ESSAYS ON THE IMPACT OF FARM INPUT SUBSIDIES ON FARM HOUSEHOLDS IN MALAWI

By

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To Favour and Sipho

with love.

ABSTRACT

Farm input subsidies are assumed to improve agricultural production and productivity for small resource poor farmers in developing countries by promoting the use of improved farm inputs, mainly inorganic fertilizers and hybrid seeds. This is expected to contribute to increased income from produce sales, improved food security at household and national levels, and consequently, contributing to poverty alleviation. Limited existing empirical evidence on the impact of farm input subsidies on food marketing, household welfare and migration suggests marginal effects. This thesis contributes to the existing literature by analysing the impact of farm input subsidies on farm households' maize market participation, welfare and migration by using the most recent nationally representative integrated household panel survey data for Malawi of 2010 and 2013.

This thesis uses the quantity of subsidised fertilizer the household redeemed to measure the impact of farm input subsidies. Different indicators and empirical models from the ones used in the existing literature on food marketing, household welfare and migration effects of farm input subsidies are used to explore more empirical evidence.

The main findings are that farm input subsidies increase farm households' market participation and food security; and reduces household members' migration. The results on market participation indicate that subsidised fertilizer increases both farmers' maize market participation as sellers and quantities they sell. On migration, subsidised fertilizer reduces rural to urban and rural to rural migration of household members. While on household welfare, the results suggest that subsidised fertilizer increases available per capita calories per day, household's months of food secure, and probability of being food secure from own production of cereals and legumes, but has statistically insignificant effects on household annual consumption expenditure.

INDEX

TOPIC PAGE

LIST OF FIGURES

PAGES

LIST OF TABLES

PAGES

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DECLARATION

An earlier version of Chapter 2 of this thesis was presented at the research seminar of the School of Economics at the University of Kent on 11th December 2013. It was also presented at the Scottish Economics Society conference on 23rd April 2014 in Perth, Scotland, and at the International Association of Agricultural Economists (IAAE) conference on 11th August, 2015 in Milan, Italy. http://purl.umn.edu/211918

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SUMMARY

Farm input subsidies are assumed to improve agricultural production and productivity for small resource poor farmers in developing countries by promoting the use of improved farm inputs, mainly inorganic fertilizers and hybrid seeds. This is expected to contribute to increased income from produce sales, improved food security at household and national levels, and consequently, contributing to poverty alleviation. Limited existing empirical evidence on the impact of farm input subsidies on food marketing, household welfare and migration suggests marginal effects. This thesis examines the impact of farm input subsidies on farm households' maize market participation, welfare and migration by using the most recent nationally representative integrated household panel survey data for Malawi of 2010 and 2013.

The Malawi government introduced a large farm input subsidy programme (FISP) in the 2005/2006 agricultural season, mainly targeting maize production, and as a result, the subsidised inputs were initially fertiliser and seeds for maize production. The standard programme full package per targeted farm household under the FISP for 2012/2013 agricultural season was designed to support the purchase of 100 kg of subsidised fertilizer (50 kg bag NPK and 50 kg bag Urea); one pack of improved maize seed (5 kg hybrid or 8 kg open pollinated variety (OPV)); and one legume pack. However, the data used in this thesis and earlier studies have shown that FISP beneficiaries received heterogeneous coupon packages (such as coupons for only maize seed, for one 50 Kg bag of fertilizer or for three 50 Kg bags of fertilizer). Therefore, the quantity of subsidised fertilizer the household redeemed, instead of the programme participation, is used in this thesis in empirical estimations to measure the impact of farm input subsidies.

Different indicators and empirical models from the ones used in the existing literature on food marketing, household welfare and migration effects of farm input subsidies are used to explore more empirical evidence. This thesis uses fixed effect (FE) and correlated random effect (CRE) estimators in estimating linear and nonlinear panel data models, respectively; and maximum likelihood estimators (MLE) in estimating cross section data models.

Chapter 1 of this thesis presents a literature review on subsidies with a focus on the agricultural sector and in developing countries. The chapter presents the policy reforms implemented in the past three decades and their impact. Differences in the implementation of farm input subsidies between the past and current policies are discussed. The chapter also discusses the theory of change, targeting criteria and implementation reforms of the farm input subsidy programme in Malawi.

Chapter 2 discusses the impact of subsidised fertilizer on farm households' maize market participation with regards to participation as sellers, quantity sold and ratio of quantity sold to quantity harvested, employing non-linear panel data models. The main findings suggests that subsidised fertilizer increases farm households' participation in maize market as sellers; and increases quantities sold of maize. In addition, subsidised fertilizer appears to increase commercialisation of maize, but the magnitude of the effects is small. However, repeated benefit to subsidised fertilizer is found to have no effects on maize marketing.

In Chapter 3, the effects of subsidised fertilizer on farm households' available per capital calories per day, months of food secure, food security status, food, non-food and total annual per capita consumption expenditure are examined by employing both linear and non-linear panel data models. The study finds that fertilizer subsidy has a positive impact on food security and its effect

is heterogeneous across the households' distribution. The results also indicate higher impact among the most food secure. The study finds that subsidised fertilizer increases farm households' available per capital calories per day, months of food secure and the probability of being food secure. The study also finds no evidence of effect on food, non-food and total annual per capita consumption expenditure. Furthermore, the frequency of benefit to subsidised fertilizer is found to increase the magnitude of effect on available calories per capita per day and food annual per capita consumption expenditure. However, the magnitude of the effects of subsidised fertilizer on food security are not large enough to eradicate food insecurity among poor households in isolation, underscoring the importance of integrated livelihood approach in development interventions.

The effects of subsidised fertilizer on farm household members' rural to urban, rural to rural and seasonal migration are discussed in Chapter 4. Overall, the study finds that fertilizer subsidy decreases the probabilities of farm household members' migration. The results suggest that subsidised fertilizer decreases the probability of farm household members' migration from rural to urban and rural to rural areas. But the study finds no evidence of effects on seasonal migration. The study also finds that repeated benefit to subsidised fertilizer does not affect the magnitude of effects on migration of household members.

Finally, Chapter 5 presents a summary of main findings, conclusion, and policy implications. Suggestions of future research in line with the empirical analyses in this thesis are also discussed.

Chapter 1

INTRODUCTION

The past fifteen years of the 21st Century has witnessed the resurgence of subsidy policies in developing countries, especially in sub-Saharan Africa (SSA). These subsidies are mainly aimed at reducing the cost of acquiring predetermined quantity of farm inputs and targeted at sub-groups of farmers. The recent renewed interest in subsidies is attributed to persistent acute food shortage experienced in most developing countries and the food price increase the world experienced from 2003, which was followed by the food price crisis in 2008 (FAO, 2011). The IMF (2008) reports that twenty two countries increased food subsidies for both targeted and universal in 2008. Thus, the motivation for governments to turn into subsidies is to attain food and income security (Dorward, et al., 2008).

