|T = 1) = E[(Y(1)|T = 1] - E[(Y(0)|T = 1] \tag{3.15}$$

$E[(Y(0)|T = 1]$ is the counterfactual mean which is unobserved according to the model and must be replaced using the mean outcome of non-MoMo user households, $E[(Y(0)|T = 0]$. This, Caliendo and Kopeinig (2005), following Rubin (1974), described as not a good idea because of selection biases that exist in most observational surveys like the GLSS. In this study, for instance, the variables that determine the household decision to use MoMo for receiving remittances may also determine vulnerability to food poverty leading to a selection bias problem. Algebraically, the τ_{ATT} can be expressed as

$$E[Y(1)|T = 1] - E[Y(0)|T = 0] = \tau_{ATT} + E[Y(0)|T = 1] - E[Y(0)|T = 0] \tag{3.16}$$

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Clearly, there is a difference between τ_{ATT} and the left-hand side of Eq. 3.16 due to selection bias. Caliendo and Kopeinig (2005) demonstrated, following Rubin (1974), that the true parameter τ_{ATT} is identified and estimable only if

$$E[Y(0)|T = 1] - E[Y(0)|T = 0] = 0 \quad (3.17)$$

In social experiments where treatment assignment is random, this is ensured, and the treatment effect is identified (Smith, 2000). However, in non-experimental studies like this, some identifying assumptions are required to solve the selection bias apparent in Eq. 3.17. The first is the Conditional Independence Assumption (CIA) which states that given the household level and covariate characteristics, $X_i s$, which are not affected by remittance medium (treatment), vulnerability to food poverty (potential outcome) is independent of the medium of remittance receipt. That is the condition of unconfoundedness (Caliendo and Kopeinig, 2005);

$$Y(0), Y(1) \perp T|X, \quad \forall X \quad (3.18)$$

With $\perp$ being statistical independence and $\forall$ carry its usual meaning in mathematics. Relation (3.18) implies that unconfoundedness is possible if the selection is based on observable characteristics and the researcher simultaneously observed all variables influencing a household's decision to use MoMo and vulnerability to food poverty. And so, in the case of a high dimensional vector, X, conditioning on all relevant covariates is somehow limited. Following Rosenbaum and Rubin (1983), the use of balancing scores has been suggested to solve this problem. Rosenbaum and Rubin (1983) demonstrated that if relation (3.18) holds, then relation (3.19) below, which is CIA based on the propensity score (PS), also holds.

(Unconfoundedness given the PS) $\quad Y(0), Y(1) \perp T|P(X), \quad \forall X \quad (3.19)$

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

That is, if the potential outcome (vulnerability to food poverty) is independent of treatment (household decision to use MoMo) conditional on Xis (relation 3.18), then potential outcomes are also independent of treatment conditional on a balancing score b(X) (relation 3.19). And the propensity score $P(T = 1|X) = P(X)$ is the probability that a household will use MoMo to receive remittance, which is a possible balancing score.

Another condition required besides CIA is the overlap or common support assumption, which rules out perfect predictability of the treatment given the *Xis;*

$$\text{(Overlap)} \qquad 0 < P(T = 1|X) < 1 \tag{3.20}$$

Common support assumption ensures that households with the same level and covariate characteristics have a positive probability of using MoMo or non-MoMo for receiving remittances (Heckman *et al.*, 1999).

Following Rosenbaum and Rubin (1983), given that CIA holds and there is overlap between users and non-users of MoMo, then generally, the PSM estimator for ATT can be expressed as

$$\tau_{ATT}^{PSM} = E_{P(X)|T=1}\{E[Y(1)|T = 1, P(X)] - E[Y(0)|T = 0, P(X)]\} \tag{3.21}$$

That is, the Propensity Score Matching (PSM) estimator is simply the mean difference in vulnerability to food poverty over the common support, approximately weighted by the propensity score distribution of MoMo using households.

3.6.1.1 Justifying the use of the PSM estimator for ATT

The formal model of Rubin (1974) presented in the preceding section can also be used to estimate the average treatment effect in the population (ATE), and over the years, has been adopted to estimate the average treatment effect in the untreated (ATU), average treatment effect in the treated

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

(ATT), and average treatment effect in the overlap (ATO). In a randomized social experiment, the treated and untreated groups will have similar household-character distributions; therefore, the ATT, ATU, and ATE will be the same. However, in the absence of randomization associated with observational data like the GLSS, the treatment groups (users and non-users of MoMo) can have widely varied distributions of attributes, and these estimands will change when these features are also related to the treatment effect (Fang *et al.* 2012). When utilizing observational data, researchers must make a decision; for whom should the treatment impact be estimated? There is no perfect rule of thumb in the literature on the target group of estimation. Much depends on the overall objective and expected policy implications of the research.

Following the views of Greifer and Stuart (2021), ATU may be relevant if the enquiry relates to a policy of extending MoMo use to households who would not already receive it. ATE can be important if the topic relates to a policy that mandates whether or not all households should use MoMo. ATO may be of interest if the enquiry relates to a practice of giving MoMo to households under conditions of uncertainty. ATT is relevant if the enquiry involves depriving households of using MoMo who would otherwise get it. In other words, the effect of the treatment (MoMo) for households that actually used MoMo to receive remittances. Therefore, the PSM estimator for ATT is justified for this study.

3.6.1.2 Implementing the PSM for this study

Following Rosenbaum and Rubin (1974, 1983), Smith, (1997), Caliendo and Kopeinig (2005), PSM is implemented in this study by following the brief procedures below;

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Estimating the Propensity Score

The PSM procedure begins with the estimation of the propensity score (*ps*). In the literature, there is not much guidance on the functional form to employ in the estimation (Smith, 1997; Caliendo and Kopeinig, 2005). However, logit and probit models often produce comparable findings for binary treatment situations like in this study, where we estimated the likelihood of using or non-using MoMo for receiving remittances. Thus, the decision in binary treatment cases is not critical, even though a probit model was used in this study.

Unlike the guidance information for deciding on the ps-score functional model, more information is available on how variables should be included (or excluded) from the ps model. PSM matching technique extends the CIA by demanding that the outcome variable(s) be conditional on the propensity score and independent of treatment (Caliendo and Kopeinig, 2005). In order words, only variables that lead to fulfilling the CIA are considered for the ps model. In addition, all variables for the ps-model are verified through the variance inflation factor (VIF) to rule out multicollinearity. The household level and covariate characteristics that were utilized in estimating the ps by the following probit estimation are outlined in table 3.2.

The decision to use MoMo by a household is unobserved. What is observed is an event that defines whether the household has used mobile money for remittances or not, which can be defined as

$$Rem_{med,i} = 1 \; if \; Rem_{med} > 0 \; (household \; used \; MoMo \; for \; remmtances)$$

$$Rem_{med,i} = 0 \; if \; Rem_{med} < 0 \; (household \; used \; other \; channels \; for \; remmtances)$$

The probability that a household used MoMo for remittances given the set of explanatory variables $X_i s$ was obtained as:

$$\Pr(Rem_{med,i}=1|\, x_i\,) = \Pr(Rem_{med} > 0) = \phi(x'_i \alpha_i\,) \qquad (3.22)$$

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Where ϕ is the cumulative distribution function of the standard normal distribution and α_i is a vector of parameters to be estimated. The marginal effects were estimated in the process as:

$$\frac{E\,(Rem_{med,i}=1 \mid x)}{xi} = \phi(x'_i\alpha_i)\alpha_i \qquad (3.23)$$

Choosing a matching method for ATT

Even though little guidance exists on choosing a matching method in the literature, matching methods for estimating ATT use data from the non-MoMo user households to mimic what would have happened if the MoMo user households were not using MoMo (i.e., the potential outcomes under non-treatment for the treated) (Crump *et al.* 2009). Thus, matching strategies that follow pair matching, weight or drop members of the non-MoMo user households while leaving members of the user households unaffected (i.e. given weights of 1) (Greifer and Stuart, 2021). Crump *et al.* (2009) argued that when estimating the ATT, no MoMo using households must be excluded from the sample or given variable weights; for example, by imposing a caliper or common support limitation will affect the estimand (Crump *et al.* 2009). Therefore, for this study, radius and kernel matches without major limitations were used for estimating the ATT.

Assessing match quality

Stuart (2010), following Rubin (2001), observed that diagnosing the quality of the matched samples is arguably the most crucial stage in using matching techniques. The suggestion is that the covariate balance in the matched groups should be evaluated after every match. Covariate balance is the similarity of the empirical distributions of all the covariates in the matched treatment and control groups, such that $P(X|T=1) = P(X|T=0)$, where P stands for the empirical distribution. Once a matching technique produces samples that are significantly out of balance, it

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

should be abandoned, and substitute approaches should be tried until the desired sample is obtained (Rubin, 2001; Agodini and Dynarski, 2004).

Numerically, following Rubin (2001)'s covariate balance statistics, Rubin's B and Rubin's R have been used to assess overall variance. Rubin's B measures the absolute standardized difference between the treatment and control groups' propensity score means (unmatched and matched). Rubin's R is the ratio of the propensity score treated to control variances. According to Rubin (2001), for the overall balance to be appropriate, B should be less than 25, and R should be between 0.5 and 2. As both test results vary before and after the matching method, Rubin's B and Rubin's R give an instructive indicator of the trade-off between bias and variance across the treatment and control groups. Stata results usually show values of B and R outside those bounds indicated by an asterisk.

However, with multiple covariates, it might be difficult to analyze numeric diagnostics for each thoroughly; graphical diagnostics can provide a fast assessment of the covariate balance. The first step is to investigate the distribution of propensity scores in the control and matched households, which clearly reveal common support. According to Stuart (2010), propensity score graphs should provide enough overlap of propensity scores and a control match for each treated household. Graphical diagnoses were therefore performed for this study.

The Stata command psmatch2 employed for the study has many matching methods available; radius, kernel, nearest neighbour (with or without replacement), k-nearest neighbours, local linear regression. It also includes routines for common support graphing (psgraph) and covariate imbalance testing (pstest) (Leuven and Sianesi, 2003).

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

3.6.2 Inverse probability of treatment weight (IPTW)

Horvitz and Thompson (1952)'s IPTW is another way of applying the propensity score for ATT, which is considered in this study for robustness. Following Horvitz and Thompson (1952), Austin (2016) submitted that IPTW uses means of the observed outcomes that have been weighted by the inverse probability of treatment to evaluate the impact of parameters. Handouyahiaet *et al.* (2013) contrasted that when creating a counterfactual, matching techniques give more weight to the comparison group (non-MoMo user households) with the estimated probability that is more similar to those of the MoMo-using households. In contrast, IPTW gives more weight to comparison-group participants with higher predicted participation rates. Intuitively, this strategy makes more sense. Selecting subjects with probabilities close to 1 rather than one with a lower estimated probability makes more sense because we know the households participated (Handouyahia, *et al.*, 2013; Cattaneo *et al.*, 2013).

Thus, the functional form for the normalized inverse probability weights differs depending on the impact parameters of potential-outcome means (POM), ATE or ATT. Since this study estimated IPTW-ATT, IPTW weight is estimated following (Horvitz and Thompson (1952; Austin, 2016) as

$$IPTW_{weight} = T_i + \frac{\hat{e_i}(1-T_i)}{(1-\hat{e_i})} \tag{3.24}$$

For T_i=1 if household used MoMo for remittances and 0 for the control (non-user) households, $\hat{e_i}$ is the propensity score estimable from Eq. 3.22.

$$\hat{\tau}_{ATT}^{IPTW} = \frac{1}{N_1}\sum_{i=1}^{N} m_i Y_i - \frac{\hat{e_i}(1-m_i)Y_i}{1-\hat{e_i}} \tag{3.25}$$

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Where N_1 is total number of MoMo-using households, $\widehat{e_i}$ is the estimated propensity score of each household, Y_i is outcome variables – food poverty incidence and vulnerability index probability. m_i is IPTW-ATT weight, which is

$$m_i = \begin{cases} 1 \quad for\ T_i = 1 \\ \dfrac{\widehat{e_i}}{1 - \widehat{e_i}} \quad for\ T_i = 0 \end{cases}$$

Computing Eqs. 3.24 and 3.25 takes a cue from the estimated propensity score and balance checks used for the score matching above. Once CIA and common support (SUTRA) conditions are satisfied, it implies that the propensity score (probit) model is correctly specified and IPTW-ATT can be estimated.

3.7 Conclusion

This chapter successfully presented a comprehensive methodology for the study focusing on estimating treatment effects for MoMo using households for potential (vulnerability to food poverty) outcomes. The methodology mainly involved estimating a propensity score and applying the matching techniques of the PSM and IPTW to estimate the ATT. The results of the analyses are presented and discussed in the next chapter.

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

CHAPTER FOUR

ESTIMATION AND DISCUSSION OF RESULTS

4.1 Introduction

This chapter presents the estimations and discussion of findings. Following the methodology in the previous chapter, the analysis for this chapter is dualized as follows. First, the analysis was performed within particular national and international food poverty line delimits. Second, the results of the IPTW-ATT were compared with ATT results from matching on propensity scores. Dualized analysis yielded results that allowed robust comparisons.

4.2 Description of key variables

4.2.1 Total cash remittance receipts by household food poverty status

The average cash remittance received via MoMo and non-MoMo channels was GHc888.24. However, as summarized in table 4.1, non-food-poor households received much more cash remittances than food-poor households. At both national ($Z_{NAT'L}$) and international ($Z_{INT'L}$) food poverty lines, non-food poor households received GH¢562.05 and GH¢599.42 more cash remittances on average than food-poor households, respectively.

According to the Ghana Statistical Service (2017), the overall headcount of non-poor households in Ghana received a total average cash remittance of GH¢ 454.25 more than the poor households and GH¢578 more than the very poor households. Similar trends of remittance receipts are evident from the Ghana living standard surveys 5 and 6. Thus, non-poor households in Ghana generally receive more cash remittances than the poor, reflecting the economic characteristics of the food-poor and non-food-poor.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

The standard deviation and further exploration of the cash remittance variable showed a wide variation of remittances between the food poor and the non-food poor. Thus, a normalized form of the cash remittance variable was used for the analysis. By normalization, the average cash remittance between the food poor and the non-food poor was 5.2 and 5.7, respectively, with a rounded standard deviation of 1 (Appendix tables B3, B4).

Table 4.1: Average remittances received by food-poor and non-food-poor households

Poverty Lines	Household status	Obs	Mean (GH¢)	Std. Dev.	Min(¢)	Max(GH¢)
$Z_{NAT'L}$	Food poor	1,674	326.19	522.65	1.7	4,800.00
	Non-food poor	3,761	888.24	3,368.89	1.5	70,000.00
$Z_{INT'L}$	Food poor	2,720	415.69	716.89	1.7	15,000.00
	Non-food poor	2,715	1,015.11	3,915.61	1.5	70,000.00
Total Observations						5,435

Note: $Z_{NAT'L}$ (log) = 6.889795(National line) $Z_{INT'L}$ (log) = 7.134524 (Int'l poverty line)

Source: Authors construct from GLSS 7 (2017)

4.2.2 Households' utilization of MoMo for remittances and consumption

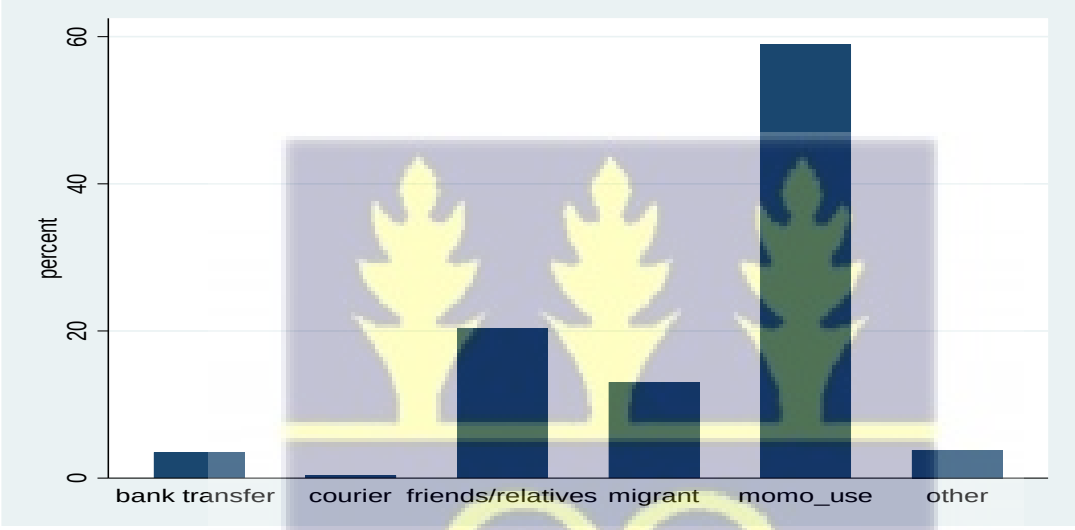
The results of the analysis, as summarized in figure 4.1, shows that the predominant households, almost 60% used mobile money to receive remittances, while 20.33% received remittances through friends and relatives. A reasonable 13.05% of the households depended on migrants that brought remittances to the households, while 3.5% and 3.81% respectively used bank transfers and other unspecified means. These findings are consistent with Baffuor *et al.* (2020), Hayford 2020) that mobile money channels are significant mediums of receiving remittances in Ghana, followed by friends and relatives, migrants, and bank transfers.