Studies on the rural economy have shown that the rural population in developing countries employ diversified livelihood strategies to achieve food and income security and these include farming, off-farm and non-farm income (Ellis, 2000). Similarly, the World Bank, (2007) categorises sources of rural income into three sub-sectors, namely; smallholder farming, labour and migration. Farm input subsidies are expected to improve the purchasing power of the beneficiaries, and thus making the subsidised input cheaper and adoption of the improved technologies associated with the subsidised inputs attractive.

Access to coupons of the subsidised inputs are expected to have effects on the rural livelihood strategies employed by rural households, especially on farming, rural wage labour and migration. These effects can occur through direct benefit which may arises from either selling the received

coupons for subsidised farm inputs or buying the inputs and using them in crops production (SOAS, 2008).

The use of improved farm inputs purchased with subsidised coupons in crops production is expected to lead to three positive effects: one, increased yields that could result in improved household food availability and hence household food security; two, increased market participation, quantities and proportions sold of produced crops by smallholder farmers and therefore, leading to increased farm income from crop sales; and three, reduced market participation as buyers of food crops, resulting in savings of household income (Chirwa and Dorward, 2013; SOAS, 2008). The income from crop sales and the savings by not purchasing extra food crops could be invested in farming or in non-agricultural enterprises, and or used to increase the consumption of non-farm produced food and of non-food commodities. The savings which are invested in farming could lead to a further increase in purchases of farm inputs in subsequent agricultural seasons and boost the future agricultural production and productivity. At the macroeconomic level, increased crop production and productivity is expected to result in reduced food crop prices whose farm inputs are subsidised and consequently, improving food security of the urban population and rural net food buyers (Chirwa and Dorward, 2013; SOAS, 2008).

The purchase of durable assets and consumption of food and non-food commodities could lead to overall improved household welfare and to increased investment in human, social and physical capital - essential for future sustainable production and smooth exit from subsidy programs. Furthermore, the improved food and income security and overall household welfare as a result of accessing coupons of subsidised farm inputs could reduce reliance on rural wage labour and migration livelihood strategies for the rural household beneficiaries of farm input subsidies. This could lead to low rural wage labour supply and hence, increased wages and labour efficiency

in the rural economy; and reduced rural to urban, rural to rural and seasonal migration of farm household members and thus, contributing to reduced urbanisation, urban food insecurity and poverty.

The justification of implementing farm input subsidy programmes in developing countries is based on the observation that most smallholder farmers[1] are faced with a number of significant challenges in their livelihood endeavours. The most obvious challenges include low assets endowment, lack of access to markets for inputs and outputs, poor infrastructure and institutions, and adverse climatic conditions.

To address the challenges of smallholder farmers' access to competitive produce and inputs markets in developing countries, several reforms have taken place in the agricultural sector in in the past three decades. The recent resurgence of subsidy policies is itself a reversal of a number of recent policy reforms in particular those reforms introduced within the Structural Adjustment Programmes (SAPs) implemented by developing countries in 1980s (Harrigan, 2003; Jayne and Jones, 1997). In general, the SAPs aimed at achieving export-oriented growth and improving efficiencies through the minimisation of government interventions and to ensure that price incentives direct market activity in marketing, while stabilisation programmes aimed at reducing public sector expenditures (Harrigan, 2003). In the agricultural sector, the SAPs aimed at improving productivity, production, agricultural exports, farmers' income and food security (SAPRIN, 2002). To achieve these objectives, reforms included liberalisation of exchange rates

[1] The term smallholder farmer is not uniformly defined in development literature and consequently several definitions have emerged. The variations in the definition are mainly attributed to differences in countries and regions of study. In this study we use the World Bank definition, in which smallholder farmers refer to farmers with up to two hectares of cropland (World Bank, 2003, p.6).

and marketing services, privatisation of state marketing agencies, reduction of tariffs and non-tariff barriers and removal of price controls and state subsidies (Husain, 1993; Onumah et al., 2007; World Bank, 2007).

Prior to the SAP reforms of the 1980s, many governments of developing countries attempted to control agricultural marketing systems with the objective of achieving food security, the generation of foreign exchange and tax revenue from food and cash crops which were considered significant to the economy (Akiyama et al., 2001). For instance, Jayne and Jones (1997) report that for Southern and Eastern African countries such as Malawi, Kenya, Tanzania and Zimbabwe, increased smallholder farmer's grain production was the main policy aim soon after attaining their independence. Various policy reforms were implemented during independences in many developing countries.

Assessment studies on the impact of government interventions in agricultural marketing systems show that the intended objectives were achieved. Jayne and Jones (1997) report that government provision of marketing services to smallholder farmers in developing countries had led to significant increase in farmer incomes and the production of grain crops. However, despite of these successes, it was evident by the beginning of the 1980s that these interventions had negative impact on the economy by becoming a fiscal burden because of government subsidies which were used in the system, declining of real producer prices due to levies producers were paying in the marketing process and contributing to insignificant increase in per capita output in food and cash crops (Akiyama et al., 2001; Jayne and Jones, 1997).

The debate on the impact of policy reforms following the implementation of SAPs in the agricultural market sector is largely inconclusive. While some authors report positive impacts,

others report negative impacts, or both. However, Jayne and Jones (1997) argue that impact analysis of the market reforms is difficult because of challenges in separating reform effects on the economy from other factors such as climatic effects, incomplete and discontinuation of reforms, and unreliable and incomplete data with which to conduct impact analysis. However, the World Bank (2000) reports that during the implementation period of these reforms, many developing countries were adversely affected by external shocks such as high world interest rates; and in some countries there were inappropriate institutions; inaccurate ordering of reforms; and opportunistic management of reforms by the elite groups.

An assessment by SAPRIN, (2002) finds that SAPs in the agricultural sector have had both positive and negative impact. According to SAPRIN, (2002), impacts of reforms include: (i) increased production in some countries, while in others it has resulted in decline in production and this is mainly attributed to differences in the structure of the economies of the assessed countries. (ii) increased inequality due to unequal access to export trade among farmers and is attributed to differences in institutional and infrastructural development, and (iii) increased food insecurity due to high inputs costs as a result of input subsidy removals and increased consumer prices as a consequence of higher producer prices. Husain (1993) also reports that SAPs have had both positive and negative impacts in Africa. Positive impacts have been achieved on markets in Africa by raising producer prices and consequently, helped the rural poor whose livelihoods are agricultural dependent. On the other hand, high producer prices and removal of consumer subsidies have negatively impacted the urban poor who rely on market purchases for their foods (Husain, 1993). Among the positives effects which some authors report include increased agricultural growth and food security; while negative effects include increased market failures due to non-corresponding attention to poor infrastructure and institutional development during the

implementation of the reforms (Jayne et al., 2002). For the Eastern and Southern Africa, Jayne and Jones (1997) report that market reforms have positively contributed to lowering trading costs of food products in areas with food shortages; and improved food availability to urban populations; while on the other hand have contributed to the degeneration of the region into food shortage, stagnation of food productivity and production; and unimproved fiscal burden. Furthermore, in most developing countries, the economic setting has changed with evident of less government involvement in economic activities and removal of barriers of domestic markets linkages with international markets (World Bank, 2000).