Dualising the analysis according to the food-poor and non-food-poor households and national (Z_{NAT})/international (Z_{INT}) food poverty lines yielded interesting findings (table 4.2; Appendix B4). As summarized in table 4.2, mobile money is still predominantly used for receiving remittances

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

among the food-poor and non-food-poor households and at both food-poverty lines, followed by friends and relatives. At the national food poverty ($Z_{NAT'L}$) line, about twice the total of food-poor households as non-food-poor households utilized MoMo to receive remittances (Table 5.2 or Appendix figure.B1). This is quite similar to the finding of Baffuor *et al.* (2020), that non-poor households used mobile money more than poor households to receive remittance, albeit they used a generalized headcount poverty approach.

Fig. 4.1: Mediums of remittance receipts



Source: Authors construct from GLSS 7 (2017)

Table 4.2: Remittance channels by Household food poverty status

	Non-food poor HH at $Z_{NAT'L}$		Food-poor HH at $Z_{NAT'L}$		Total
	Count	Percentage	Count	Percentage	
MoMo use	2,137	66.68%	1,068	33.32%	3,205
Non-MoMo use	1,624	72.83%	606	27.17%	2,230
Total	3,761	69.20%	1,674	30.80%	5,435
	Non-food poor HH at $Z_{INT'L}$		Food-poor HH at $Z_{INT'L}$		
	Count	Percentage	Count	Percentage	
MoMo use	1,518	47.36%	1,687	52.64%	3,205
Non-Momo use	1,197	53.68%	1,033	46.32%	2,230
Total	2,715	49.95%	2,720	50.05%	5,435

Note: $Z_{NAT'L}$ (log) = 6.889795 $Z_{INT'L}$ (log) = 7.134524

Source: Authors construct from GLSS 7 (2017)

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Table 4.3 summarizes the purpose of using either MoMo or non-MoMo channels to receive remittances among food-poor and non-food-poor households in Ghana. The statistics reflect the GLSS7 data that 81.4% of all remittances received either via MoMo or non-MoMo channels are used for daily consumption, like food, with no remittance savings (GSS 2017; Baffuor *et al.* 2020). However, there are differences in the expenditure pattern among the food-poor and non-food-poor households that used mobile money to receive remittances. In the current period, 61.32% of food-poor households that used MoMo to receive remittances were for daily consumption like food. As well, almost 55.7% of non-food poor households that used MoMo to receive remittances were for the same purpose of daily consumption (Table 4.3).

Table 4.3: Remittance use by channel of receipt by HH food poverty status

		Non-food poor Households				Food poor Households			
		via non-MoMo		via MoMo		via non-MoMo		via MoMo	
Remittance use	Daily consumption	1,263	44.30%	1,588	55.70%	468	38.68%	742	61.32%
	Housing	43	50.59%	42	49.41%	14	30.43%	32	69.57%
	Business	74	30.96%	165	69.04%	14	18.67%	61	81.33%
	Education	65	36.93%	111	63.07%	19	22.35%	66	77.65%
	Health	96	48.24%	103	51.76%	33	27.50%	87	72.50%
	Funerals	35	41.67%	49	58.33%	12	34.29%	23	65.71%
	Other ceremonies	16	36.36%	28	63.64%	17	60.71%	11	39.29%
	Savings	0	0.00%	3	100.00%	0	0.00%	0	0.00%
	Other	32	40.00%	48	60.00%	29	38.67%	46	61.33%
	Total	1,624	43.18%	2,137	56.82%	606	36.20%	1,068	63.80%

Note: $Z_{NAT'L}$ (log) = 6.889795

Source: Authors construct from GLSS 7 (2017)

The test of mean proportion differences for households' use of either MoMo or non-MoMo channels to receive remittances for consumption purposes are summarized in table 4.4 at both food poverty lines. Clearly, the average proportion of food-poor households in Ghana ($Z_{NAT'L}$) significantly used MoMo channels more to receive remittances for consumption than non-MoMo channels. On the other hand, the average proportion of non-food poor households in Ghana ($Z_{NAT'L}$)

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

significantly used less MoMo channels to receive remittances for consumption. Thus, at the national food poverty line, we expect MoMo use to receive remittances for consumption at the household level to affect the vulnerability of the food-poor and non-food-poor households differently.

Compared to the higher international food poverty line ($Z_{INT'L}$), it can be seen that for food-poor households, the average proportion of non-MoMo channels used to receive remittances for consumption is significantly more compared to MoMo channels. For non-food poor households, even though the average proportion of non-MoMo channels used to receive remittances for consumption is more compared to MoMo channels, the average difference is insignificant. This thus presents a special case of analyzing the effect of MoMo use for receiving remittances on the vulnerability of the households should exogenous factors push up the food poverty line.

Table 4.4: Mean difference of remittance use for consumption by remittance channel

Poverty lines	Incidence status	Channel	Means	Mean diff.	*p*-value of diff.
$Z_{NAT'L}$	Food poor	MoMo user	0.773(.017)	0.076***(.022)	0.001
		non-MoMo user	0.695(.015)		
	Non-food poor	MoMo user	0.743(.01)	-0.035**(.014)	0.014
		non-MoMo user	0.778(.01)		
$Z_{INT'L}$	Food poor	MoMo user	0.689(.011)	-0.065***(.018)	0.000
		non-MoMo user	0.754(.013)		
	Non-food poor	MoMo user	0.769(.011)	-0.026(.016)	0.105
		non-MoMo user	0.795(.012)		

Note: $Z_{NAT'L}$ (log) = 6.889795 Standard errors in parentheses *** p<.01, ** p<.05, * p<.1

Source: Authors construct from GLSS 7 (2017)

4.2.3 Difference in transaction cost by remittance channel used

The study conceptualized that the extent of using either MoMo or non-MoMo channels to receive remittances for consumption has a differing effect on the vulnerability to food poverty of food-poor and non-food-poor households in Ghana. The transmission mechanism is conceptualized to

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

work through reciprocal altruistic cost differences between MoMo and non-MoMo channels. Given that table 4.4 showed significant differences in the utilization of MoMo or non-MoMo channels between food-poor and non-food-poor households, the difference in transaction costs of receiving remittance by the remittance channel used was tested. Effect size estimations were considered following Glass's delta (Glass *et al.*, 1981) and Hedges'*g* (Hedges, 1981).) tests. Given that the standard deviations for MoMo or non-MoMo users were different and the sample size is large (>20), glass delta effect size estimation was preferred over Cohens' *d* and Hedges' *g* (Glass *et al.*, 1981). However, since the sampled household sizes for MoMo or non-MoMo users are different, Hedges'*g* is added for robustness.

Following Cohen (1988), a commonly used interpretation is to refer to effect sizes as small (d = 0.2), medium (d = 0.5), and large (d = 0.8). The estimates for Glass's Δ and Hedges's g indicate that the mean difference per standard deviation of transaction costs is significantly higher for using non-MoMo channels to receive remittances than MoMo channels. Following Cohen (1988), the Glass's Δ effect size of 0.734 is a significant size effect. The Hedges's *g*=0.528 is also a significant medium effect (table 4.5). This implies that the higher transaction cost of using non-MoMo channels to receive remittances than MoMo channels is non-trivial.

Table 4.5: Difference in transaction cost by remittance channel used

		Obs per group:	
		non_momo	2,230
		momo_use	3,205
Effect Size	Estimate	[95% Conf.	Interval]
Hedges's g	0.528	-0.230	1.129
Glass's Delta	0.734	-0.264	1.173

Source: Authors construct from GLSS 7 (2017)

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

4.2.4 Remittance channel and regularity of remittance

Another important statistic for the relevance of the vulnerability analysis in this study is whether households regularly received remittances via MoMo or non-MoMo channels. As theorized by Friedman (1957) and Modigliani (1976) PIH/LCH, irregular remittances are 'windfall gains' which, according to the World Bank (2006), must be saved/invested in the current period for consumption smoothing rather than consumed. Out of the 5,435 households that received cash remittances in this study, only 47.82% were confident that their remittances were regular (GSS, 2017). For food-poor households that used MoMo to receive remittances, only 42.51% indicated that their remittance receipts were regular. Moreover, only 46.7% of non-food poor households that used MoMo for remittances also suggested that their remittance receipts were regular (table 4.6). According to the data, regularity in order of highest to lowest frequency reflects quarterly, annually, and monthly.

All other things being equal, given that remittances may or may not come to the majority of households, the implications of using remittances received mainly for consumption rather than savings in the current period borders on consumption smoothing ability over time. Contrary to PIH/LCH, if households use MoMo to receive remittances for only consumption purposes in the current period instead of savings (table 4.3), food consumption smoothing ability may suffer (Friedman, 1957; Modigliani, 1976). This is particularly true for food-poor households in this study, who are also extremely poor with minimal sources of income. As FAO (2009) stability dimension expects, the efficacy of using mobile money for remittances is seen if it defies the preceding factual/theoretical expectation and lowers household vulnerability to food poverty.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Table 4.6: Whether remittances receipts are regular

Regular remittances?	Non-food poor Households				Food poor Households			
	Non-MoMo users		MoMo users		MoMo users		Non-MoMo users	
No	745	45.87%	1,139	53.30%	338	55.78%	614	57.49%
Yes	879	54.13%	998	46.70%	268	44.22%	454	42.51%
Total	1624	100.00%	2,137	100.00%	606	100.00%	1,068	100.00%

Note: $Z_{NAT'L}$ (log) = 6.889795

Source: Authors construct from GLSS 7 (2017)

4.2.5 Incidence of food poverty vs. Vulnerability to food poverty

Following the FGT in Eq. 3.0 and WBI (2005), Tassew *et al.* (2008), food-poor households were identified in this study as those with the natural log of per adult equivalent food consumption expenditure (lnPEFCE) to be less than the log of the food poverty line (lnZ). That is for all households where $lnPEFCE_i < lnZ$, (food poor) or $lnPEFCE_i \geq lnZ$,(non-food poor) have been summarized in tables 4.7 and 4.8, where Z is the food poverty either at the national or international level. The corresponding vulnerability to food poverty estimated following Chaudhuri *et al.* (2002)'s vulnerability as expected poverty (VEP) approach (a 3-step feasible generalized least squares approach) has also been summarized in tables 4.7 and 4.8.

In the current period under the national food poverty line ($Z_{NAT'L}$), while the incidence of food poverty of 30.8% representing 1,674 households were food-poor, as high as 52.42% of households were vulnerable to food poverty according to the estimated vulnerability index probability ($V_{NAT'L}$). Stated differently, under the national food poverty line, while the incidence of non-food poor households was 69.2% in the current period, the actual non-vulnerable proportion was 47.58%, given the available coping mechanism, ceteris paribus. This finding is similar to that of Koomson *et al.* (2020), who found using GLSS7 dataset that while the incidence of overall poverty was 23.4%, vulnerability to poverty among Ghanaians more than doubled at 51%. Novignon *et al.*

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

(2012), also using the GLSS5 data, found the incidence of poverty at 29% when vulnerability to overall poverty was 56%. Thus, as FAO's (2009) stability dimension emphasizes, reducing vulnerability to food poverty 'at all times' is more critical than incidence status at a point in time.

Interestingly, at the international food poverty, while a higher food poverty line predisposed a predominant half of the households to a higher incidence of food poverty, those expected to be vulnerable (food poor) roughly remained the same as obtained under $Z_{NAT'L}$ at 51.54%. Noteworthy also is the non-vulnerable index proportions ($V_{INT'L}$ = 48.46% ≅ $V_{NAT'L}$ = 47.58%), even though the incidence of food-poor households at $Z_{INT'L}$ is higher at 50%. This is the power of the vulnerability as expected (VEP) model approach, which according to Christiaensen and Subbarao (2005), Chaudhuri *et al.* (2002), provides higher immunity against sample and variable biases. Christiaensen and Subbarao (2005) argue that VEP-produced vulnerability indexes provide superior stability for food poverty analysis than static incidence measures such as food insecurity experience scales (FIES), Food consumption score(FCS), headcount poverty, etc. Therefore, the relatively similar $V_{NAT'L}$ and $V_{INT'L}$ in this study at different times allowed us to evaluate the real effect of using mobile money for receiving remittances as a coping mechanism among households.

Table 4.7: Incidence vs Vulnerability to food poverty at $Z_{NAT'L}$

Incidence			Vulnerability		
Food poverty	Freq.	Percent	$V_{NAT'L}$	Freq.	Percent
Non-food poor	3,761	69.2	Non-vulnerable	2,586	47.58
Food poor	1,674	30.8	Vulnerable	2,849	52.42
Total	5,435	100	Total	5,435	100

Note: $Z_{NAT'L}$ (log) = 6.889795 $Z_{INT'L}$ (log) = 7.134524

Source: Authors construct from GLSS 7 (2017)

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Table 4.8: Incidence vs Vulnerability to food poverty at $Z_{INT'L}$

Incidence			Vulnerability		
Food poverty	Freq.	Percent	$V_{INT'L}$	Freq.	Percent
Non-food poor	2,715	49.95	Non-vulnerable	2,634	48.46
Food poor	2,720	50.05	Vulnerable	2,801	51.54
Total	5,435	100	Total	5,435	100

Note: $Z_{NAT'L}$ (log) = 6.889795 $Z_{INT'L}$ (log) = 7.134524

Source: Authors construct from GLSS 7 (2017)

4.3 Generating propensity scores for HHs decision to use MoMo for remittances

As indicated in the methodology, this process involves using a probit estimation model to predict the propensity scores for household decision to use MoMo for remittances. Table 4.9 summarises the probit estimates (marginal effect) of households' decision to use mobile money for receiving remittances. Household-level factors such as household head ownership of mobile phone, ownership of bank account, household head is educated, employed, married, preferred phone usage records and financial history to be private, among others are significant determinants of household decision to use mobile money for receiving remittances. Other significant determinant factors are if the household head is risk averse, prefer immediate to delayed rewards, prefer private phone number, and experienced stealing incident in the community.

The predicted propensity scores (ps) are summarized in table 4.10/11. The outlay of the estimate shows that the overlap option has been selected. The region of overlap for MoMo user households is [0.227, 0.997] and for non-MoMo user households are [0.179, 0.875]. Common support expects the estimated score at the 50% percentile to hover around 50% (Caliendo and Kopeinig, 2005); thus, the estimate of about 54.56% provides a good fit of overlap. The model does not have a propensity that perfectly scored 1.00 unless approximated to 1 decimal place. A standard deviation of 0.1 and variances of 0.01 and 0.02, respectively for MoMo user and non-MoMo user households

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

means that the data is fairly concentrated around the means and limits the number of outliers. The data is fairly normal with skewnesses of -0.1888, -0.2688 and kurtoses of 2.9429, 2.6471. Hair *et al.* (2010) and Bryne (2010) argued that data is considered to be normal if skewness is between -2 to +2 and kurtosis is between -7 to +7.