Overall, the impact assessment results show that SAP reforms in isolation have been insufficient in facilitating increased income and growth for the majority of the population in most developing countries. In the agricultural sector, the findings suggest that liberalisation of agricultural markets alone has not resulted into more competitive agricultural produce and input markets. Barrett (2008) argues that achieving increased produce prices and reduced input prices can only promote increased production from smallholder farmers when those farmers are engaged in those markets, otherwise the prevalent prices they face reflect scarcity internal to their farms and households alone. Therefore, a set of policies which focus on 'getting prices right' for smallholder farmers is unlikely to lead to improved output or welfare if household and public assets are not available in adequate quantities and access to services is not enhanced to produce surpluses for the market and improve market access. Important factors to be considered are infrastructure and institutional development; smallholder farmers' access to information, assets endowment, organisation; geographical access and the structure of markets (Kydd and Dorward, 2001; IFAD 2003). Therefore, a simple rolling back of the state espoused by the SAP may have hindered

development especially where it relies heavily on production activity conducted by very small scale farmers.

Fafchamps and Gabre-Madhin, (2001) report that liberalisation of the agricultural market has led to domination of the market by petty traders, who are characterised by significant constraints financially and not capable of inter-seasonal and inter-regional arbitrage. In developing countries, financial constraint is attributed to lack of access to credit for most traders in agricultural markets, while inter-seasonal and inter-regional arbitrage failure is attributed to poor infrastructure development (such as roads and storage facilities) and institutional development (such as information, communication, credit, security and extension services). Consequently, this has led into uneven and slow pace of the expansion of private-sector traders' coverage of some geographical areas following the withdrawal of government marketing agencies (IFAD, 2003).

To some extent, the failure of the reforms to achieve the expected objectives in most developing countries is the reason for the reversal of the SAP reforms, such as the current resurgence of subsidies. Among the countries which have recently implemented input studies include Malawi where farm input subsidies were re-introduced in 2005 (Denning et al., 2009); Zambia in 2001 (Hamukwala et al., 2012); and India in 1993 (Acharya, 2009). The main aim of these subsidies is to achieve food security at household and national levels.

The recent re-introduction of subsidies has seen countries devising new ways of implementation, called 'market-smart' subsidies. The design of the 'market smart' subsidies draw enormously from the new institutional economics (NIE) theory. Under the NIE theory, markets are viewed as important institutions in the economic development process, and a limited period of government intervention is deemed necessary to establish basic conditions required to achieve

increased productivity and efficient marketing, with the objective of inducing increased input demand, surplus output and profitability (Dorward et al., 2005). The World Bank, (2007, p.151) defines "market-smart" subsidies as "subsidies whose implementation facilitates development of private sector-led input markets, targets the poor, sustains existing commercial markets, is of limited period and uses instruments such as vouchers, marching grants and partial loan guarantees".

Despite the existence of a wide range of literature on the demerits of subsidies on the economy, many governments in developing countries are turning back to agricultural input subsidies. According to Schwartz and Clements (1999), economic arguments for use of governments' subsidies are to remove market failures in the economy, achieving production, input and output marketing economies of scale and for social protection. However, donors are against the introduction of subsidies and they argues that it is costly, creates distortions in the market, leads to diversion of resources from other critical sectors of the economy, lack exit strategies and targeting is poor (Schwartz and Clements, 1999; World Bank 2007).

Empirical studies on the effects of the recent input subsidies suggest that there is increased production at both beneficiaries' household and national levels and increased in productivity due to increased use of improved seeds and fertilisers. For instance, in Malawi the initial phase of farm input subsidy programme (FISP) was introduced in 2005/2006 agricultural season, targeting mainly maize production, and as a result, the subsidised inputs were initially fertiliser and seeds for maize production. Impact analysis of this programme shows that the objectives to increase production and productivity have been achieved in Malawi (Dorward, et al., 2008; Denning et al., 2009; Dorward and Chirwa, 2011).

There is a wide range of literature on the impact of farm input subsidies and the existing literature has focused on production and productivity; subjective food security and poverty, economy wide and income. However, there is little literature on the impact of targeted farm input subsidies on smallholder farmers' output market participation, migration, consumption expenditure and food security. The objective of this thesis is to fill this knowledge gap by examining the effects of farm input subsidies on farm households' maize market participation, food security, consumption expenditure and internal migration of household members. Since the use of subsidised fertilizer is expected to lead to increased food crops' production and productivity, an analysis on its effects on household market participation, food availability and consumption expenditure will contribute to understanding the role of the subsidy policy in alleviating poverty and addressing food insecurity.

The potential effects on household food security and income on the decision of household members to migrate out of the farm household, especially from rural to urban as a result of receipt and use of farm input subsidy coupons is of interest because it has an effect on urbanisation in developing countries. To the best of our knowledge, this is the first study to have analysed these effects in more detail and using different indicators and econometric models to explore more evidence of effects of farm input subsidies.

The research in this thesis focuses on Malawi, which is one of the first developing countries to have reintroduced a large scale farm input subsidy programme in the 21st Century. The Malawi government reintroduced the large farm input subsidy programme (FISP) in the 2005/2006 agricultural season and has been implementing it every agricultural season to date. The main objective of FISP is to improve access to improved farm inputs to resource poor small farmers and consequently, achieving food self-sufficiency at beneficiary households and national level and

improving farm incomes from crop sales (Dorward and Chirwa, 2013). The implementation of the 2015/16 farm input subsidy programme makes Malawi reach a span of ten years in implementing this large scale farm input subsidy programme. However, the research in this thesis uses the two-wave panel data with information on farm input subsidies covering the 2009/2010 and 2012/2013 agricultural seasons.

Although the stated main objective of the FISP focuses on addressing the problems of persistent food and income insecurity among the resource poor smallholder farmers and at national level, achieving political objectives by the ruling party elites underlines the influence in the implementation of agricultural policies such as the farm input subsidy policy (Poulton, 2012). The objective to gain political patronage, especially during the period of general elections are some of the political objectives associated with the implementation of the subsidies. As a result, the implementation processes of such policies may be prone to political influence and against technical guidelines of achieving efficiency and effectiveness. It might be due to political considerations in the implementation of the FISP that the exit strategy is not well defined and political parties' manifestos on agricultural policies focus on strategies of continuing the FISP. Poulton, (2012) explains in more detail the processes of developing agricultural policies in the context of the presence of political and technical influence.