Table 4.9: Probit estimates (marginal effect) of HH decision to use MoMo

Variables	Coefficient
Household size	0.0449***(0.0066)
Household location(base; rural)	-0.258***(0.0515)
Phone expenditure	0.00818(0.00774)
Regularity of internal remittance (base; regular)	-0.0877**(0.036)
Community access to electricity(base; yes)	-0.0763***(0.0189)
HH head own mobile phone (base; yes)	-0.354***(0.0441)
Risk preference of HH head (base; risk averse)	-0.174***(0.0548)
Time preference of HH head (base; immediate rewards)	-0.0427(0.0361)
Education status of HH Head (base; uneducated)	0.00477(0.0128)
Marital status of HH head (base: unmarried)	-0.00473(0.011)
Expenditure on financial services	0.0242*(0.0141)
Employment status (base; unemployed)	-0.0211*(0.0121)
Experienced stealing incident (base; no)	0.0507**(0.0235)
Prefer phone number private (base; unimportant)	-0.0810***(0.0168)
Prefer financial history private(base; important)	-0.02(0.0245)
Prefer phone usage records private (base; important)	0.0314(0.0208)
Ownership of bank account (base; yes)	-0.162***(0.0429)
Community access to mobile network (base; yes)	-0.0223(0.0525)
Community access to financial inst. (base; yes)	-0.0633(0.0504)
If HH receive internal remittances (base; yes)	-0.320***(0.113)
Age(yrs) of household head	0.000216(0.000837)
Religion (base; no religion)	0.0339***(0.0108)
Migration status (base; no migrant)	0.0329(0.0532)
Remittance transaction cost	-0.000188(0.000508)
Observations	5,435

Note: Standard errors in parentheses *** p<.01, ** p<.05, * p<.1

Source: Authors construct from GLSS 7 (2017)

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Table 4.10: Predicted propensity score in percentiles

	Percentiles	Smallest		
1%	0.269	0.179		
5%	0.359	0.181		
10%	0.412	0.194	Obs	5,435
25%	0.511	0.195	Sum of Wgt.	5,435
50%	0.546		Mean	0.5893
		Largest	Std. Dev.	0.1279
75%	0.677	0.940		
90%	0.746	0.942	Variance	0.0164
95%	0.795	0.942	Skewness	-0.2899
99%	0.848	0.997	Kurtosis	2.9239

Source: Authors construct from GLSS 7 (2017)

Table 4.11: Predicted propensity score in percentiles by channels

MoMo Users					Non-MoMo Users				
	Percentiles	Smallest				Percentiles	Smallest		
1%	0.3	0.2			1%	0.2	0.2		
5%	0.4	0.2			5%	0.3	0.2		
10%	0.5	0.2	Obs	3,205	10%	0.4	0.2	Obs	2,230
25%	0.5	0.3	Sum of Wgt.	3,205	25%	0.5	0.2	Sum of Wgt.	2,230
50%	0.6		Mean	0.6171	50%	0.6		Mean	0.5495
		Largest	Std. Dev.	0.1179			Largest	Std. Dev.	0.1312
75%	0.7	0.9			75%	0.6	0.9		
90%	0.8	0.9	Variance	0.0139	90%	0.7	0.9	Variance	0.0172
95%	0.8	0.9	Skewness	-0.1888	95%	0.8	0.9	Skewness	-0.2688
99%	0.9	1.0	Kurtosis	2.9429	99%	0.8	0.9	Kurtosis	2.6471

Source: Authors construct from GLSS 7 (2017)

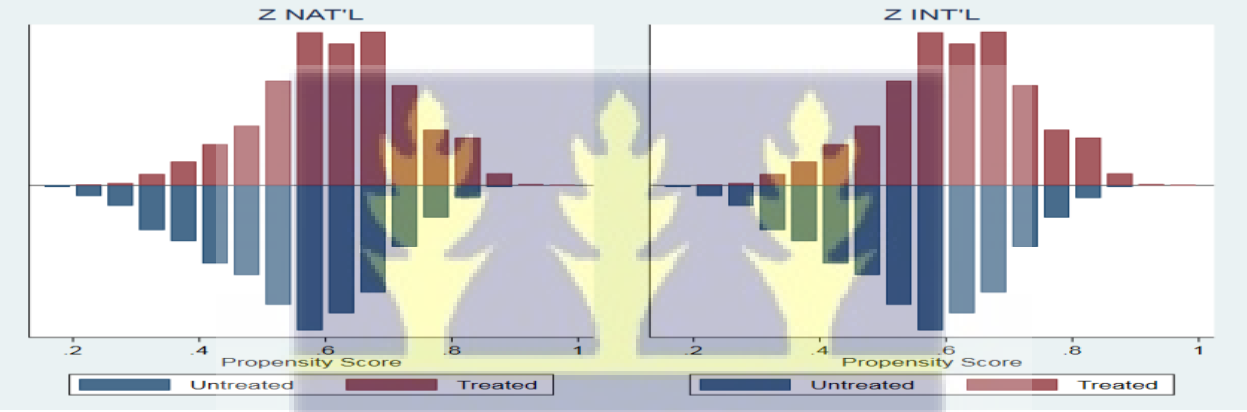
4.4 Graphical assessment of common support

Quality of matching techniques and finally using neighbour and radius matches followed the proposition of Stuart (2010) that propensity score graphs should provide enough overlap of propensity scores for a control (non-MoMo user) match for each treated (MoMo user) household. The graphical diagnoses that satisfy this criterion of common support thus qualifying neighbour and radius matches and IPTW for the ATT are presented in figures 4.2, 4.3 and 4.4.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Figure 4.2 presents the propensity score distribution of common support for overall household vulnerability to food poverty dualised according to the food poverty lines $Z_{NAT'L}$ and $Z_{INT'L}$. The propensity score distribution of common support under both poverty lines is distributed similarly over a range of [0.228, 0.997] for MoMo user households and [0.179, 0.875] for non-MoMo user households, providing a feasible overlap range of [0.179, 0.875]. Over this feasible overlap range, all households that used MoMo to receive remittances have matching households that did not use MoMo.

Fig. 4.2: Propensity score distribution of overlap for overall household vulnerability



Source: Authors construct from GLSS 7 (2017)

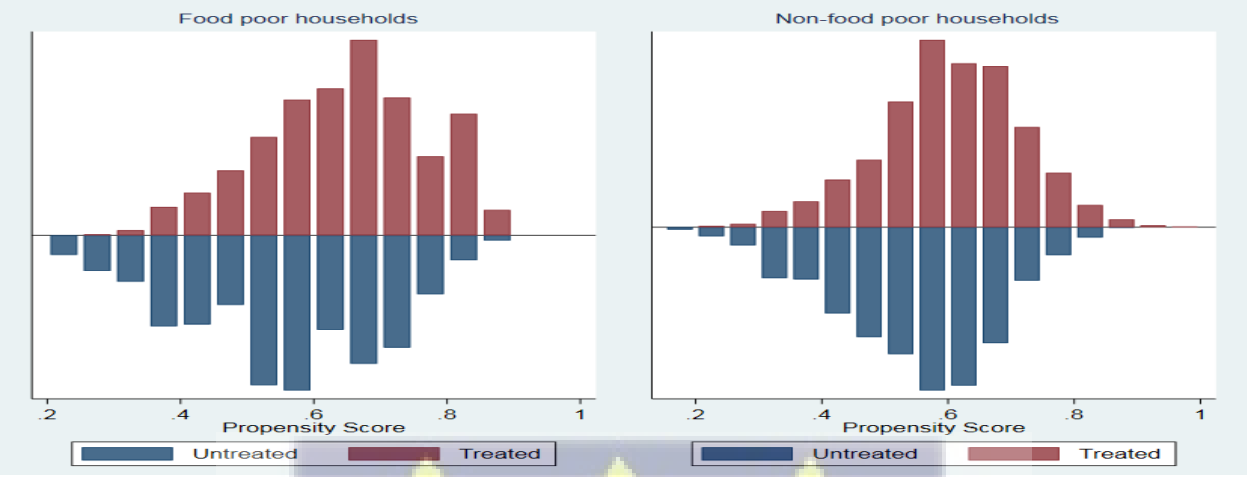
Figures 4.3 and 4.4 presents the propensity score histogram of common support for household vulnerability to food poverty according to the dualised analyses of household food poverty incidence status in the current period at $Z_{NAT'L}$ and $Z_{INT'L}$. For food-poor households, the propensity score distribution of common support for vulnerability to food poverty under both food poverty lines is distributed over a range of [0.267, 0.884] for MoMo user households and [0.205, 0.884] for non-MoMo user households, providing a feasible overlap range of [0.267, 0.884].

For non-food poor households in the current period, the propensity score distribution of common support for expected food poverty under both poverty lines is distributed over a range of [0.205,

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

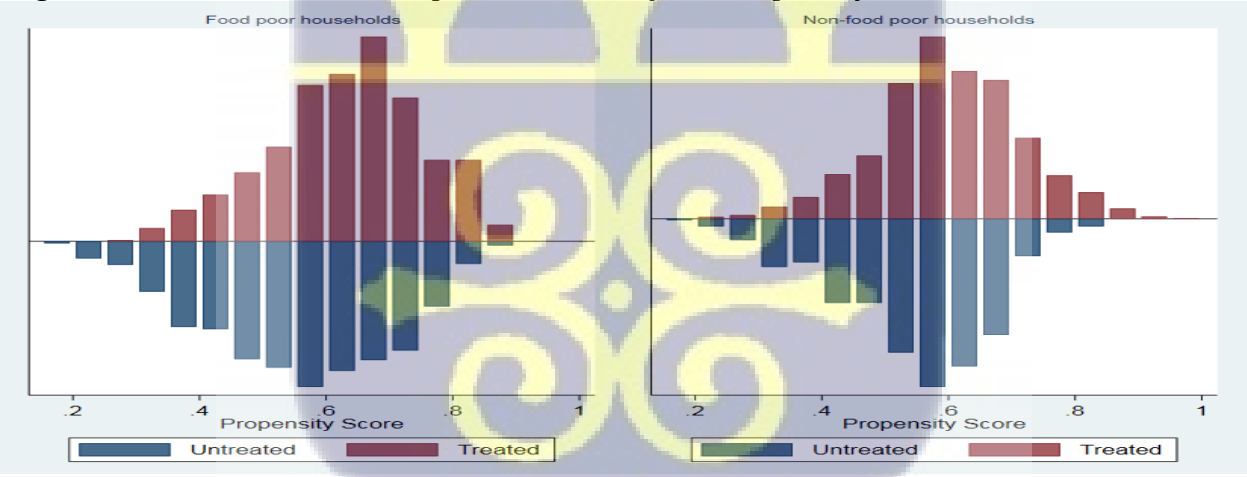
0.997] for MoMo user households and [0.179, 0.884] for non-MoMo user households, providing a feasible overlap range of [0.267, 0.884].

Fig. 4.3: Ps distribution of overlap for vulnerability to food poverty at $Z_{NAT'L}$



Source: Authors construct from GLSS 7 (2017)

Fig. 4.4: Ps distribution of overlap for vulnerability to food poverty at $Z_{INT'L}$



Source: Authors construct from GLSS 7 (2017)

4.5 Effect of using mobile money to receive remittances on household vulnerability to food poverty

Per FAO (2009) stability emphasis 'at all times', the use of MoMo for remittances as a coping mechanism should be dependable in mitigating vulnerability and guaranteeing stability in food

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

security at all times. The overall effect of using mobile money to receive remittances on household vulnerability to food poverty was examined in two ways – direction and significance of effects. At the national food poverty line in Ghana ($Z_{NAT'L}$), the PSM-ATT and IPTW-ATT results indicate that vulnerability to food poverty is lower for households that used MoMo channels to receive remittances for consumption than non-MoMo users. The results are, however, insignificant at 5% level. This overall result suggests that using MoMo channels to receive remittances is weak as a coping mechanism in mitigating households' vulnerability to food poverty (tables 4.12,4.13). However, based on the significant differences in remittance channels utilized (table 4.4) and significant differences in transaction costs between remittance channels (table 4.5), the vulnerability of food-poor and non-food-poor households are expected to be affected differently.

Moreover, at a relatively higher international food poverty line ($Z_{INT'L}$), the PSM-ATT and IPTW-ATT estimates indicate that vulnerability to food poverty was higher among households that used MoMo channels to receive remittances for consumption than non-MoMo users. The results are however insignificant at 5% level. The change in the direction of effects at a higher food poverty line presents an opportunity to examine the households' vulnerability should exogenous factors push the food poverty line up.

Table 4.12: Effect of MoMo use on household vulnerability to food poverty (PSM)

Poverty lines	Matching Technique	Outcome variable	Treated	Control	PSM-ATT	t-values
$Z_{NAT'L}$	Radius match	Vulnerability index probability	3,205	2,230	-0.0246*	-1.87
	Kernel match		3,205	2,230	-0.0104	-0.81
$Z_{INT'L}$	Radius match	Vulnerability index probability	3,205	2,230	0.0059	0.73
	Kernel match		3,205	2,230	0.0097	0.79

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Table 4.13: Effect of MoMo use on household vulnerability to food poverty (IPTW)

Poverty lines	Estimation Technique	Outcome variable	Treated	Control	IPTW-ATT	*p*-values
$Z_{NAT'L}$	Inverse Probability Treatment Weighting	Vulnerability index probability	3,205	2,230	-0.0216*	0.068
$Z_{INT'L}$			3,205	2,230	-0.0186	0.106

Note: *** p<.01, ** p<.05, * p<.1 $Z_{NAT'L}$ (log) = 6.889795 $Z_{INT'L}$ (log) = 7.134524

Source: Authors construct from GLSS 7 (2017)

4.5.1 Effect on vulnerability of food-poor and non-food-poor households

Given the incidence of food poverty status, the results indicate that using mobile money to receive remittances for consumption affects the vulnerability of the food-poor and non-food-poor households differently. The PSM-ATT and IPTW-ATT results for the direction and significance of effects are reported in Tables 4.14 and 4.15. At both food poverty lines, using MoMo channels to receive remittances for consumption is negatively related to household vulnerability to food poverty among food-poor households. The results for non-food poor households are however a positive relationship. The strength of the relationship is stronger for food-poor households at the national food poverty line and weaker for non-food-poor households at both poverty lines.

At 5% significance level, radius match ATT result at the national poverty line ($Z_{NAT'L}$) indicates that vulnerability to food poverty is significantly lower for food-poor households that used MoMo channels to receive remittances by 8.8% index probability compared to non-MoMo users. At 5% significance level, the kernel match result also indicates that vulnerability to food poverty is significantly lower for food-poor households that used MoMo to receive remittances by 7.3% index probability compared to non-MoMo users (table 4.14). The IPTW ATT result in table 4.15 for robustness also indicates that household vulnerability to food poverty is significantly lower for food-poor households that used MoMo channels to receive remittances by 4.4% index probability

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

compared to non-MoMo users. These results reflect that the average proportion of food-poor households in Ghana significantly utilized MoMo channels more to receive remittances for consumption than non-MoMo channels (table 4.4). Thus, they significantly benefited from the reciprocal altruistic cost advantages of using MoMo channels (table 4.5), resulting in lower vulnerability for these food-poor households, despite no remittance savings (table 4.3) for consumption smoothing purposes. These findings align with FAO (2009) stability expectation that a coping tool should be dependable enough to mitigate vulnerability and guarantee stability in food security 'at all times'.

However, at the national poverty line ($Z_{NAT'L}$), vulnerability to food poverty is higher for non-food-poor households that used MoMo channels to receive remittances compared to non-MoMo users, even though this effect is insignificant at 5% (tables 4.14, 4.15). This result reflects the finding that the average proportion of non-food-poor households in Ghana significantly used less MoMo channels to receive remittances for daily consumption than non-MoMo channels (table 4.4). Since non-food poor households also saved no remittances for consumption purposes (table 4.3), they bear the significantly higher reciprocal altruistic cost disadvantages of using more non-MoMo channels (table 4.5), resulting in higher vulnerability.

Suppose exogenous economic factors push the food poverty line to at least the international line ($Z_{INT'L}$). In that case, radius match, kernel match, and IPTW ATT results indicate that, at 5% level, using MoMo channels to receive remittances compared to non-MoMo channels will no longer be significant at lowering vulnerability to food poverty among food-poor households. For non-food poor households, radius, kernel, and IPTW ATT results indicate that household vulnerability to food poverty is higher for those using MoMo channels to receive remittances than non-MoMo users. The effect is, however, insignificant at 5%. These results may particularly reflect

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

vulnerability effects at a relatively higher food poverty line and presents an exceptional case to examine the vulnerability effects of food-poor and non-food-poor households.