The FISP targeting and implementation processes have undergone several reforms since its inception in the 2005/2006 agricultural season. Dorward and Chirwa (2013) outline changes in the targeting criteria of FISP from the 2005/2006 to the 2009/2010 agricultural seasons and report that overall the targeting is done at the area and beneficiary levels. Area targeting, which refers to districts or Extension Planning Area (EPAs) has all along been done by the Ministry of Agriculture and Food Security (MoAFS) Headquarters, while beneficiary targeting processes at the village

level have been unclear is some seasons and has been done by different groups in different seasons. The district targeting and coupons allocation criteria changed from focusing on the tobacco and maize crops area in the 2005/06 and 2006/2007 agricultural seasons to a focus on the number of farm households in the district or EPA in later years of FISP implementation period (Dorward and Chirwa, 2013). In terms of beneficiary targeting, the 2005/2006 FISP had no clear criteria, while in the later agricultural seasons have been well defined, but with variations in the actual implementation. The official targeting criteria has been changing over the years from: "fulltime smallholder farmers unable to afford the purchase of one or two unsubsidised fertilizer" in the 2006/2007 agricultural season to "resource poor local resident with land, guardians looking after physically challenged, vulnerable (elderly, child or female headed, people living with HIV)" in the 2009/2010 agricultural season (Dorward and Chirwa, 2013).

The processes of allocating coupons have also undergone several reforms. While coupons allocation to districts has always been done by the MoAFS Headquarters, several changes have occurred on coupons allocation to villages. In the 2005/2006 FISP, village coupons allocations were done by traditional authorities (TAs); in the 2006/2007 and 2007/2008 was done by the District Development Committees (DDCs), Area Development Committees (ADCs) and TAs; while in the 2008/2009 and 2009/2010 was done my MoAFS staff, DDCs, ADCs and TAs (Dorward and Chirwa, 2013).

The strategies and processes of identifying of, allocating and distributing coupons to beneficiaries have also undergone several changes over the FISP implementation period. TAs and village development committees (VDCs) had the responsibility of identifying, allocating and distributing coupons to beneficiaries at village level in the 2005/2006 , while in the 2006/2007 and 2007/2008 agricultural seasons, MoAFS staff were also involved. The use of farm household

registers and open meetings in identification of, coupons allocations and distribution to beneficiaries and facilitated by MoAFS staff was introduced in the 2008/2009 agricultural season, while the use of voter registration numbers and IDs were introduced in the 2009/2010 agricultural season (Dorward and Chirwa, 2013). However, despite of these changes in the strategies and processes of identification of, coupons allocations and distribution to beneficiaries, Dorward and Chirwa (2013) report that reallocation and redistribution of coupons at village level has been common in all the years of FISP implementation , and thus, defeating the whole purpose of the reforms.

The types of farm inputs which are included in the FISP have also been changing over time. Lunduka et al., (2013) report that the subsidised inputs in the 2005/2006 was only fertilizer for maize production; in 2006/2007 were fertilizer and maize seed for maize production; in 2007/2008 were fertilizer, maize and legumes seed for maize and legumes production; in 2008/2009 were fertilizer and maize seed for maize, tobacco and cotton production; while in 2009/2010 and 2010/2011 were fertilizer, maize and legumes seed for maize, legumes and cotton production. Storage pesticides were also included in the 2009/2010 agricultural season.

These changes in the types of farm inputs which are included in the FISP means that the standard programme full package per targeted farm household under the FISP has also undergone several modifications since its inception. For the 2009/2010 and 2012/2013 agricultural seasons' FISP, the full standard program package was designed to support the purchase of 100 kg of subsidised fertilizer (50 kg bag NPK and 50 kg bag Urea); one pack of improved maize seed (5 kg hybrid or 8 kg open pollinated variety (OPV)); and one legume pack (Dorward, et al., 2013). However, the data used in this thesis and earlier studies (Chibwana et al., 2010; Holden and Lunduka, 2010; Ricker-Gilbert and Jayne, 2011) show that FISP beneficiaries received

heterogeneous coupon packages (such as coupons for only maize seed, for one 50 Kg bag of fertilizer or for three 50 Kg bags of fertilizer). Therefore, the quantity of subsidised fertilizer the household redeemed, instead of programme participation, is used in this thesis in empirical estimations to measure the impact of farm input subsidies.

The application of the correlated random effects (CRE) estimators in the empirical analyses of non-linear panel data models for binary and count outcome indicators is one of the important contribution of this thesis in analysing the effects of farm input subsidies. Furthermore, analysing different types of migration and using various indicators of food security, poverty and market participation in examining the effects of farm input subsidies provide a more comprehensive policy effects.

This thesis is divided into five chapters. **Chapter 2** presents empirical analyses of the impact of subsidised fertilizer on maize marketing. Although several studies have analysed the effects of farm input subsidies, none has analysed the direct effects on smallholder farmers' market participation, such as on maize marketing despite being the target crop in most subsidy programmes in sub-Saharan Africa. This thesis analyses maize marketing in terms of the decision to sell, quantity sold and ratio of quantity sold to total quantity harvested (commercialisation index). The effects of repeated benefit to subsidised fertilizer on maize marketing is also examined in this thesis.

The purpose of **Chapter 3** is to analyse the effects of farm input subsidies on households' food security and annual consumption expenditure. The cumulative impact of subsidised fertilizer due to repeated benefits is also analysed in this chapter. This thesis uses the following food security indicators: (i) per capita calories per day, and (ii) annual food security status (i.e. food secure or

insecure). And for annual consumption expenditure we use: (i) annual food per capita consumption expenditure, (ii) annual non-food per capita consumption expenditure and (iii) annual total per capita consumption expenditure.

Chapter 4 analyses the relationship between farm input subsidies and the decision of farm household members to migrate out of the farm. This thesis focuses on internal migration and indicators used are rural to urban, rural to rural and seasonal migration. Furthermore, this thesis also analyses the heterogeneity effects of subsidised fertilizer on migration based on repeated benefits to the subsidy programme, which aims to capture the effects of continuous flow of benefits.

Lastly, **Chapter 5** concludes by presenting main thesis findings from the empirical analyses, policy implications of the results and suggesting future research areas to explore more on the effects of farm input subsidies.

Chapter 2

THE IMPACT OF FARM INPUT SUBSIDIES ON MAIZE MARKETING

2.1 Introduction

Small farmers' participation in markets is one of the most important factors necessary for economic growth and poverty reduction in developing countries (Heltberg and Tarp, 2002; Muriithi et al., 2015; Pingali, 2007; World Bank, 2007). Markets offer households opportunities to engage in productive activities through investments in diversified livelihood strategies and sell both labour and products (IFAD, 2003; Njuki et al., 2008; World Bank, 2000). Access to input and output markets is also important for farm households' adoption of modern technologies (e.g. fertilizers and hybrid seed varieties), which are important for increased productivity and incomes (Dorward and Kydd, 2005; Zeller et al., 1997). However, in developing countries poor access to, and low participation in markets are pervasive, especially as far as small farmers are concerned, which limit livelihoods opportunities and perpetuate their poverty (Barrett, 2008; Heltberg and Tarp, 2002; Jayne et al., 2010; Poulton et al., 2006). This is one of the major concerns for governments which depend on agriculture as a pro-poor growth strategy (de Janvry et al., 1991).

Small farmers' poor access to, and low participation in markets, is mainly attributed to barriers to entry (Barrett, 2008; Jayne et al., 2010). These barriers include high inputs requirements in form of land, chemicals, fertilizer and processing; high products' quality demand, and high transaction costs of marketing (Barrett, 2008; Heltberg and Tarp, 2002; Mather et al., 2013; Poulton et al., 2006). The global agricultural conditions are rather instable due to multiple factors, including changes in farm policies in high-income countries and a significant decline in donor and state

support to the agricultural sector (Jayne et al., 2010). As a result, the majority of small farmers in developing countries focus on production of food crops for subsistence.

To increase the use of fertilizers and hybrid seeds by small farmers, and consequently, improve crop production and productivity, a range of farm input subsidy programs had been used as policy tools by many developing countries prior to the implementation of structural adjustment and stabilisation programs (IMF, 2008). Although most of these input subsidy programs were phased out in the 1980s and early 1990s in most countries in sub-Saharan Africa (Husain, 1993; World Bank, 2007), since 1998 several countries have reintroduced them, including Malawi (Dorward et al., 2008; IMF, 2008). Since the input subsidies target specific crops, coupons used to redeem subsidised inputs are for specific crops and this may affect farmers' decisions on cropping patterns and, therefore, may have direct effects on marketing of food crops. Such potential marketing effects have not been fully analysed in previous studies.

The main objective of this Chapter is to estimate the effects of subsidised fertilizer on marketing of maize in Malawi. The specific objectives are to estimate the impact of subsidised fertilizer on (i) farmers' participation in maize market as sellers; (ii) quantity of maize sold; and (iii) commercialisation index of maize, i.e. the ratio of maize quantity sold to total quantity of maize harvested. Determining the extent of farmers' maize market participation, quantity sold and the degree of commercialisation is important to give insights into the potential increase in maize market supply as a result of the fertilizer subsidy program. Such information is essential for understanding the effects on maize prices since most small farmers are net maize buyers. It will also provide an indication of the ability of the program beneficiaries to self-finance commercial purchase of fertilizer in the future with income from maize sales and hence the sustainability of

the subsidy program. The estimations are based on the nationally representative two-wave Integrated Household Panel Survey (IHPS) data of 2010 and 2013 for Malawi.

There are several recent studies analysing different aspects of the effects of farm input subsidies (Chibwana et al., 2012; Chibwana et al., 2010; Chirwa et al., 2013; Dorward and Chirwa, 2011; Holden and Lunduka, 2010; Ricker-Gilbert et al., 2013; Ricker-Gilbert et al., 2011; Ricker-Gilbert and Jayne, 2011; Xu et al., 2009) and agricultural marketing in general. To our best knowledge, this is the first study to empirically quantify the effects of subsidised fertilizer on marketing of maize in Malawi. The only studies which are close to some of the aspects analysed in this chapter are Ricker-Gilbert et al., (2013), who investigate the effects of fertilizer subsidy on maize prices in Malawi and Zambia; and Takeshima and Liverpool-Tasie (2015), who analyse the effects of fertilizer subsidies on grain prices in Nigeria.. In contrast to previous studies which focused on marketing of food crops, this chapter adds estimation of factors influencing commercialisation of maize, which helps to identifying key determinants necessary for the transition of farmers from subsistence to commercial maize farming; and estimation of the effects of repeated benefit to subsidised fertilizer on maize marketing in order to assess the cumulative effects of subsidies.

This Chapter is structured as follows. The next section presents an overview of smallholder farmers' market participation in developing countries. A review of farm input subsidies in developing countries is presented in section 2.3. Section 2.4 discusses the performance of the agricultural sector and marketing in Malawi. Sections 2.5 and 2.6 present the conceptual framework and the empirical models, respectively. Data sources, descriptive statistics and endogeneity tests are discussed in section 2.7. Results and discussions are presented in section 2.8, and section 2.9 conclude and discusses policy implications.

2.2 Smallholder farmers' market participation in developing countries

In this section, we explore historical overview of smallholder farmers' participation in markets and empirical evidence on the role of smallholder farmers' market participation in economic growth, poverty reduction and food security. The role of transaction costs and farmer organisations on smallholder farmers' market participation is also discussed.

2.2.1 Market Participation and Poverty Reduction

Markets are of paramount importance in poverty alleviation because of their link with livelihood strategies in the rural economy. Most of the rural population in developing countries have diversified livelihood strategies, making them rely on a number of sources of food and income, which includes farming, off-farm and non-farm income (Ellis, 2000). The World Bank, (2007) categorises sources of rural income into three sub-sectors, namely, smallholder farming, labour and migration.

Furthermore, the World Bank (2007) categories the rural population based on income sources into five livelihood strategies; (i) market-oriented smallholders, defined as those smallholders whose larger share of income comes from sales of their agricultural produce on markets; (ii) subsistence-oriented smallholders, defined as those smallholders which use larger part of their produce for household consumption; (iii) labour-oriented household, defined as those households whose major sources of income is from wage labour markets in the farming sector or income from the nonfarm labour markets; (iv) migration-oriented households, defined as those households whose larger proportion of income is from remittances from migrants or the entire household migrate; and (v) diversified households, defined as those households, which have

multiple important sources of income from engaging in agriculture, off-farm labour markets and remittances or wages from migration. The type of livelihood strategy the household adopts determines the type of market it is engaged in and the degree of its engagement. Subsistence-oriented smallholders have very little engagement with agricultural markets, as evidenced by small proportions of their contributions to marketed agricultural products compared with market-oriented smallholders[2] (World Bank, 2007).

Ellis, (2000) argues that since the rural population operate in an environment which is characterised with risks, diversifying livelihoods helps to secure income and food; and reduces vulnerability to risks. However, in order for the rural population to have diverse sources of livelihoods and improve their living standard, market access is fundamental and (IFAD, 2003) reports that households which do not have access to market fail to diversify their livelihoods and improve their living standards.

Despite of multiple livelihood strategies in the rural economy, most households are poor because of pervasive market failures under which livelihood activities operate, and consequently leading to inefficient outcomes due to high transaction costs (World Bank, 2007). Therefore, in order to achieve economic growth in agro-based economies and to improve rural incomes, enhancing market access for rural households is a precondition and this requires producing surpluses for the market and existence of competitive markets (IFAD, 2003). Access to market is critical in contributing and sustaining achievements in poverty reduction through agricultural growth and non-farm livelihood strategies (Njuki et al., 2008). This is achieved through enhanced earnings and agricultural productivity by selling produce, engaging in non-farm income, use of

[2] The World Bank (2007, p.78) reports that subsistence oriented smallholder farmers contribute only nine per cent in Malawi and two per cent in Nepal and Vietnam to marketed agricultural produce.

improved technologies in production; and access to food at competitive prices (Dorward and Kydd, 2005).