The results, in summary, are pretty clear on how using mobile money channels for receiving remittances for consumption mitigates household vulnerability to food poverty in Ghana. At the national food poverty line, food-poor households that use mobile money to receive remittances for consumption are likely to experience significantly lower vulnerability to food poverty, thus improved stability in food security, in line with FAO (2009) expectations. However, should exogenous factors push the food poverty line to at least the international food poverty line, using mobile money to receive remittances will no longer be significant in mitigating vulnerability to food poverty among food-poor households. At the same time, non-food poor households that use less mobile money channels to receive remittances for consumption may slightly experience higher vulnerability to food poverty. These findings are discussed in the section below.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Table 4.14: MoMo effect on vulnerability of food poor/non-poor households (PSM)

Poverty lines	Match Technique	Outcome variable	Incidence status	Treated	Control	PSM-ATT	t-values
$Z_{NAT'L}$	Radius	Vulnerability index probability	Food poor	1,068	606	-0.088***	-3.76
			Non-food poor	2,137	1,624	0.0026	0.16
	Kernel	Vulnerability index probability	Food poor	1,068	606	-0.0734***	-3.34
			Non-food poor	2,137	1,624	0.006	0.39
$Z_{INT'L}$	Radius	Vulnerability index probability	Food poor	1,687	1,033	-0.0145	-1.45
			Non-food poor	1,518	1,197	0.0076	0.69
	Kernel	Vulnerability index probability	Food poor	1,687	1,033	-0.0038	-0.34
			Non-food poor	1,518	1,197	0.0148	1.08

Table 4.15: MoMo effect on vulnerability of food poor/non-poor households (IPTW)

Poverty lines	Estimation Technique	Outcome variable	Incidence status	Treated	Control	IPTW-ATT	*p*-values
$Z_{NAT'L}$	Inverse Probability Treatment Weighting	Vulnerability index probability	Food poor	1,068	606	-0.0435**	0.029
			Non-food poor	2,137	1,624	0.0221	0.139
$Z_{INT'L}$			Food poor	1,687	1,033	-0.0236	0.152
			Non-food poor	1,518	1,197	0.005	0.765

Note: *** p<.01, ** p<.05, * p<.1 $Z_{NAT'L}$ (log) = 6.889795 $Z_{INT'L}$ (log) = 7.134524

Source: Authors construct from GLSS 7 (2017)

4.6 Discussion of findings

4.6.1 Situating the findings in conceptual and economic theories

As conceptualized, the transfer of remittances, which is a reciprocal act, comes with altruistic costs (Whitlock *et al.* 2007; Hamilton, 1964a, b). This study found in line with the adoption studies (Suri and Jack, 2011, 2014; Kikulwe *et al.*, 2014; Kirui *et al.*, 2013) that using mobile money channels for remittances presents significantly lower altruistic (transaction) costs compared to non-MoMo channels (table 4.5). This presents lower costs to the sender and the receiver, thus encouraging more remittance transfers to the household. Low altruistic (transaction) costs at the household level also reflect higher net disposal remittances received. Following the few impact studies (Aker *et al.*, 2013; Lee *et al.*, 2018; Murendo and Wollni, 2016), this is expected to increase food

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

consumption in the current period, contrary to PIH/LCH postulates of Friedman (1957)/Modigliani (1976). The findings of this study take effect from here. Unlike the static studies that immediately conclude food insecurity reduction, this study found that other transmission conditions must be satisfied before the effect on vulnerability to food poverty can be concluded.

Find 1: In Ghana, food-poor households that significantly used mobile money to receive remittances for consumption purposes are likely to experience significantly lower vulnerability to food poverty and improved stability in food security, in line with FAO (2009) expectations.

The recent studies (Lee *et al.*, 2018; Murendo and Wollni, 2016) are emphatic that households predominantly use mobile money to receive cash remittances for food consumption in the current period. However, this could come at the cost of food consumption smoothing if remittance savings is jeopardized in the current period (Friedman 1957; Modigliani 1976). The results in table 4.3 clearly show that the overwhelming use of remittances for daily consumption left no remittance savings for consumption smoothing purposes. The PIH/LCH consumption theory of Friedman (1957)/Modigliani (1976) considers remittances as 'windfall gains' which does not affect current or permanent consumption. Remittances are therefore saved/invested in the current period for food consumption smoothing (World Bank, 2006). Once food consumption smoothing is guaranteed, vulnerability to food poverty is lowered, and improved stability of food security 'at all times' can be concluded (FAO, 2009).

Thus, the finding above at the national line reveals the potency of using mobile money for remittances against vulnerability to food poverty in defying Friedman (1957)/Modigliani (1976) PIH/LCH but meeting the expectation of FAO stability dimension of food security for food-poor households. Since MoMo remittance savings is jeopardized in the current period (table 4.3), following Friedman (1957) and Modigliani (1976) PIH/LCH, we expect food consumption

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

smoothing ability to suffer and vulnerability to food poverty to be higher for food-poor households. However, the economic characteristic of the food (extreme) poor in Ghana is that they have minimal sources of income and are usually excluded from the formal financial system (Ouma *et al.*, 2017; Bank of Ghana, 2020). Thus, they have minimal coping mechanisms, and the lower altruistic cost of mobile money increases utilization for remittance transfers among them. Therefore, this study finds that vulnerability to food poverty is significantly lower for food-poor households that utilized mobile money channels significantly to receive remittances for consumption in the current period, even when no remittance was saved for consumption smoothing.

Find 2: In Ghana, non-food poor households that significantly used less mobile money channels to receive remittances for consumption may slightly experience high vulnerability to food poverty.

One of this study's findings reveals that Ghana's non-food poor households utilized more non-MoMo channels to receive remittances for consumption than mobile money (table 4.4). The non-MoMo channels, according to the GSS (2017), include person-to-person, bank transfers, brought by migrants, post offices, etc. In reverse effect, these channels attract higher reciprocal altruistic costs than mobile money channels (Suri and Jack, 2011, 2014 Kikulwe *et al.*, 2014; Kirui *et al.*, 2013). Compared to MoMo channels, these relatively high altruistic costs present higher costs both to the sender and the receiver, thus discouraging significant remittance transfer to the household. At the household level, high altruistic (transaction) costs also reflect lower net disposal remittances received for food consumption smoothing, thus increasing vulnerability to food poverty.

This study found that non-food poor households received more remittances than food-poor households (table 4.1) but utilized more non-MoMo remittance channels with high altruistic costs that discouraged both remittance receipts and reduced net remittance income. This study also

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

observed that non-food poor households saved no remittance received for consumption smoothing purposes (table 4.3). Given that remittances may or may not come to the majority of non-food poor households (table 4.5), the food consumption smoothing ability of those that utilized less MoMo remittance channels may suffer (Friedman 1957; Modigliani 1976). This may ultimately increase their vulnerability to food poverty as mobile money is less depended upon as a coping tool.

4.6.2 Drawing comparisons with recent incidence studies

For food-poor households that significantly used mobile money to receive remittances for consumption purposes, the findings of this study mean improved stability in their food security 'at all times' in line with FAO (2009) stability dimension. Thus, generally speaking, the findings for food-poor households may align with those from Murendo and Wollni (2016), Wiser *et al.* (2019), and Hayford (2020), even though these studies were static to the current period. For instance, in the study by Murendo and Wollni (2016) in Uganda, they analyzed food security using a static binary food insecurity measure and a 7-day and 30-day recall period to elicit food expenditures. Their results showed that using mobile money reduced food insecurity among households. Again in Uganda, Wiser *et al.* (2019) investigated and found that using mobile money reduced households with severely low food security from 62.9% to 47.2%. Hayford (2020) also used the static food insecurity experience scale and concluded that using mobile money for remittances improves the incidence of food insecurity.

Being static analysis to the current period, these recent studies do not suffice for FAO (2009) stability emphasis on food security 'at all times'. The perspectives of Friedman (1957) and Modigliani (1976) PIH/LCH further provide interesting insights that limiting the analysis to a static instead of dynamic analysis is premature for the conclusions of food poverty reduction. Following the proportion analyses from table 4.6, households' significant use of mobile money to receive

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

remittances for consumption is likely to increase food consumption expenditure in the current period. However, zero remittance savings recorded means no remittance savings for food consumption smoothing purposes 'at all times', all other things being equal (Friedman 1957; Modigliani 1976; FAO, 2009). Particularly for the food poor or extremely poor with minimal sources of income, it is crucial to verify if such defiance of the economics of remittances (PIH/LCH) through mobile money use is sustainable for mitigating vulnerability and guaranteeing stability in food security. This study found that using mobile money to receive remittances defies such theoretical expectations and lowers vulnerability to food poverty only among food-poor households that significantly utilized mobile money.

On the other hand, the vulnerability of non-food-poor households that used MoMo channels to receive remittances for consumption is slightly higher compared to non-MoMo users. Hence, the shortfall in the findings of these static studies compared to the findings of this study is evident. This change in the direction of effects due to differences in utilization between food-poor and non-food-poor households may provide the missing link to the study of Baborska *et al.* (2017). On a broader level of financial inclusion, Baborska *et al.* (2017) examined the effects of utilizing one, many, or all three of the formal financial services – savings, credit, and payments – on individuals' experiences with food security in rural regions throughout 88 low- and middle-income countries. The results show a range of implications on food security depending on the kind of service provided. The likelihood that a person would experience food insecurity is greatly impacted by their use of savings accounts, significantly impacted by their use of credit, and unaffected by their use of formal payment systems. Their results support the idea that the ultimate experience of food security is determined more by certain characteristics than by the variety of services provided by the formal financial sector. Thus, the extent of utilization of the mobile money channel, which is

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

missing in previous studies, is critical for all types of food insecurity and particularly vulnerability analysis.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The study primarily assessed how using mobile money to receive remittances for consumption affects households' vulnerability to food poverty in line with FAO (2009) stability dimension of food security. In fulfilling this primary objective, the study estimated the vulnerability to food poverty index probability by the vulnerability as expected poverty (VEP) model approach. It then examined how using mobile money to receive remittances mitigates this vulnerability among food-poor and non-food-poor households. This chapter presents the summaries, conclusions, and policy recommendations. A few recommendations for further research are also made.

5.2 Summary

The connection between using mobile money to receive remittances as a coping mechanism and household vulnerability to food poverty status was conceptualized following FAO (2009) stability dimension of food security 'at all times', reciprocal altruistic cost effectiveness of using mobile money channels for remittances compared to non-MoMo channels (Trivers 1971; Whitlock *et al.* 2007), as well as Friedman (1957)/Modigliani (1976) permanent income/lifecycle hypotheses (PIH/LCH). Per FAO's 'at all times' stability emphasis, household vulnerability to food poverty is more critical than the incidence of food poverty. This is because, at every point where food poverty incidence is measured, vulnerability to food poverty is higher; thus, the latter drives the former (Koomson *et al*., 2020).

The study considered the FGT headcount measure for the incidence of food poverty to estimate the food-poor and non-food-poor households and a dynamic approach (vulnerability as expected

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

poverty model) to estimate the vulnerability to food poverty. The empirical model was specified following Singh *et al*. (1986) general household utility framework, Philips and Taylor (1990)'s optimal control, and evoking FAO (2009) stability dimension of food security. The model estimation procedure followed the estimation of treatment effects in observational studies and the use of propensity score-based approaches to address selection biases in the cross-sectional data (GLSS 7) (Rosenbaum and Rubin, 1983). For robustness, the study applied propensity score to two propensity matching techniques – radius and kernel matches – and inverse probability treatment weighting (IPTW) to estimate the ATT. The following key findings ascertained pertain to the study's objectives.

First is the estimated incidence of household food poverty versus the estimated vulnerability to food poverty. At the national food poverty line, where the incidence of household food poverty was measured at 30.8%, vulnerability to food poverty almost doubled. This is similar to Novignon *et al*. (2012) and Koomson *et al*. (2020), who respectively found, using GLSS5&7, that where the incidence of poverty was measured, vulnerability to poverty in Ghana is about double the incidence estimate. Thus, FAO emphasizes food stability and ways to mitigate the vulnerability to food poverty over the years.

Overall, the study found at the national poverty line that vulnerability to food poverty is insignificantly lower for households that used MoMo channels to receive remittances for consumption compared to non-MoMo users. At the higher international food poverty line, vulnerability to food poverty was insignificantly higher for households that used MoMo channels to receive remittances for consumption than non-MoMo users.

However, the study found that even though Friedman (1957)/Modigliani (1976) expected remittances to be saved for consumption smoothing purposes, zero remittances saved in the current

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

period did not increase the vulnerability of food-poor households that significantly used MoMo channels to receive remittances for consumption. The study thus observed that significant differences in utilization and reciprocal altruistic costs between MoMo and non-MoMo remittance channels gave rise to different effects on vulnerability to food poverty among food-poor and non-food-poor households:

At the national food poverty line, food-poor households in Ghana that significantly used mobile money to receive remittances for consumption are likely to experience significantly lower vulnerability to food poverty and improved stability in food security, in line with FAO (2009) expectations. On the other hand, non-food poor households that significantly used non-mobile money channels for receiving remittances for consumption purposes may slightly experience high vulnerability to food poverty.

At the international food poverty line, food-poor households' significant use of mobile money to receive remittances for consumption may no longer effectively lower their vulnerability to food poverty.

5.3 Conclusion

The direction and significance of the effects of using mobile money to receive remittances on household vulnerability to food poverty are not straightforward. As found in this study, households' use of mobile money to receive remittances for consumption purposes, which jeopardizes remittance savings in the current period, has implications for food consumption smoothing ability following Friedman (1957)/Modigliani (1976) PIH/LCH. Given the food poverty line in Ghana, households that significantly utilize the reciprocal altruistic cost advantages of mobile money channels are likely to defy this theoretical expectation and lower their vulnerability to food poverty. On the hand, households that significantly used mobile money

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

channels less to receive remittances for consumption may slightly experience high vulnerability to food poverty. Thus, much depends on the extent of utilization of mobile money channels vis-à-vis non-mobile money channels among food-poor and non-food-poor households.

These important transmission mechanisms are unobserved in previous static studies, making their conclusions premature. In any case, the overall effect of using mobile money to receive remittances for consumption on household vulnerability to food poverty is insignificantly lower at the national food poverty line and slightly higher at the international food poverty line. Again, the underlying factor is the significant difference in using MoMo or non-MoMo channels for remittance receipts.

Thus, the current study used the dynamic VEP model on a two-year time horizon for food poverty vulnerability analysis to test the potency of using mobile money to receive remittances for consumption as a coping mechanism. Even in just a two-year time horizon, the difference is clear that limiting studies to static analysis could be misleading.

5.4 Policy recommendations

Based on the findings, the following policy recommendations are made:

Reciprocal altruistic cost advantages of using mobile money channels for remittances over non-mobile money channels have been identified to make a difference in lowing vulnerability to food poverty. Thus, the use of mobile money must be greatly encouraged, and the government and MoMo operators must find ways of resolving the relatively higher cost of remittance transactions on the poor brought upon by the electronic transactions levy.

In particular, diversifying revenue streams could help reduce the concentration on P2P and C2B transaction fee as the sole revenue streams available to Mobile Money operators. In the long-term, the transaction fee model may not be sustainable with the kind of competition and innovation

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

happening in the market. In Ghana for example, GCB Bank and Zeepay have just received clearance to issue electronic money, bringing the number of players in the market to five. The size of the pie is about to shrink. Diversification becomes the only means of survival. Mobile Money operators can consider leveraging on their agent network, customer base and customer transaction data to provide adjacent services to third party companies to reduce dependency on transaction fees.

The National Communication Authority (NCA) should implement policies that will lead to the digital maturity of the economies to ensure that more value circulation is happening on-net to reduce outgoing transaction cost. Innovation around the cost structure of Cash In Cash Out could be game-changing but it must be thought through carefully.

The Bank of Ghana, the apex regulator of the digital finance space, must spearhead the introduction of digital insurance through mobile money as a percentage of remittances received to support consumption smoothing of food-poor households. This will strategic partnerships between Bank of Ghana, the National Insurance Commission, NCA and the Telcos. The findings of this study show that should exogenous factors push up the food poverty line beyond the national level, using mobile money to receive remittances will no longer be effective at mitigating vulnerability to food poverty among food-poor households. The National Communications Authority (NCA), working with the Telcos must also design and implement relevant financial literacy targeted at the responsible use of mobile money remittances, particularly for extreme or food-poor households. The findings of this study show that all food-poor and non-food-poor households consumed all remittances received in the current period without saving any for food consumption smoothing.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Government must continue to strengthen support programs like the Livelihood Empowerment Against Poverty (LEAP) program directly targeted at the extreme poor, who are also the food poor in Ghana. The LEAP data for the extreme poor can be leveraged for this.