Improved access to markets is one of the fundamental factors in the promotion of economic opportunities for poor people. The importance of access to markets for smallholder farmers is evident through increased incomes, productivity and diversified livelihoods. Literature on rural development point out that majority of the population in developing countries are still poor due to limited access to market, which remains one of the significant factors which prevents smallholder farmers from realising benefits of their farming. In developing countries, poverty alleviation and economic growth can be achieved more quickly if favourable terms of trade for the rural sector are put in place, because the rural sector comprises majority of the poor whose livelihoods are agricultural-based (Husain, 1993).

2.2.2 Historical Overview of Smallholder Farmer's markets Participation

Barrett (2008) shows that more than half of farming households do not sell their staple food grains in Eastern and Southern African. This phenomenon is attributed to the wide spread market failures in developing countries due to barriers to access markets for some households because of high transaction costs of market participation; and differences in the integration of markets to national and international markets due to differences in geographical and spatial costs of trade and level of competition of market players (Barrett, 2008).

However, de Janvry et al., (1991) argue that market failure should be considered at a household level, rather than at commodity level[3]. Market failure is defined by de Janvry et al., (1991, p.1401) as:

> "referring to when the cost of transaction through market exchange creates disutility greater than the utility gain that it produces, with the result that the market is not used for the transaction."

Several research studies have been conducted on smallholder farmers' participation in markets in developing countries. Non-price factors namely risks, technology and transport infrastructure significantly determine market participation and volume of sales for smallholder farmers in Mozambique (Heltberg and Tarp, 2002). Jayne et al. (2010) find low maize market participation for smallholder farmers in Zambia, Malawi, Mozambique, Kenya and Ethiopia. The authors show that a larger proportion (an average of 50 % in the sampled countries) of rural farmers participates in staple grain markets are buyers only; less than 20 % participate are sellers only; and about 30 % of the rural farmers are autarky, with the exception of Ethiopia and Kenya where it is only 2% and 8 %, respectively.

Market participation for smallholder farmers is also dependent on types of crops grown. Smallholder farmers who produce traditional export crops such as tobacco, cotton, tea and coffee participate more in markets because these crops are solely produced for sale. This is because these commodities require factory processing before they can be consumed; little quantities are consumed at household level and the high integration of domestic with the world markets offers

[3] de Janvry et al. (1991, p. 14001) argue that distinction should be made between lack of market and general market failure, in which the former is considered as an extreme of the later. They argue that for most goods, markets are available; however, they fail to some households and consequently rendering such goods as non-tradable to them.

relatively better prices compared with most food crops. However, it is relatively only a small proportion of smallholder farmers in developing countries who are engaged in production of traditional export crops. For instance, Heltberg and Tarp (2002) find that only 7.1 percent of Mozambican farmers sold cash crops compared to 14.3 percent who sold basic food crops.

According to Poulton et al., (2006), the poor performance of the African domestic markets for agricultural products is attributed to involvement of small traders with limited capital; volatile prices due to seasonality and fluctuations of productions; high transaction costs due to geographical and spatial barriers; and little production services[4] for food crops. With all these enormous challenges smallholder farmers are facing in accessing and participating in agricultural markets, the future contribution of the smallholder sector in rural poverty reduction, economic growth and food security seems rather abating.

2.2.3 Transaction Costs and Market Participation of Smallholder Farmers

Key et al., (2000) categorise transaction costs[5] into two: (i) "proportional transaction costs (variant transaction costs dependent on the level of transaction such as unobservable transport and marketing costs e.g. cost of self-transportation and time spent selling commodities in the market); and (ii) fixed transaction costs (invariant transaction costs such as unobservable costs of search, negotiation, bargaining, selection and enforcement)". Key et al., (2000) and de Janvry et al. (1991) have shown that due to proportional transaction costs, a price band is formed[6] in the marketing

[4] Production services refer to services which are important at the production stage and include services such as input supply, extension and credit.

[5] Transaction costs refers to "costs of planning, adapting, search, *monitoring task completion".* Williamson, (1981, p.553)

[6] de Janvry et al. (1991, p. 1403) report that "the wider the price bands is formed, the more internalisation of external shocks effects, which displace the shadow prices of food and labour".

chain, in which, final buyers pay higher prices, while producers receive lower prices, and consequently, rendering market participation unprofitable to some households either as buyers or producers. This also explains the lower net returns for net-buyer households, compared with commercial farmers who solely produce for the market.

The presence of fixed transaction costs in market participation means that marketing economies of scale can be gained with larger traded commodities. This also means that increased benefits from improved infrastructure and institutional development, which results in reduction of transaction costs can be achieved by corresponding increased supply by smallholder farmers. In most cases, individual traders are relatively involved with larger quantities of traded commodities compared with individual smallholder sellers or buyers. Consequently, it is conjectured that reduction in transaction costs associated with marketing would be more beneficial to traders compared with individual smallholder sellers in the absence of corresponding significant increased supply by smallholder farmers[7].

Transaction costs affect both traders and producers in the process of their engagement with markets either as sellers or buyers. High transaction costs in marketing of agricultural produce are attributed to poor infrastructure and institutional development in developing countries. Poor transport and telecommunication infrastructure; information asymmetry on prices, traders, and new technologies are common phenomenon in developing countries (Poulton et al., 2006). High transport, communication and search costs are among the costs which are associated with marketing in remote areas in developing countries and are considered the main cause for the poor

[7] Individual smallholder farmers can still gain economies of scale without corresponding increased supply or production to reduce transaction cost by joining farmer organisations and sale their produce as a group, which in essence increases the volume of traded commodities.

market access for smallholder farmers and consequently, the pervasiveness of subsistence farming (Davidova et. al., 2009). Fafchamps and Gabre-Madhin (2001) find that agricultural traders in Malawi and Benin incur highest transaction costs in search and transport because of the small quantities of transacted goods and the reliance in physical visits to markets, respectively, which is attributed to lack of access to telephone services. It is therefore, envisaged that low transaction costs would reduce the costs associated with marketing and consequently increase profitability and market participation (Raballand et al., 2011). Dorward et al., (2004) point out to the potential of low transaction costs associated with communication due to increased access to cell phones in rural areas.

A study on the impact of mobile phone on market participation by Muto and Yamano (2009), using panel data of Uganda smallholder farmers find a large increased percentage of banana sellers (from 43% in 2003 to 68% in 2005) in areas covered by mobile network and which are more than 20 miles from district centres. But they find no increase in the percentage of maize sellers in remote areas and that possession of mobile phone at household level does not significantly impact on participation in banana sales and marketing of maize. This suggests that mobile phones influence smallholder farmers' marketing participation for certain types of crops.