Above all, it is evident that a change in exogenous economic factors that raises the food poverty line weakens the efficacy of using mobile money channels to receive remittances to lower household vulnerability to food poverty. Thus, the Ministry of Finance and the Bank of Ghana must work to stabilize the macroeconomic environment and manage the cost of living.

5.4.1 Recommendations for further research

The findings of this study, particularly for non-food poor households, call for concern and need for further research. The study found that non-food poor households in Ghana that significantly used less mobile money channels to receive remittances for consumption may slightly experience high vulnerability to food poverty. Though this effect on vulnerability is insignificant, the positive relationship requires recent data to study the phenomenon further.

The current study utilizes typical observational data from the national cross-sectional GLSS7 survey conducted in 2017. The use of mobile money for receiving remittances and household food consumption was therefore limited to that time of the year. The study is thus limited to the use of the dynamic VEP approach for only a two-year time horizon, which is good enough for the resultant conclusions. It will be interesting to see how the findings will compare using expected data from the GLSS8.

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

APPENDIX A

References

Abadi, N., Techane, A., Tesfay, G., Maxwell, D., & Vaitla, B. (2018). *The impact of remittances on household food security: A micro perspective from Tigray, Ethiopia* (No. 2018/40). WIDER Working Paper.

Acheampong, P. P., Obeng, E. A., Opoku, M., Brobbey, L., & Sakyiamah, B. (2022). Does food security exist among farm households? Evidence from Ghana. *Agriculture & Food Security*, *11*(1), 1-13.

ACP Observatory on Migration (2014). Mobile money services: 'A bank in your pocket' - Overview and opportunities. Background Note, ACPOBS/2014/BN13. Available at http://publications.iom.int/bookstore/free/Mobile_money.pdf

Addai, K. N., Ng'ombe, J. N., & Temoso, O. (2022). Food Poverty, Vulnerability, and Food Consumption Inequality Among Smallholder Households in Ghana: A Gender-Based Perspective. *Social Indicators Research*, 1-29.

African Union (2021). Reducing remittance costs: consolidating trends and harnessing gains. Background paper for the EU-AIR Webinar. https://www.icmpd.org/file/download/56366/file/Background%2520paper_AIR-EC%2520Webinar_Remittances_25Nov2021_FINAL_V1122021.pdf

Agodini, R., & Dynarski, M. (2004). Are experiments the only option? A look at dropout prevention programs. *Review of Economics and Statistics*, *86*(1), 180-194.

Ahinful, G., Boateng, F., & Oppong-Boakye, P. (2013). Remittances from abroad: The Ghanaian household perspective. *International Journal of Business and Social Science*, *4*(1).

Ahmad, A. H., Green, C., & Jiang, F. (2020). Mobile money, financial inclusion and development: A review with reference to African experience. *Journal of Economic Surveys*, *34*(4), 753-792.

Ahmed, I. (2013). *Social safety nets in Bangladesh*. Citeseer.

Aker, J. C., and Blumenstock .J. E (2015). In "The Economics of New Technologies in Africa." In *The Oxford Handbook of Africa and Economics*, Vol. 2, edited by C. Monga and J. Y. Lin, 353–71. Oxford: Oxford University Press.

Akomea-Frimpong I, Andoh C, and Dwomoh-Okudzeto Y (2019). "Control of Fraud On Mobile Money Services In Ghana: An Exploratory Study," Journal of Money Laundering Control 22, no. 2: 301.

Alliance for Financial Inclusion (2021). "Ghana's First Mobile Money Interoperability System Deepens Financial Inclusion and Promotes Cashless Agenda," accessed November 13,

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

2021, https://www.afi-global.org/newsroom/news/ghanas-first-mobile-money-interoperability-system-deepens-financial-inclusion-and-promotes-cashless-agenda.

Almalki, S. (2016). Integrating Quantitative and Qualitative Data in Mixed Methods Research--Challenges and Benefits. *Journal of education and learning*, *5*(3), 288-296.

Alwang, J., Siegel, P. B., & Jorgensen, S. L. (2001). *Vulnerability: a view from different disciplines* (Vol. 115, p. 60). Social protection discussion paper series.

Amemiya, T. (1977). The maximum likelihood and the nonlinear three-stage least squares estimator in the general nonlinear simultaneous equation model. *Econometrica: Journal of the Econometric Society*, 955-968.

Ando, A., & Modigliani, F. (1963). The" life cycle" hypothesis of saving: Aggregate implications and tests. *The American economic review*, *53*(1), 55-84.

Antwi, K. D., & Lyford, C. P. (2021). Socioeconomic determinants of rural households' food security status in Northern Ghana. *Journal of Agriculture and Food Sciences*, *19*(2), 86-94.

Aron, J. (2018). Mobile money and the economy: A review of the evidence. *The World Bank Research Observer*, *33*(2), 135-188.

Arthur J. T (2015). "Ghana's E-Zwich System and the Characteristics of Innovation" (master's thesis, Eastern Illinois University, 2015), 83–86, https://thekeep.eiu.edu/cgi/viewcontent.cgi?article=3356&context=theses.

Atuoye, K. N., Kuuire, V. Z., Kangmennaang, J., Antabe, R., & Luginaah, I. (2017). Residential remittances and food security in the Upper West Region of Ghana. *International Migration*, *55*(4), 18–34.

Austin PC. (2011a). A tutorial and case study in propensity score analysis: an application to estimating the effect of in-hospital smoking cessation counseling on mortality. *Multivariate Behavioral Research* 2011; 46:119–151.

Austin PC. (2011b). An introduction to propensity-score methods for reducing the effects of confounding in observational studies. *Multivariate Behavioral Research 2011*; 46:399–424.

Austin, P. C. (2016). Variance estimation when using inverse probability of treatment weighting (IPTW) with survival analysis. *Statistics in medicine*, *35*(30), 5642-5655.

Ayifli RWA (2017). Food security and sustainability. J Food Process Techno. 2017;8:5. https:// doi. org/ 10. 4172/ 2157- 7110- C1- 062.

Azeem, M. M., Mugera, A. W., & Schilizzi, S. (2018). Vulnerability to Multi-Dimensional Poverty: An empirical comparison of alternative measurement approaches. *The Journal of Development Studies*, *54*(9), 1612–1636

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Azeem, M. M., Mugera, A. W., Schilizzi, S., & Siddique, K. H. (2017). An assessment of vulnerability to poverty in Punjab, Pakistan: Subjective choices of poverty indicators. *Social Indicators Research*, *134*(1), 117-152.

Baborska, R., Hernandez, E., Magrini, E., & Morales-Opazo, C. (2020). The impact of financial inclusion on rural food security experience: A perspective from low-and middle-income countries. *Review of Development Finance*, *10*(2), 1-18.

Baffour, P. T., Rahaman, W. A., & Mohammed, I. (2020). Impact of mobile money access on internal remittances, consumption expenditure and household welfare in Ghana. *Journal of Economic and Administrative Sciences*. Vol. 37 No. 3, pp. 337-354.

Banda H (2018), "Ghana's Banking Bust," Africa Report, November 22, 2018, https://www.theafricareport.com/445/ghana-finance-banking-bust.

Bank of Ghana (2019a) "Payment Systems Strategy (2019-2024),", accessed August 10, 2022, https://www.bog.gov.gh/wp-content/uploads/2022/01/National-Payment-Systems-Strategic-Plan-2019-to-2024-2.pdf.

Bank of Ghana (2019b) "Payment Systems and Services Act 2019 (Act 987)," Bank of Ghana, accessed August 11, 2022, https://www.bog.gov.gh/wp-content/uploads/2019/08/Payment-Systems-and-Services-Act-2019-Act-987-.pdf See generally section 7 of the act.

Bank of Ghana (2020). "About Us," Zeepay, accessed January 6, 2022, https://www.myzeepay.com/about-us; Bank of Ghana, "Bank of Ghana Licenses First Fintech," news release, April 30, 2022, https://www.bog.gov.gh/wp-content/uploads/2020/04/Press-Release-Bank-of-Ghana-licenses-First-Fintech.pdf.

Bank of Ghana (2022a). "Notice to Banks and Savings and Loans Companies: Guidelines to Branchless Banking," Bank of Ghana, accessed August 10, 2022, https://dfsobservatory.com/sites/default/files/Bank%20of%20Ghana%20-%20Notice%20No%20BG-GOV-SEC-2008-21%20-%20Regulatory%20Framework%20for%20Branchless%20Banking.pdf.

Bank of Ghana (2022c) "Notice to E-Money Issuers and The General Public: Guidelines for E-Money Issuers in Ghana and Agent Guidelines," Bank of Ghana, accessed August 10, 2022, https://www.bog.gov.gh/wp-content/uploads/2019/08/NOTICE-Guidelines-for-E-Money-Issues-in-Ghana.pdf.

Barrett, C. B. (2002). Food security and food assistance programs. *Handbook of Agricultural Economics*, *2*, 2103–2190.

Barrett, C. B. (2010). Measuring food insecurity. *Science*, *327*(5967), 825–828.

Batista, C., & Vicente, P. C. (2020, May). Adopting mobile money: Evidence from an experiment in rural Africa. In *AEA papers and proceedings* (Vol. 110, pp. 594-98).

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Bayudan-Dacuycuy, C., & Lim, J. A. (2014). Chronic and transient poverty and vulnerability to poverty in the Philippines: Evidence using a simple spells approach. *Social Indicators Research*, *118*(1), 389-413.

Blumenstock, J., Cadamuro, G., & On, R. (2015). Predicting poverty and wealth from mobile phone metadata. *Science*, *350*(6264), 1073-1076.

Boateng J. A (2022). "Panic Withdrawals Hit Mobile Money Nationwide Over 1.7% E-Levy"; "E-Levy: Telecom Chamber Warns Public against Fraudsters," Ghana Web, May 9, 2022, https://www.ghanaweb.com/GhanaHomePage/NewsArchive/E-levy-Telecom-Chamber-warns-public-against-fraudsters-1533860?msclkid=3041c6decfdd11eca8e1dd075723d268.

Boateng K. (2018). "Ghana's Progress on Reaching Out to the Unbanked Through Financial Inclusion," *International Journal of Management Studies* 5, no. 2

Bogale, A. (2012). Vulnerability of smallholder rural households to food insecurity in Eastern Ethiopia. *Food Security*, 4(4), 581–591.

Brown N (2021), "Over 4,000 Cyber Fraud Cases Currently Under Investigation," Joy Online, April 23, 2021, https://www.myjoyonline.com/over-4000-cyber-fraud-cases-currently-under-investigation/?param=.

Buller, A. M., Hidrobo, M., Peterman, A., & Heise, L. (2016). The way to a man's heart is through his stomach?: a mixed methods study on causal mechanisms through which cash and in-kind food transfers decreased intimate partner violence. *BMC public health*, *16*(1), 1-13.

Burchi, F., & De Muro, P. (2016). From food availability to nutritional capabilities: Advancing food security analysis. *Food Policy*, *60*, 10-19.

Byrne, B. M. (2010). *Structural Equation Modeling with Amos: Basic Concepts, Applications, and Programming (2nd ed.).* New York: Taylor and Francis Group.

Caliendo, M., & Kopeinig, S. (2005). Some Practical Guidance for the Implementation of Propensity Score Matching. *Discussion Paper Series*, IZA DP(1588).

Capaldo, J., Karfakis, P., Knowles, M., & Smulders, M. (2010). A model of vulnerability to food insecurity. ESA working paper no. 10–03 August 2010. Agricultural Development Economics Division Food and Agriculture Organization of the United Nations

Capone, R., Bilali, H. E., Debs, P., Cardone, G., & Driouech, N. (2014). Food system sustainability and food security: connecting the dots. *Journal of Food Security*, *2*(1), 13–22.

Carroll, C. D. (1997) "Buffer-Stock Saving and the Life-Cycle/Permanent-Income Hypothesis," *Quarterly Journal of Economics* 112(1), February 1997, 1–55.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Carroll, C. D. (2001). A theory of the consumption function, with and without liquidity constraints. *Journal of Economic perspectives*, *15*(3), 23-45.

Cassel G. (1921). *The World's Monetary Problems*, Constable, London

Cattaneo, M. D., Drukker, D. M., & Holland, A. D. (2013). Estimation of multivalued treatment effects under conditional independence. *The Stata Journal*, 13(3), 407-450.

Chagomoka, T., Unger, S., Drescher, A., Glaser, R., Marschner, B., & Schlesinger, J. (2016). Food coping strategies in northern Ghana. A socio-spatial analysis along the urban–rural continuum. *Agriculture & Food Security*, *5*(1), 1-18.

Chaudhuri, S. (2001), "Empirical Methods for Assessing Household Vulnerability to Poverty", Department of Economics, Columbia University, mimeographed.

Chaudhuri, S. (2003). Assessing vulnerability to poverty: concepts, empirical methods and illustrative examples. *Department of Economics, Columbia University, New York*, *56*.

Chaudhuri, S., J. Jalan and A. Suryhadi (2002), "Assessing household vulnerability to poverty: Illustrative examples and methodological issues". Presentation at the IFPRI- World Bank Conference on Risk and Vulnerability: Estimation and Policy Applications, September 23-24, Washington D.C.

Chenail, R. J. (2009). Making phenomenological inquiry accessible: A review of Jonathan A. Smith, Paul Flowers, and Michael Larkin's interpretive phenomenological analysis: Theory, method, and research. *The Qualitative Report*, *14*(2), 156-160.

Christiaensen L., and R.N. Boisvert (2000), "On Measuring Household Food Vulnerability: Case evidence from Northern Mali", Department of Agricultural, Resource, and Managerial Economics, Cornell University, mimeographed.

Christiaensen, L. J., & Subbarao, K. (2005). Towards an understanding of household vulnerability in rural Kenya. *Journal of african economies*, *14*(4), 520-558.

Chuang, Y., and Schechter L. (2015). "Social Networks in Developing Countries." *Annual Review of Resource Economics* 7: 451–72.

Coates, J. (2013). Build it back better: Deconstructing food security for improved measurement and action. *Global Food Security*, *2*(3), 188– 194.

Cobla, G. M., & Osei-Assibey, E. (2018). Mobile money adoption and spending behaviour: the case of students in Ghana. *International Journal of Social Economics*, *45*(1), 29–42.

Cohen, J. (1988). Statistical power analysis for the behavioral sciences–second edition. 12 Lawrence Erlbaum Associates Inc. *Hillsdale, New Jersey*, *13*.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Coulombe, H., and Q. Wodon. 2012. "A Food Insecurity Map for Ghana." *In Improving the Targeting of Social Programs in Ghana*, edited by Q. Wodon, 50-58. Washington, DC: World Bank.

Crump, R. K., Hotz, V. J., Imbens, G. W., & Mitnik, O. A. (2009). Dealing with limited overlap in estimation of average treatment effects. *Biometrika*, *96*(1), 187-199.

Crush, J., & Caesar, M. (2017). *Food remittances: rural-urban linkages and food security in Africa*. Southern African Migration Programme.

Cruz, P., Barretto Filgueiras Neto, L., Munoz-Gallego, P., & Laukkanen, T. (2010). Mobile banking rollout in emerging markets: evidence from Brazil. *International Journal of Bank Marketing*, *28*(5), 342-371

Da Cruz V., Fengler W. & Schwartzman A. (2004). "Remittance to Comoros: Volume, Trends, Impact and Implications." Africa Region Working Paper N075. World Bank, Washington, D.C.

Darfour, B., & Rosentrater, K. A. (2016). Agriculture and food security in Ghana. In *2016 ASABE Annual International Meeting* (p. 1). American Society of Agricultural and Biological Engineers.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Management Science*, 35(8), 982–1003.

De Weerdt, J., & Dercon, S. (2006). Risk-sharing networks and insurance against illness. *Journal of development Economics*, *81*(2), 337-356.

Demeke A.B, Keil A, Zeller M (2011). Using panel data to estimate the effect of rainfall shocks on smallholders food security and vulnerability in rural Ethiopia. *Clim Change* 108(1–2):185–206

Department for International Development (2003), "Social Protection", chapter 20 in *Policy Planning and Implementation*, April.

Dercon, S., and P. Krishnan (2000), "Vulnerability, Seasonality and Poverty in Ethiopia", *Journal of Development Studies*, Vol. 36, No.6, pp. 25-53.

Dercon, S., and P. Krishnan (2001). 'Vulnerability, Seasonality and Poverty in Ethiopia'. *Journal of Development Studies*, 36 (6): 25-53.