The World Bank (2004) reports that Malawi's domestic transport rates are much higher compared with other neighbouring countries. Comparing domestic transport rates for Malawi, South Africa and Zimbabwe, the World Bank (2004) finds that in Malawi the rate per tonne and per kilometre is between US$0.065 to US$0.075, while in South Africa and Zimbabwe are US$0.002 on track roads and US$0.035 on rural roads. The high domestic transport rates in Malawi is attributed to firstly, poor conditions of rural roads, which are rated below the SADC region

average; secondly, lack of competition due to a few transport operators; and finally, high transport taxes.

Developing infrastructure and institutions is one of the most recommended options in development literature in order to reduce transaction costs and consequently, improving access and participation of smallholder farmers in markets in developing countries (Dorward et al., 2004; IFAD, 2003; Raballand et al., 2011; World Bank, 2007). Improved infrastructure (such as roads, markets and storage facilities) and improved institutions (such as information, communication, credit, security and extension services) are hypothesised to greatly reduce transaction costs. With improved rural road networks and quality of roads, more transport operators are expected to use rural routes, which increases competition among operators and hence leading to competitive transport fares. Improved roads networks in Malawi have also contributed to establishment of community mobile markets[8] in rural and urban trading centres, which have helped to reduce distances travelled to markets for both rural buyers and sellers.

Improved communication through both private and public radio stations facilitate access to timely, frequent and accurate information on agricultural production practices and marketing through radio agriculture programmes[9]. Therefore, households' ownership of radios is expected to reduce transaction costs associates with market information searching and addresses information

[8] Community mobile markets are markets which are organised periodically in different trading centres, both in rural and urban areas and are organised either on a weekly or a fortnight basis in a particular area.

[9] The Ministry of Agriculture in Malawi annually announces minimum producer prices for several crops through private and public radio stations, to help smallholder farmers to have access to accurate and correct price information. Large commercial traders also announce their buying prices and buying centres for various crops; and selling prices and selling points of farm inputs on private and public radio stations.

asymmetry. Furthermore, installation of mobile phone networks covering both urban and rural areas has led to increased ownership of cell phones in most developing countries. With the introduction of cell phone, new innovative means of addressing the challenge of information asymmetry on agricultural marketing have been developed in Africa by Esoko[10], which works with governments, international organisations, NGOs and private businesses to provide current and accurate marketing information on prices, bids and offers, weather forecasts and agricultural advices to smallholder farmers and traders via text messages through short message service (SMS) on their cell phones.

2.2.4 Farmer Organisations and Market Participation for Smallholder Farmers

Due to low levels of production and productivity, smallholder farmers individually sale small quantities in output markets and this increases assembling costs of commodities for buyers from numerous smallholder farmers. This is one of the factors which impede smallholder farmers' access to markets in developing countries. It is argued in agricultural marketing literature that such smallholder farmers can overcome these challenges by forming farmer organisations, which help to reduce transaction costs for both farmers and buyers. This can be achieved through bulking of commodities and improved access to communication, extension, credit, transport, and contract

[10] Esoko is a technology platform and consulting service that helps organisations profile people and manage the information flows between them and is currently working in sixteen countries in Africa and these are: Malawi, Burkina Faso, Burundi, Cameroun, Cote d'Ivoire, Ghana, Kenya, Madagascar, Mozambique, Nigeria, Rwanda, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe. Through this technology, smallholder farmers sign up to Esoko to receive a package of weekly marketing or advisory information from an organisation which has partnered with Esoko. More details of Esoko are on: www.esoko.com.

services through reduced costs of service delivery for service providers and service users[11] (Poulton et al., 2006; World Bank, 2007).

Most governments in developing countries have put in place policies which promote the formation of farmer organisations with the objective of improving smallholder farmers' access to markets (GoM, 1997, 2009). In most developing countries, formation of farmer organisations dates back to periods before independence and decades have passed since developing countries started promoting establishment of farmer organisations. However, empirical evidence on effectiveness of farmer organisations in facilitating smallholder farmers' access to competitive market has been mixed (Chirwa et al., 2005; Poulton et al., 2006).

A study by Okello (2005) finds that farmer organisations have helped smallholder farmers to access markets through their collective supply of produce, which has helped to reduce marketing transaction costs and benefiting from economies of scale for both sellers and buyers. However, other evidence shows that several farmer organisations have failed and closed-up in developing countries, and the few still functioning have few members compared with the total number of smallholder farmers, are ineffective and their performance is poor (Salifu et al., 2010Shiferaw et al., 2009). Closing-down and poor performance of most farmer organisations is attributed to poor management and poor organisation structure (Salifu et al., 2010).

Despite the implementation of policies which promote formation of famer organisations in most developing countries, majority of smallholder farmers are not members of producer organisations. This is evident in one of the major findings in the evaluation of the National

[11] By providing services to farmers in a group, service providers incur lower costs of service delivery compared with individual service provision.

Smallholder Farmers' Association of Malawi (NASFAM) during the period 2003 -2006. The study finds that the members' number one priority was the prospect of selling their produce at the national and international markets and thereby having access to better prices for their produce. However, membership analysis for NASFAM reveals that it does not targeted the poorest subsistence farmers, but only those with a potential surplus to bring to the market (NASFAM, 2006).

2.3 Farm Input Subsidies in Developing Countries

Against the orthodox evidence that subsidies distort markets in the economy, a new wave of agricultural input subsidies is emerging in most developing countries. Introduction of input subsidies is aimed at addressing challenges of low output and productivity of poor smallholder farmers who are financially constrained to purchase improved inputs for production and consequently, contributing to achieving self-food sufficiency at household and national levels and alleviating poverty. Table 2.1 presents a list of countries and the time frame they have been implementing the recently large scale farm input subsidy programmes in the Eastern and Western Africa in the period of the post-structural adjustment programmes. Zambia and Malawi were the first and second to reintroduce the large scale farm input subsidies in Eastern Africa, respectively, while Nigeria was the first in Western Africa.

Table 2.1: Implementation period of large scale farm input subsidy programmes in Eastern and Western Africa in the period of the post-structural adjustment programmes.

Region	Country	Large scale farm input subsidy programme implementation period
Eastern Africa	1. Zambia	2002 - on
	2. Malawi	2005 - on
	3. Tanzania	2008 - on
	4. Rwanda	2007 - 2009
	5. Kenya	2007 - on
Western Africa	1. Burkina Faso	2008 - on
	2. Senegal	2008 - on
	3. Mali	2008 - on
	4. Nigeria	1999 - on
	5. Ghana	2008 - 0n

Source: DANIDA, (2011); Druilhe and Barreiro-Hurle, (2012); Ricker-Gilbert et al., (2013).

There are several studies on the impact of the recently implemented farm input subsidy programmes in sub-Saharan Africa (SSA). However, the literature shows that there are more studies focusing on Malawi and Zambia. Probably because these two countries were among the first to reintroduce the large scale farm input subsidies in this region in the early 2000s. The recent studies have focused on both direct and general equilibrium impact of farm input subsidies.