Devicienti, F. (2002). Poverty persistence in Britain: a multivariate analysis using the BHPS, 1991–1997. *Journal of Economics*, *77*(1), 307-340.

Doenges, R. C. (1966). Transitory income size and savings. *Southern Economic Journal*, 258-263.

Dolan, J. (2009). *Accelerating the development of mobile money ecosystems.* Washington, DC: IFC and the Harvard Kennedy School.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Duda, I., Fasse, A., & Grote, U. (2018). Drivers of rural-urban migration and impact on food security in rural Tanzania. *Food Security*, *10*(4), 785-798.

Duesenberry, J.S. (1949) *Income, Saving, and the Theory of Consumer Behavior*. Harvard University Press, Cambridge.

Duflo, E., & Udry, C. R. (2004). Intrahousehold resource allocation in Cote d'Ivoire: Social norms, separate accounts and consumption choices. NBER Working Papers 10498, National Bureau of Economic Research, Cambridge, MA

Dupas, P, and Robinson J. (2013). "Why Don't the Poor Save More? Evidence from Health Savings Experiments." *American Economic Review* 103 (4): 1138–71.

Échevin, D. (2013). Measuring vulnerability to asset-poverty in sub-Saharan Africa. *World Development*, *46*, 211-222.

Ecker, O., & Fang, P. (2016). Economic development and nutrition transition in Ghana: Taking stock of food consumption patterns and trends. *Achieving a nutrition revolution for Africa: the road to healthier diets and optimal nutrition*, 28-50.

Ellis, F. (2003). Human Vulnerability and Food Insecurity: Policy Implications. Forum for Food Security in Southern Africa, Overseas Development Group, Overseas Development Institute, London (www. odi. org. uk/food-securiy-forum) Background Research Paper: Human Vulnerability. In *13 United Nations Development Programme*.

F. A. O., World Health Organization, & WHO Expert Committee on Food Additives. (2017). *Evaluation of certain contaminants in food: eighty-third report of the Joint FAO/WHO Expert Committee on Food Additives*. World Health Organization.

Fafchamps, M., Udry, C., & Czukas, K. (1998). Drought and saving in West Africa: are livestock a buffer stock? *Journal of Development economics*, *55*(2), 273-305.

Fang, G., Brooks, J. M., & Chrischilles, E. A. (2012). Apples and oranges? Interpretations of risk adjustment and instrumental variable estimates of intended treatment effects using observational data. *American journal of epidemiology*, *175*(1), 60-65.

FAO (2009). Declaration of the world summit on food security. *World Food Summit*, 16-18.

FAO (2009). Nutrition country Profile: Republic of Ghana. ftp:// ftp. fao. org/ag/ agn/ nutri tion/ ncp/ gha. pdf

FAO, IFAD, UNICEF, WFP and WHO. (2017). *The State of Food Security and Nutrition in the World 2017. Building resilience for peace and food security*. Rome, FAO.

FAO. (2020). *Nutrition and livestock: technical guidance to harness the potential of livestock for improved nutrition of vulnerable populations in programme planning*. Rome. (also available at https://doi.org/10.4060/ca7348en).

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Feleke, S. T., Kilmer, R. L., & Gladwin, C. H. (2005). Determinants of food security in Southern Ethiopia at the household level. *Agricultural Economics*, *33*(3), 351-363.

Findley, S. E. (1997). Migration and family interaction in Africa. In A. Adepoju (Ed.), *Family, population and development in Africa* (pp. 109- 138). London: Zed Books.

Finnie, R., & Sweetman, A. (2003). Poverty dynamics: empirical evidence for Canada. *Canadian Journal of Economics/Revue canadienne d'économique*, *36*(2), 291-325.

Food and Agriculture Organization (1996). *Rome Declaration on World Food Security and World Food Summit Plan of Action*. World Food Summit 13–17 November 1996. Rome: FAO.

Food and Agriculture Organization (2009). Declaration of World Summit on Food Security.

Food and Agriculture Organization (2013). The State of Food Insecurity in the World: Multiple Dimensions of Food Security. Rome: FAO.

Food and Agriculture Organization (2015). The State of Food Insecurity in the World. Rome: FAO

Foster J, Greer J. and Thorbecke E (1984). A Class of Decomposable Poverty Measures. *Econometrica*, Vol. 52, No. 3, pp. 761-766

Frayne, B., Pendleton, W., Crush, J., Acquah, B., Battersby-Lennard, J., Bras, E., & Zanamwe, L. (2010). The state of urban food insecurity in southern Africa. *Urban food security series*, *2*.

Freund, C., & Spatafora, N. (2008). Remittances, transaction costs, and informality. *Journal of development economics*, *86*(2), 356-366.

Friedman, M. (1957). The permanent income hypothesis. In *A theory of the consumption function* (pp. 20-37). Princeton University Press.

Gabbert, S., and H.-P. Weikard. 2001. "How Widespread is Undernourishment? A Critique of Measurement Methods and New Empirical Results." *Food Policy* 26 (3): 209–228.

Gelaw F, Sileshi M (2013). Impact of grain price hikes on poverty in rural Ethiopia. *Afr J Agric Resour Econ* 8(2):69–89

Ghana Interbank Payment and Settlement Systems Limited (2021a), "Who We Are," accessed September 6, 2022, https://ghipss.net/index.php/about/who-we-are.

Ghana Interbank Payment and Settlement Systems Limited (2021b), "E-Zwich Biometric Card," accessed September 14, 2022, https://ghipss.net/index.php/services/e-Zwich-biometric-card.

Ghana Statistical Service (2012). 2010 Population and housing census post enumeration survey report. Accra, Ghana.

Ghana Statistical Service (2014). *Ghana Living Standard Survey Round 6 (GLSS 6):* Main Report. Ghana: Ghana Statistical Service.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Ghana Statistical Service (2017). *Ghana Living Standard Survey Round 7 (GLSS 7):* Main Report. Ghana: Ghana Statistical Service.

Ghana Statistical Service (2018). *Ghana Living Standard Survey Round 7 (GLSS 7):* Main Report. Ghana: Ghana Statistical Service.

Ghana Statistical Services (GSS). 2010 Population and housing census: national analytical report. Accra, Ghana.

Gibson, J., McKenzie, D., & Zia, B. (2014). The impact of financial literacy training for migrants. *The World Bank Economic Review*, *28*(1), 130-161.

Glass, G. V., McGaw, B., & Smith, M. L. (1981). *Meta-analysis in social research*. Sage Publications, Incorporated.

Glewwe, P., and G. Hall (1998), "Are Some Groups More Vulnerable to Macroeconomic Shocks than Others? Hypothesis Tests Based on Panel Data from Peru", *Journal of Development Economics*, Vol. 56, No. 1, pp. 181-206.

Gray, D. E. (2016). *Doing research in the real world.* New Dehli: Sage Publication.

Greenacre, J., & Buckley, R. P. (2014). Using trusts to protect mobile money customers. *Sing. J. Legal Stud.*, 59.

Greifer, N., & Stuart, E. A. (2021). Matching methods for confounder adjustment: an addition to the epidemiologist's toolbox. *Epidemiologic Reviews*, *43*(1), 118-129.

GSMA (2020). The Mobile Money Regulatory Index.

GSMA (2020). *The Mobile Money Regulatory Index.*

GSMA (2021). *State of the Industry Report on Mobile Money.*

GSMA (2022). "MTN MoMo Pay Merchant Payments: Expanding Women's Mobile Money Use in Ghana," GSMA, accessed June 12, 2022, https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2020/05/MTN-MoMo-Pay-Merchant-Payments-Expanding-Female-Mobile-Money-Usage-in-Ghana.pdf.

Günther, I., & Harttgen, K. (2009). Estimating households vulnerability to idiosyncratic and covariate shocks: A novel method applied in Madagascar. *World Development*, *37*(7), 1222-1234.

Guriting, P., & Oly Ndubisi, N. (2006). Borneo online banking: evaluating customer perceptions and behavioural intention. *Management Research News*, *29*(2), 6–15.

Gyasi, R. M., Phillips, D. R., & Adam, A. M. (2021). How far is inclusivity of financial services associated with food insecurity in later life? Implications for Health Policy and Sustainable Development Goals. *Journal of Applied Gerontology*, *40*(2), 189-200.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Hair, J. F., Ortinau, D. J., & Harrison, D. E. (2010). *Essentials of marketing research* (Vol. 2). New York, NY: McGraw-Hill/Irwin.

Hamilton, W. D. (1964a). The genetical evolution of social behavior. Part I. J. *Theor. Biol*. 7, 1–16.

Hamilton, W. D. (1964b). The genetical evolution of social behavior. Part II. J. *Theor. Biol*. 7, 17–52.

Handouyahia, A., Haddad, T., & Eaton, F. (2013). Kernel matching versus inverse probability weighting: a comparative study. *International Journal of Mathematical and Computational Sciences*, *7*(8), 1218-1233.

Hayford E. K (2020). The impact of mobile money use on internal remittance and household food insecurity in Ghana (Unpublished master's thesis).University of Ghana, Legon, Accra.

Heckman, J. J., LaLonde, R. J., & Smith, J. A. (1999). The economics and econometrics of active labor market programs. In *Handbook of labor economics* (Vol. 3, pp. 1865-2097). Elsevier.

Hedges, L. V. (1981). Distribution theory for Glass's estimator of effect size and related estimators. *journal of Educational Statistics*, *6*(2), 107-128.

Hesse A, Akpaka B, and Williams, K. (2021). "A History of Mobile Money in Ghana," February 2, 2021, in Decode Fintech, podcast, MP3 audio, 33:20, https://decodefintech.simplecast.com/episodes/mobile-money-in-ghana-CLoEOtNl.

Holzmann, R., & Jørgensen, S. (2001). Social risk management: A new conceptual framework for social protection, and beyond. *International Tax and Public Finance*, *8*(4), 529-556.

Holzmann, R., and S. Jørgensen (2000), "Social Risk Management: A New Conceptual Framework for Social Protection, and Beyond", Social Protection Discussion Paper No. 0006, Washington DC, World Bank, February.

Hong, S.-J., Thong, J. Y., Moon, J.-Y., & Tam, K.-Y. (2008). Understanding the behavior of mobile data services consumers. *Information Systems Frontiers*, *10*(4), 431.

Horvitz, D. G., & Thompson, D. J. (1952). A generalization of sampling without replacement from a finite universe. *Journal of the American statistical Association*, *47*(260), 663-685.

Horvitz, D., and D. Thompson (1952): "A Generalization of Sampling Without Replacement from a Finite Population", *Journal of the American Statistical Association*, 47, 663-685.

Hundtofte, S. and Gladstone J. (2017). "Who Uses a Smartphone for Financial Services? Evidence of a Selection for Impulsiveness from the Introduction of a Mobile FinTech App". Working Paper.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Hundtofte, S., and J. Gladstone. (2017). "Who Uses a Smartphone for Financial Services? Evidence of a Selection for Impulsiveness from the Introduction of a Mobile FinTech App". Working paper.

IMF (2021). Is Mobile Money Part of Money? Understanding the Trends and Measurement. *IMF Working Papers*, *2021*(177).

International Finance Corporation (2014). "IFC, The MasterCard Foundation and Tigo Ghana to Expand Mobile Financial Services in Ghana," news release, May 27, 2014, https://pressroom.ifc.org/all/pages/PressDetail.aspx?ID=17891;

International Food Policy Research Institute, IFPRI, (2000) Women, the Key to Food Security. Washington, D, C.

ITU (2013). The Mobile Money Revolution. Part 2: Financial Inclusion Enabler. ITU-T Technology Watch Report.

Jack, W., & Suri, T. (2011). Mobile Money: The Economics of M-PESA. NBER Working Paper Series 16721.

Jack, W., & Suri T. (2014). "Risk Sharing and Transactions Costs: Evidence from Kenya's Mobile Money Revolution." *American Economic Review* 104 (1): 183–223.

Jack, W., Suri, T & Townsend R. (2010). "Monetary Theory and Electronic Money: Reflections on the Kenyan Experience." *Federal Reserve Bank of Richmond Economic Quarterly* 96 (1): 3–122.

Jacoby, H. G., & Skoufias, E. (1997). Risk, financial markets, and human capital in a developing country. *The Review of Economic Studies*, *64*(3), 311-335.

Jakiela, P., & Ozier, O. (2016). Does Africa need a rotten kin theorem? Experimental evidence from village economies. *The Review of Economic Studies*, *83*(1), 231-268.

Jenkins, S. P., Schluter, C., & Wagner, G. (2003). The dynamics of child poverty: Britain and Germany compared. *Journal of comparative family studies*, *34*(3), 337-355.

Johnen C, Parlasca M, & Mußhoff O (2021) Promises and pitfalls of digital credit: Empirical evidence from Kenya. PLoS ONE 16(7): e0255215. https://doi.org/10.1371/journal.pone.0255215

Johnson, S. (2016). Competing visions of financial inclusion in Kenya: the rift revealed by mobile money transfer. *Canadian Journal of Development Studies/Revue canadienne d'études du développement*, *37*(1), 83-100.

Kakwani, N., & Son, H. H. (2016a). Measuring food insecurity: Global estimates. In *Social welfare functions and development* (pp. 253-294). Palgrave Macmillan, London.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Kakwani, N., & Son, H. H. (2016b). Global poverty estimates based on 2011 purchasing power parity: where should the new poverty line be drawn?. *The Journal of Economic Inequality*, *14*(2), 173-184.

Kamanou, G., & J. Morduch (2002), "Measuring Vulnerability to Poverty". NYU Wagner Working Paper No. WP1012. New York: New York University.

Karlan, D., J. Kendall, R. Mann, R. Pande, T. Suri, & Zinman J. (2016). "Research and Impacts of Digital Financial Services." NBER Working Paper No. 22633, National Bureau of Economic Research, Cambridge, MA.

Keynes, J. M. (1936). *The General Theory of Employment, Interest and Money*. New York: Harcourt, Brace.

Khalifa, M., & Shen, K. N. (2008). Drivers for transactional B2C m-commerce adoption: Extended theory of planned behavior. *Journal of Computer Information Systems*, *48*(3), 111–117.

Khodawandi, D., Pousttchi, K., & Wiedemann, D. G. (2003). Acceptance of mobile payment procedures in Germany. In *Workshop Mobile Commerce. Augsburg* (pp. 42-57).

Kikulwe E.M, Fischer E, & Qaim M (2014) Mobile Money, Smallholder Farmers, and Household Welfare in Kenya. *PLoS ONE* 9(10)

Kimalu, P., Nancy, N.D.,Kulundu M.G., & Mwabu ,S. K., (2002). A Situational Analysis of Poverty in Kenya, the Kenyan Institute for Public Policy Research and Analysis (KIPPRA), Working Paper Series, WP/6/2002.

Kimani-Murage, E. W., Schofield, L., Wekesah, F., Mohamed, S., Mberu, B., Ettarh, R., & Ezeh, A. (2014). Vulnerability to food insecurity in urban slums: experiences from Nairobi, Kenya. *Journal of urban health*, *91*(6), 1098-1113.

Kirui, O. K., Okello, J. J., Nyikal, R. A., & Njiraini, G. W. (2013). Impact of mobile phone-based money transfer services in agriculture: evidence from Kenya. *Quarterly Journal of International Agriculture*, *52*(892-2016-65177), 141-162.

Koenig-Lewis, N., Palmer, A., & Moll, A. (2010). Predicting young consumers' take up of mobile banking services. *International Journal of Bank Marketing*, *28*(5), 410-432.

Koomson, I., Villano, R. A., & Hadley, D. (2020). Effect of financial inclusion on poverty and vulnerability to poverty: Evidence using a multidimensional measure of financial inclusion. *Social Indicators Research*, *149*(2), 613-639.

Koomson, I., Villano, R. A., & Hadley, D. (2020). Effect of financial inclusion on poverty and vulnerability to poverty: Evidence using a multidimensional measure of financial inclusion. *Social Indicators Research*, *149*(2), 613-639.

Kreinin, M. E. (1961). Windfall income and consumption: Additional evidence. *The American Economic Review*, 51(3), 388-390.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Kuiper, M., & Cui, H. D. (2021). Using food loss reduction to reach food security and environmental objectives–A search for promising leverage points. *Food Policy*, *98*, 101915.

Kuwornu J. K. M, Suleyman D. M., & Amegashie D. P. K (2013). Analysis of food security status of farming households in the forest belt of the Central Region of Ghana. *Russian Journal of Agricultural and Socio-Economic Sciences*, *13*(1), 26-42.

Lancaster H (2022). "Ghana Telecoms Market Report: Telcoms, Mobile and Broadband – Statistics and Analyses," Budde Comm, last updated May 25, 2022, https://www.budde.com.au/Research/Ghana-Telecoms-Mobile-and-Broadband-Statistics-and-Analyses.

Lang, T., & Heasman, M. (2015). *Food wars: the global battle for mouths, minds and markets*. Routledge.

Laukkanen, T., & Kiviniemi, V. (2010). The role of information in mobile banking resistance. *International Journal of Bank Marketing*, *28*(5), 372-388.

Lee, J. N., Morduch, J., Ravindran, S., Shonchoy, A., & Zaman, H. (2018). Poverty and migration in the digital age: Experimental evidence on mobile banking in Bangladesh. *American Economic Journal: Applied Economics*, *13*(1), 38-71.

Leuven, E. & Sianesi, B. (2010) PSMATCH2: Stata Module to Perform Full Mahalanobis and Propensity Score Matching, Common Support Graphing, and Covariate Imbalance Testing. http://EconPapers.repec.org/RePEc:boc:bocode:s432001

Levi-Strauss, C. (1969). *The Elementary Structures of Kinship*. James Harle Bell, John Richard von Sturmer, and Rodney Needham, trans. Boston: Beacon Press.

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

Ligon, E., & L. Schechter (2004), "Evaluating Different Approaches to Estimating Vulnerability", Social Protection Discussion Paper No. 0410, Washington DC, World Bank.

Liu, Y., & Li, H. (2010). Mobile internet diffusion in China: An empirical study. *Industrial Management & Data Systems*, *110*(3), 309–324.

López-Nicolás, C., Molina-Castillo, F. J., & Bouwman, H. (2008). An assessment of advanced mobile services acceptance: Contributions from TAM and diffusion theory models. *Information and Management*, *45*(6), 359–364.

Løvendal, C.R., and M. Knowles (2005), "Tomorrow's Hunger: A Framework for Analysing Vulnerability to Food Insecurity", Agricultural and Development Economics Division, FAO, ESA Working Paper No. 05-07.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Løvendal, C.R., Knowles, & N. Horii (2004), "Understanding Vulnerability to Food Insecurity Lessons from Vulnerable Livelihood Profiling", Agricultural and Development Economics Division, FAO, ESA Working Paper No. 04-18.

MacVaugh, J., & Schiavone, F. (2010). Limits to the diffusion of innovation: A literature review and integrative model. *European Journal of Innovation Management*, *13*(2), 197-221.

Mansuri, G., & Healy A (2001). 'Vulnerability Prediction in Rural Pakistan'. Washington, DC: World Bank. Mimeo.

Mas, I., & Klein. M (2012). "A Note on Macro-Financial Implications of Mobile Money Schemes." Work-ing Paper No. 188, Frankfurt School of Finance & Management, Frankfurt.

Masahudu, M. (2019). Food insecurity and coping strategies of farm families in the Savelugu-Nanton Municipal of Northern region. *International Journal of Advance Research, Ideas and Innovations in Technology.*

Maurer, B. (2012). Mobile money: communication, consumption and change in the payments space. *Journal of Development studies*, *48*(5), 589-604.

Mazzucato, V. (2008). The double engagement: Transnationalism and integration. Ghanaian migrants' lives between Ghana and the Netherlands. *Journal of ethnic and migration studies*, *34*(2), 199-216.

Mbiti, I., & Weil, D. N. (2011). Mobile banking: The impact of M-Pesa in Kenya. In *African successes, Volume III: Modernization and development* (pp. 247-293). University of Chicago Press.

McGuire, S. (2015). FAO, IFAD, and WFP. The state of food insecurity in the world 2015: meeting the 2015 international hunger targets: taking stock of uneven progress. Rome: FAO, 2015. *Advances in Nutrition*, *6*(5), 623-624.

McKay, C., & Pickens, M. (2010). *Branchless banking 2010: Who's served? At what price? What's next?* (Vol. 66). CGAP Focus Note.

Medhi, I. Ratan, A & Toyama K. 2012, "Mobile-Banking Adoption and Usage by Low-Literate, Low-Income Users in the Developing World". *Microsoft Research India*, 196/36; accessed in June 2013 at www.gsma.com/mobilefordevelopment/wp-content

Mendy, J., Asongwe, G. A., & Nkongho, R. N. (2020). Vulnerability to food insecurity and coping strategies of agrarian households in the lower river region of the Gambia: Implication for policy. *International Journal of Agricultural Science and Food Technology*, *6*(1), 115-126.

Mensah, J., Oppong, J. R., & Schmidt, C. M. (2010). Ghana's National Health Insurance Scheme in the context of the health MDGs: an empirical evaluation using propensity score matching. *Health economics*, *19*(S1), 95-106.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Ministry of Communications (2021). "National SIM Card Registration Takes Off Next Month (October)," Ministry of Communications and Digitisation, accessed November 15, 2021, http://m.ghheadlines.com/agency/ghanaian-times/20210906/150486263/national-sim-card-registration-exercise-begin-next-month.

Modigliani, F. (1966), "The life-cycle hypothesis of saving, the demand for wealth and the supply of capital", *Social Research* vol. 33, pp. 160-217. 21 pages

Modigliani, F., & Brumberg, R. (1954). Utility analysis and the consumption function: An interpretation of cross-section data. *Franco Modigliani*, *1*(1), 388-436.

MoFA, GHS, WFP & UNICEF (2020a). Food Security and Nutrition Monitoring System (FSNMS) Ghana. https:// relie fweb. int/ sites/ relie fweb. int/ files/resou rces/ WFP- 00001 22435. pdf.

MoFA, GHS, WFP, & FAO (2020b). Comprehensive Food Security and Vulnerability Analysis (CFSVA) of Ghana. http://s1.statsghana.gov.gh/gssmain/fileUpload/pressrelease/Comprehensive%20Food%20Security%20and%20Vulnerability%20Analysis%20(CFSVA).pdf

Morawczynski, O. (2009). "Exploring the Usage and Impact of 'Transformational' Mobile Financial Services: The Case of M-Pesa in Kenya." *Journal of Eastern African Studies* 3 (3): 509–25.

Morawczynski, O., & Pickens, M. (2009). *Poor people using mobile financial services: observations on customer usage and impact from M-PESA.* Washington, DC: Consultative Group to Assist the Poorest.

Morduch, J. (1995). Income smoothing and consumption smoothing. *Journal of economic perspectives*, *9*(3), 103-114.

Munyegera, G. K., & Matsumoto, T. (2016). Mobile money, remittances, and household welfare: panel evidence from rural Uganda. *World Development*, 79, 127–137.

Murendo, C., & Wollni, M. (2016). *Mobile money and household food security in Uganda* (No. 858-2016-60328).

Mutabazi-Mwesigire, D., Katamba, A., Martin, F., Seeley, J., & Wu, A. W. (2015). Factors that affect quality of life among people living with HIV attending an urban clinic in Uganda: a cohort study. *PloS one*, *10*(6), e0126810.

Narteh, B., Mahmoud, M. A., & Amoh, S. (2017). Customer behavioural intentions towards mobile money services adoption in Ghana. *The Service Industries Journal*, *37*(8), 426–447.

Nicco-Annan J (2021). "MTN Mobile Money – Spotlight on Ghana," GSMA, October 21, 2009, https://www.gsma.com/mobilefordevelopment/country/ghana/mtn-mobile-money-spotlight-on-ghana; Jason Nicco-Annan, "That's Momo Like It: Everything You Need To

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Know About Mobile Money In Ghana," WorldRemit, accessed October 8, 2021, https://www.worldremit.com/en/blog/money-transfer/mobile-money-ghana.

Novignon, J., Nonvignon, J., Mussa, R., & Chiwaula, L. S. (2012). Health and vulnerability to poverty in Ghana: Evidence from the Ghana Living Standards Survey Round 5. *Health Economics Review*, *2*(1), 11.

Nubé, M. (2001). Confronting dietary energy supply with anthropometry in the assessment of undernutrition prevalence at the level of countries. *World Development*, *29*(7), 1275-1289.

OECD (2018), G20/OECD Policy Guidance on Financial Consumer Protection Approaches in the Digital Age

Ogundari, K. (2017). Categorizing households into different food security states in Nigeria: the socio-economic and demographic determinants. *Agricultural and Food Economics*, *5*(1), 1-20.

Orlikowski, W. J., & Iacono, C. S. (2001). Research commentary: Desperately seeking the "IT" in IT research—A call to theorizing the IT artifact. *Information systems research*, *12*(2), 121-134.

Orozco, M. (2003, June). Remittances, the rural sector, and policy options in Latin America. In *United States Agency for International Development-World Council of Credit Unions conference, "Paving the Way Forward for Rural Finance: An International Conference on Best Practices", Washington, DC* (pp. 2-4).

Osei-Assibey, E. (2015). What drives behavioral intention of mobile money adoption? The case of ancient susu saving operations in Ghana. *International Journal of Social Economics*.

Ouma, S. A., Odongo, T. M., & Were, M. (2017). Mobile financial services and financial inclusion: Is it a boon for savings mobilization? *Review of Development Finance*, 7, 29–35

Owusu W Y (2011). "Zap Changes to Airtel Money," Modern Ghana, December 16, 2011, https://www.modernghana.com/news/367341/zap-changes-to-airtel-money.html; Vodafone, "Vodafone Launches M-Pesa in Ghana," news release, accessed November 15, 2021, https://www.african-markets.com/en/news/west-africa/ghana/m-pesa-hits-280-000-users-in-ghana#:~:text=In%20December%202015%2C%20Vodafone%20launchedSeptember%2C%20according%20to%20Vodafone%20Ghana.

Ozughalu, U. M. (2016). Relationship between household food poverty and vulnerability to food poverty: Evidence from Nigeria. *Social Indicators Research*, *125*(2), 567-587.

Padashetty, S., & Krishna Kishore, S. V. (2013). An empirical study on consumer adoption of mobile payments in Bangalore City–A case study. *Researchers World: Journal of Arts, Science & Commerce*, *4*(1).

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Page, J, & Plaza S (2006). Migration Remittances and Development: A Review of Global Evidence. *Journal of African Economies* 15 (Suppl. 2): 245–336.

Palley, T. I. (2010). The relative permanent income theory of consumption: a synthetic Keynes–Duesenberry–Friedman model. *Review of Political Economy*, *22*(1), 41-56.

Panos, G. A., & Wilson, J. O. (2020). Financial literacy and responsible finance in the FinTech era: capabilities and challenges. *The European Journal of Finance*, *26*(4-5), 297-301.

Phillips, T. P., & Taylor, D. S. (1990). Optimal control of food insecurity: a conceptual framework. *American Journal of Agricultural Economics*, *72*(5), 1304-1310.

Porteous, D. (2007). The enabling environment for mobile banking in Africa. Department for International Development. Retrieved from http://www.ruralfinance.org/discussion/ru/?no_cache=1&srec=11508&tdet=training&tdet2=&tdet3=2&referer=MTA1Mjk%3D [Accessed: 17/5/2018].

Püschel J., Afonso M. J., Mauro C. & Hernandez, J. (2010). Mobile banking: proposition of an integrated adoption intention framework. *International Journal of Bank Marketing*, *28*(5), 389-409.

Quaye, W. (2008). Food security situation in northern Ghana, coping strategies and related constraints. *African journal of agricultural research*, *3*(5), 334-342.

Radcliffe, D., & Voorhies. R (2012). "A Digital Pathway to Financial Inclusion." (December 11, 2012). Available at: https://ssrn.com/abstract=2186926.

Ramayah, T., Siron, R., Dahlan, N., & Mohamad, O. (2002). Technology usage among owners/managers of SME's: The role of demographic and motivational variables. In *The proceedings of the 6th Annual Asian-Pacific Forum for Small Business on Small and Medium Enterprises Linkages, Networking and Clustering*.

Rao, B. B., & G. Hassan (2012). A Panel Data Analysis of Growth Effects of Remittances, *MPRA Paper 18021*, University Library of Munich, Germany

Rapsomanikis, G., & Sarris, A. (2008). Market integration and uncertainty: The impact of domestic and international commodity price variability on rural household income and welfare in Ghana and Peru. *The Journal of Development Studies*, *44*(9), 1354-1381.

Ratha, D. (2013). The impact of remittances on economic growth and poverty reduction. *Policy Brief*, *8*(1), 1-13.

Ravallion, M. (1988), "Expected Poverty under Risk-induced Welfare Variability", *Economic Journal*, Vol. 98, No. 393, pp. 1171-1182.

Riley, E. (2018). Mobile money and risk sharing against village shocks. *Journal of Development Economics*, *135*, 43-58.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Rogers, E. M. (2003). Diffusion of innovations (5th ed.). New York: Free Press. Rosenbaum, P. R., & Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, *70*(1), 41-55.

Rosenbaum, P. R., & Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, *70*(1), 41-55.

Rosenzweig, M. R., & Stark, O. (1989). Consumption smoothing, migration, and marriage: Evidence from rural India. *Journal of political Economy*, *97*(4), 905-926.

Rubin, D. B. (1974). Estimating causal effects of treatments in randomized and nonrandomized studies. *Journal of educational Psychology*, *66*(5), 688.

Rubin, D. B. (2001). Using propensity scores to help design observational studies: application to the tobacco litigation. *Health Services and Outcomes Research Methodology*, *2*(3), 169-188.

Sadoulet, E., & A. de Janvry. (1995). *Quantitative Development Policy Analysis.* Baltimore and London: The John Hopkins University Press.

Sander, C., & Maimbo, S. M. (2005). Migrant remittances in Africa: A regional perspective. In S. M. Maimbo, & D. Ratha (Eds.), *Remittances: Development impact and future prospects* (pp. 53-79). Washington, DC: World Bank

Santeramo, F. G. (2021). Exploring the link among food loss, waste and food security: what the research should focus on?. *Agriculture & Food Security*, *10*(1), 1-3.

Sassi, M. (2015). A Spatial, Non-parametric Analysis of the Determinants of Food Insecurity in Sub-Saharan Africa. *African Development Review*, *27*(2), 92–105.

Scaramozzino, P. (2006). *Measuring vulnerability to food insecurity*. Agricultural and Development Economics Division of the Food and Agriculture Organization of the United Nations (FAO-ESA).

Sein, M. K., & Harindranath, G. (2004). Conceptualizing the ICT artefact: Toward understanding the role of ICT in national development. *The Information Society*, 20(1), 15-24.

Sen A. (1981). *Poverty and Famines: An Essay on Entitlement and Deprivation.* Oxford: Clarendon Press;

Sen A. (1999). *Development as Freedom.* New York: Alfred Knopf

Sen, A. (1988), "The Concept of Development", *Handbook of Development Economics* Vol. 1, Ed.H. Chenery and T.N. Srinivasan. Amsterdam: North Holland.

Senyo P. K. (2021a), "There Will Be No Escaping Ghana's New Levy on Electronic Transactions," Quartz Africa, November 19, 2021, https://qz.com/africa/2092221/ghana-introduces-a-1-75-percent-levy-on-electronic-transactions.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Senyo P. K. (2021b), "Ghanaians Should Brace Themselves: The Electronic Transactions Tax Is Here to Stay," The Conversation, November 18, 2021, https://theconversation.com/ghanaians-should-brace-themselves-the-electronic-transactions-tax-is-here-to-stay-172153.

Service GS Population & Housing Census of Ghana. NA-ZU, vol. 3: Ghana Statistical Service; 2005; 2000.

Shaikh, A. A., Glavee-Geo, R., Karjaluoto, H., & Hinson, R. E. (2019). How is the use of mobile money services transforming lives in Ghana?. In A. A. Shaikh, & H. Karjaluoto (Eds.), *Marketing and Mobile Financial Services: A Global Perspective on Digital Banking Consumer Behaviour* (pp. 256-280). Routledge. Routledge Studies in Marketing. https://doi.org/10.4324/9781351174466-12

Sharaunga S, Mudhara M, & Bogale A (2015). The impact of 'women's empowerment in agriculture' on household vulner-ability to food insecurity in the KwaZulu-Natal Province. *Forum Dev Stud* 42(2):195–223

Shetty, P. (2015). From food security to food and nutrition security: role of agriculture and farming systems for nutrition. *Current Science*, 456-461.

Sileshi, M., Kadigi, R., Mutabazi, K., & Sieber, S. (2019a). Analysis of households' vulnerability to food insecurity and its infuencing factors in east Hararghe, Ethiopia. *Journal of Economic Structures*, 41(8), 1

Sileshi, M., Kadigi, R., Mutabazi, K., & Sieber, S. (2019b). Impact of soil and water conservation practices on household vulnerability to food insecurity in eastern Ethiopia: Endogenous switching regression and propensity score matching approach. *Food Security*, 11(4), 797–815

Singh, I., Squire, L., & Strauss, J. (1986). *Agricultural household models: Extensions, applications, and policy*. The World Bank.

Smith, J. (2000) 'A Critical Survey of Empirical Methods for Evaluating Active Labor Market Policies', Schweiz. Zeitschrift fur Volkswirtschaft und Statistik, Vol. 136(3) 1-22

Smith, L. C. (1998). Can FAO's measure of chronic undernourishment be strengthened? *Food Policy*, *23*(5), 425-445.

Spencer, R., Pryce, J. M., & Walsh, J. (2014). Philosophical approaches to qualitative research. *The Oxford handbook of qualitative research*, 81-98.

Statista, (2022). Share of population with a mobile money account in Ghana from 2018 to 2022. Available at https://www.statista.com/statistics/1175988/mobile-money-accounts-ghana/#:~:text=As%20of%20January%202022%2C%2038.9,decreased%20slightly%20compared%20to%202020.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Stauss, J. (1983). *Socio-economic determinants of food consumption and production in rural Sierra Leone: application of an agricultural household model with several commodities* (No. 1094-2016-88111).

Stuart, E. A. (2010). Matching methods for causal inference: A review and a look forward. *Statistical science: a review journal of the Institute of Mathematical Statistics*, *25*(1), 1.

Suri, T., & Jack, W. (2016). The long-run poverty and gender impacts of mobile money. *Science*, *354*(6317), 1288-1292.

Suri, T., Jack, W., & Stoker, T. M. (2012). Documenting the birth of a financial economy. *Proceedings of the National Academy of Sciences*, *109*(26), 10257-10262.

Suro, R., (2003). *Remittance Senders and Receivers*, Pew Research Center's Hispanic Trends Project. United States of America. Retrieved from https://policycommons.net/artifacts/629381/remittance-senders-and-receivers/1610680/ on 07 Oct 2022. CID: 20.500.12592/tb49wn.

Swindale, A., & Bilinsky, P. (2006a). Development of a universally applicable household food insecurity measurement tool: process, current status, and outstanding issues. *The Journal of Nutrition*, *136*(5), 1449S–1452S.

Swindale, A., & Bilinsky, P. (2006b). Household dietary diversity score (HDDS) for measurement of household food access: indicator guide. *Washington, DC: Food and Nutrition Technical Assistance Project, Academy for Educational Development*.

Takahashi, K., Ikegami, M., Sheahan, M., & Barrett, C. B. (2016). Experimental evidence on the drivers of index-based livestock insurance demand in Southern Ethiopia. *World Development*, *78*, 324-340.

Tassew, W.,Hoddinott J., Dercon S., (2008). *Poverty and income inequality in Ethiopia*: 1995/96 – 2004/05, Addis Ababa, Ethiopia.

Teye, J. K., Boakye-Yiadom, L., Asiedu, E., Awumbila, M., & Appiah Kubi, J. W. (2019). Changing Patterns of Migration and Remittances: A Case Study of Rural Ghana.

The Economist (2018) "Not so fast. Borrowing by mobile phone gets some poor people into trouble". Issued November, 17, 2018. Retrieved February 1, 2019, from https://www.economist.com/finance-andeconomics/2018/11/17/borrowing-by-mobile-phone-gets-some-poor-people-into-trouble

Tobbin, P. (2011). Understanding mobile money ecosystem: Roles, structure and strategies. In *2011 10th International Conference on Mobile Business* (pp. 185–194). IEEE.

Tobbin, P., & Kuwornu, J. K. (2011). Adoption of mobile money transfer technology: structural equation modeling approach. *European Journal of Business and Management*, *3*(7), 59–77.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Tour, J. (2016). *Food Insecurity and Coping Strategies in Nadowli District, Upper West Region, Ghana* (Doctoral dissertation, University of Ghana).

Townsend, R. M. (1994). Risk and insurance in village India. *Econometrica: journal of the Econometric Society*, 539-591.

Trivers, R. (1971). "The Evolution of Reciprocal Altruism." *The Quarterly Review of Biology.* 46 (March): 35-57.

Tsai, M. C., & Dzorgbo, D. B. S. (2012). Familial reciprocity and subjective well-being in Ghana. *Journal of Marriage and Family*, *74*(1), 215-228.

Tsu Wei, T., Marthandan, G., Yee-Loong Chong, A., Ooi, K.-B., & Arumugam, S. (2009). What drives Malaysian m-commerce adoption? An empirical analysis. *Industrial Management & Data Systems*, *109*(3), 370–388

Udry, C. (1994). Risk and insurance in a rural credit market: An empirical investigation in northern Nigeria. *The Review of Economic Studies*, *61*(3), 495-526.

Unicef. (2017). *In brief to the state of food security and nutrition in the World 2017*. FAO, IFAD, UNICEF, WFP and WHO.

United Nations (2015). *The Millennium Development Goals Report 2015. United Nations publication.* New York. Available at https://www.un.org/millenniumgoals//2015_MDG_Report/pdf/MDG%202015%20rev%20(July%201).pdf.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, *27*, 425–478

Weil, D. N., Mbiti, I & Mwega F. (2012). "The Implications of Innovations in the Financial Sector on the Conduct of Monetary Policy in East Africa." Working Paper 12/0460, International Growth Centre, London.

Weil, D., Mbiti, I., & Mwega, F. (2012). The implications of innovations in the financial sector on the conduct of monetary policy in East Africa. *Report submitted to the International Growth Centre Tanzania Country Program.*

Whitlock, M. C., Davis, B. H., & Yeaman, S. (2007). The costs and benefits of resource sharing: reciprocity requires resource heterogeneity. *Journal of evolutionary biology*, *20*(5), 1772-1782.

Wieser, C., Bruhn, M., Kinzinger, J. P., Ruckteschler, C. S., & Heitmann, S. (2019). The impact of mobile money on poor rural households: Experimental evidence from Uganda. *World Bank Policy Research Working Paper*, (8913).

Willassen, Y. (1978). An analysis of the effect of transitory income on consumption. *The Scandinavian Journal of Economics*, 299-310.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Wilson, K., Harper, M., & Griffith, M. (Eds.). (2010). *Financial promise for the poor: How groups build microsavings*. Kumarian Press.

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

World Bank (2005), *Afghanistan. Poverty, Vulnerability and Social Protection: An Initial Assessment*, Human Development Unit, South Asia Region, Report No. 29694-AF, Washington DC.

World Bank (2006). Economic implications of remittances and migration, Global Economic Prospects

World Bank (2018). *Inflows: Annual Remittances Data* (Updated may 2018)

World Bank (2021). The World Bank, Remittance Prices Worldwide Quarterly (Washington: World Bank Group, June 2021), https://remittanceprices.worldbank.org/sites/default/files/rpw_main_report_ and_annex_q221.pdf.

World Bank Institute (2005).Introduction to Poverty Analysis; Poverty Manual, All, JH Revision

World Bank, (2020a).'*Annual Remittances Data: Inflows'*, Migration and Remittances Data, May 2021

World Bank (2000b). *World development report 2000/2001: Attacking poverty*. The World Bank.

World Bank (2002). A sourcebook for poverty reduction strategies. *urban poverty: core technique and cross cutting issues*, vol 1. World Bank Press, Washington, D.C

World Food Program (2012). Ghana Comprehensive food security & vulnerability analysis 2010: focus on Northern Ghana, Ministry of Food and Agriculture Ghana Statistical Service. http:// docum ents. wfp. org/ stell ent/groups/ public/ docum ents/ ena/ wfp25 7009. Pdf

World Food Program. (2010). Ghana Comprehensive food security & vulnerability analysis: focus on Northern Ghana, Ministry of Food and AgricultureGhana Statistical Service 2012. http://docum

Yue, P., Korkmaz, A. G., Yin, Z., & Zhou, H. (2022). The rise of digital finance: Financial inclusion or debt trap?. *Finance Research Letters*, *47*, 102604.

Zhang, X., Li, H. Y., Deng, Z. D., Ringler, C., Gao, Y., Hejazi, M. I., & Leung, L. R. (2018). Impacts of climate change, policy and Water-Energy-Food nexus on hydropower development. *Renewable Energy*, *116*, 827-834.

Zhang, Y., & Wan, G. (2008). *Can we predict Vulnerability to Poverty?* Retrieved from World Institute for Development Economics Research paper/UNU-WIDER 2008/82 website: https://www.wider.unu.edu/sites/default/files/rp2008-82.pdf

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Zhou, T. (2011). An empirical examination of users' post-adoption behaviour of mobile services. *Behaviour & Information Technology*, *30*(2), 241– 250.

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

APPENDIX B

Table B1: VIF of variables in probit estimation of MoMo use decision

Variable	VIF	1/VIF
Time preferences of HH head	9.81	0.10194
Risk preference of HH head	9.73	0.10277
Remittance transaction cost	9.52	0.10504
Religion	9.08	0.11013
Regularity of internal remittance	9.02	0.11086
Prefer phone usage records private	8.94	0.11186
Prefer phone number private	8.92	0.11211
Prefer financial history private	8.75	0.11429
Phone expenditure	8.6	0.11628
Ownership of bank account	7.95	0.12579
Migration status	7.8	0.12821
Marital status of HH head	7.51	0.13316
If HH receive internal remittances	7.44	0.13441
Household size	6.65	0.15038
Household location	6.45	0.15504
HH head own mobile phone	6.22	0.16077
HH food poverty	3.47	0.28818
Experienced stealing incident	3.29	0.30395
Expenditure on financial services	2.96	0.33784
Employment status	2.69	0.37175
Education status of HH Head	2.67	0.37453
Community access to mobile network	2.01	0.49751
Community access to financial inst.	1.8	0.55556
Community access to electricity	1.09	0.91743
Age(yrs) of household head	1.05	0.95238
Mean VIF	6.14	

*VIF < 10 is accepted for this study (*Hair *et al.* 2010; Bryne, 2010)

Table B2: VIF of variables for VtFP index estimation

Variable	VIF	1/VIF
Buy/sell land in comm.	9.88	0.101215
Cash remittance	9.72	0.102881

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

Community irrigation	9	0.111111
AgeY	8.62	0.116009
Community coop.	8.6	0.116279
Educational status	7.85	0.127389
Employment status	7.31	0.136799
Fertilizer(yes)	7.2	0.138889
Food CPI	6.47	0.15456
Food remittance	6.19	0.161551
HH location	5.58	0.179211
HH size	5.36	0.186567
Marital status of HH head	5.22	0.191571
Access to comm. Market	4.61	0.21692
Miscellaneous income	4.02	0.248756
Non-food CPI	3.32	0.301205
Poverty status	3	0.333333
Real total HH expenditure	2.81	0.355872
Regularity of remittance	2.4	0.416667
Religion	1.92	0.520833
Rice/maize husking machine	1.71	0.584795
Risk preference	1.53	0.653595
Sex	1.27	0.787402
Time preference	1	1
Mean VIF	5.19	

*VIF < 10 is accepted for this study (*Hair *et al.* 2010; Bryne, 2010)

Table B3: Cash remittance summary of the food poor

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh

```
. summarize lncashrem, detail, if fudpover==1

                          lncashrem
-------------------------------------------------------------
      Percentiles      Smallest
 1%     2.302585       .5306283
 5%     3.688879       1.609438
10%     3.912023       1.609438       Obs                1,674
25%      4.60517       1.609438       Sum of Wgt.        1,674

50%     5.135798                      Mean           5.153367
                       Largest        Std. Dev.      1.093751
75%     5.828946       8.476371
90%      6.39693       8.476371       Variance       1.19629
95%     7.090077       8.476371       Skewness       .1296892
99%     8.006368       8.476371       Kurtosis       3.382069
```

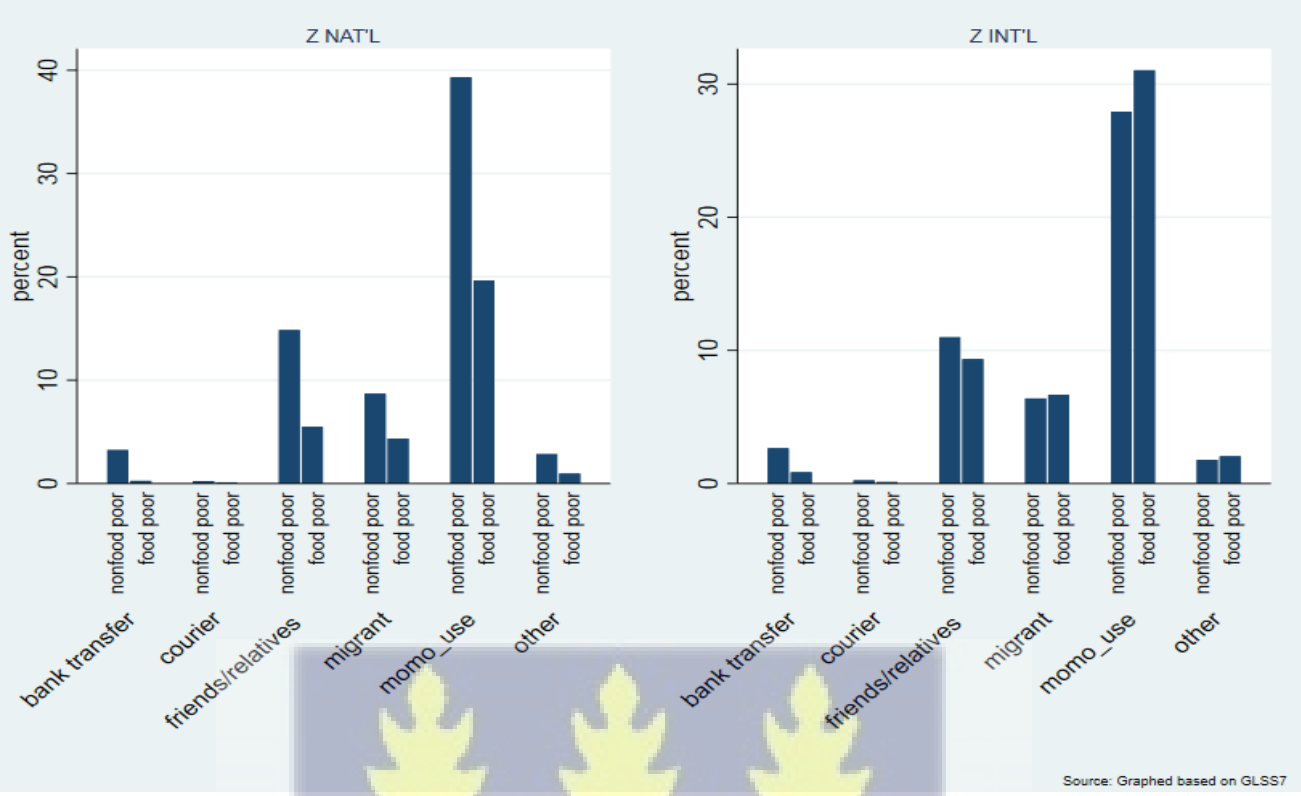
Table B4: Cash remittance summary of the non-food poor

```
. summarize lncashrem, detail, if fudpover==0

                          lncashrem
-------------------------------------------------------------
      Percentiles      Smallest
 1%     2.995732       .4054651
 5%     3.912023       .4054651
10%     3.912023       1.386294       Obs                3,761
25%     4.787492       1.386294       Sum of Wgt.        3,761

50%     5.703783                      Mean           5.773192
                       Largest        Std. Dev.       1.32535
75%     6.633318       11.15625
90%     7.600903       11.15625       Variance       1.756552
95%     8.006368       11.15625       Skewness       .1801661
99%     8.699514       11.15625       Kurtosis       3.354266
```

NB: Cash remittance (lncashrem) and food poverty status (fudpover) in natural logs

Fig. B1: Remittance channels by HH food poverty status

University of Ghana http://ugspace.ug.edu.gh
University of Ghana http://ugspace.ug.edu.gh



Note: $Z_{NAT'L}$ (log) = 6.889795 $Z_{INT'L}$ (log) = 7.134524

Source: Authors construct from GLSS 7 (2017)

INTEGRI PROCEDAMUS