Crop output effects of farm input subsidies is one of the areas which has been extensively studied. Studies by Chibwana, et al., (2010); Dorward et al., (2013); Holden and Lunduka, (2010); Ricker-Gilbert and Jayne, (2011) all find statistically significant positive effects of farm input subsidies on maize production and productivity in Malawi. Ricker-Gilbert and Jayne, (2011) find

that an additional kilogram (kg) of subsidised fertilizer increases maize production by 1.82 kg in the current year and 3.16 kg in the third year of using subsidised fertilizer. Analysing maize yield response to farm input subsidies, Chibwana, et al., (2010) find that using subsidised fertilizer only increases maize yield by 249 kg per hectare, while using both subsidised hybrid maize and fertilizer increases maize yield by 447 kg per hectare. Dorward et al., (2013) evaluates the 2012/2013 FISP and based on simulation results report that a full FISP package increases maize production by at least 500 kg, while only 50 kg bag of subsidised fertilizer or with hybrid maize seed increases maize production between 200 kg and 400 kg. Similar results are reported in a study by Mason et al., (2013) who analyse the effects of subsidised fertilizer on maize production in Zambia and find that an additional kilogram of subsidised fertilizer increases maize production by 1.88 kg. The most recent study is by Wiredu et al., (2015) who analyse the impact of fertilizer subsidy on land and labour productivity in Ghana and find that receipt of subsidised fertilizer increases rice production by 29 kg per hectare.

The effects of farm input subsidies on input market has also been analysed by several researchers. Ricker-Gilbert et al., (2011) and Mason and Ricker-Gilbert (2013) find that an additional kg of subsidised fertilizer and hybrid maize seed in Malawi crowd-out commercial purchases of fertilizer and hybrid maize seed by 0.22 kg and 0.58 kg, respectively. A similar effect of crowding-out of commercial fertilizer is reported in a study by Chirwa et al., (2013), who find a decrease in purchase of commercial fertilizer of between 0.15 % and 0.21% for a 1 % increase in subsidised fertilizer. However, Xu et al, (2009) find both crowding out and crowing in effects on commercial fertilizer purchases in Zambia, and Liverpool-Tasie (2014) find that subsidised fertilizer increases both participation in and quantities of commercial fertilizer bought from the private fertilizer markets in Kano State, Nigeria.

Farm diversification effect of farm input subsidies are examined in the existing literature in the context of their impact on land allocation to various crops at household level. Holden and Lunduka, (2010); and Chibwana, et al., (2012) are some of the recent studies for Malawi. However, these two studies find contradicting results, which is mainly attributed to differences in the analytical methodologies employed (Lunduka et al., (2013). Chibwana et al., (2012) find increased land allocated to maize, while Holden and Lunduka (2010) find reduced land allocated for maize production. However, Dorward et al., (2013) and NSO (2014b) show decreasing trend on land located to maize and increasing proportion of farmers growing other crops, mainly legumes. The most recent study is by Yi et al., (2015) who analyse the effects of grain subsidies on grain cultivated area in China and they find positive effects, but only on the liquidity-constrained households.

Several studies have also analysed the household welfare effects of farm input subsidies in Malawi. Dorward and Chirwa, (2011); Dorward et al., (2013); and Chirwa et al., (2013) all find improvement in adequacy of food availability at household level. A study by Ricker-Gilbert and Jayne, (2011) find that on average, an additional kg of subsidised fertilizer increases farm net crop income by US$1.16, however, they find no evidence of effects on asset worth. Ricker-Gilbert and Jayne (2012) also analyse the effects of subsidised fertilizer on crop income employing quantile regression model and find increased crop income to richer households at the top percentiles and no statistically significant effect on poor households at the bottom percentiles. Chirwa, et al., (2013) analyse the effects of farm input subsidies on poverty, primary school enrolment and sickness of under-five year old children and they find overall increase in primary school enrolment and reduced probability of having sick under-five year old children, but the study finds no statistically significant effects on subjective self-assessed poverty at household level. However,

Dorward et al., (2013) find no significant differences on school attendance, sickness of a household member or of under-five year children based on number of times of receipt of subsidies.

Studies on equilibrium effects have focused on food prices and macroeconomic indicators. Ricker-Gilbert et al., (2013) find small effects on maize prices in Malawi and Zambia. Similar results are found by Takeshima and Liverpool-Tasie (2015) who analyse the effects of fertilizer subsidies on grain prices in Nigeria. Chirwa et al., (2013) study the effect of farm input subsidies on GDP and agricultural sector growth, poverty and inflation trends in Malawi and they find that during the implementation period of the farm input subsidy programme, Malawi experienced increased GDP and agricultural sector growth; and a decline in poverty and inflation, which are attributed to the FISP. However, their study does not analyse the causal relationship between the macroeconomic indicators under consideration and the farm input subsidy programme.

2.4 Agricultural sector performance and marketing in Malawi

In the post-structural adjustment reform period the performance of the agriculture sector in Malawi has been poor and this has been attributed to the low productivity and profitability of the sector, emanating from the multiple risks associated with production and marketing processes (World Bank, 2004). Inadequate access to agricultural markets due to high transaction costs is a major challenge to most small farmers in Malawi. The World Bank (2010) reports that the marketing system for the agricultural sector in Malawi is inefficient and this is evidenced by higher traders' margin compared to the profits realised by producers. The unfavourable developments of agricultural terms of trade have been another challenge facing the agriculture sector, which has contributed to low profitability. These adverse development have been due to the high costs of

transport for both imports to and exports from the country (World Bank, 2004), and the inefficiency of the marketing systems in rural areas (Dorward et al., 2004).

Low agricultural output and the high transaction costs faced by smallholder farmers have resulted in the fact that only a small proportion of small farmers in Malawi participate as sellers of cereals and legumes. Using the 1997/98 data from the first integrated household survey (IHS1), Chirwa (2006) reports that while in general 39 per cent of households which produced crops participated in markets as sellers, only 9 per cent of households which produced maize participated in the market as sellers. Employing data from the second integrated household survey (IHS2), Chirwa (2009) finds out some improvement reporting that in 2004/05 this percentage increased to 15. Figure 2.1 presents trends in market participation of farmers as sellers of selected cereals and legumes in Malawi including maize, based on surveys conducted between 1997/1998 (IHS1) and 2013 integrated household panel survey (IHPS). The results show that apart from maize, the proportion of farmers who sold beans, groundnuts, and rice significantly decreased following the 2003/2004 agricultural season compared to proportion of sellers following the 1996/1997 agricultural season. A comparison between the period before (statistics based on the 2004/2005 data) and after the implementation of the large scale farm input subsidy programme (FISP) suggests there has been no significant increase in the proportion of farmers who sold maize and rice. However, the results show an increase in proportion of sellers of groundnuts, beans and pigeon peas.

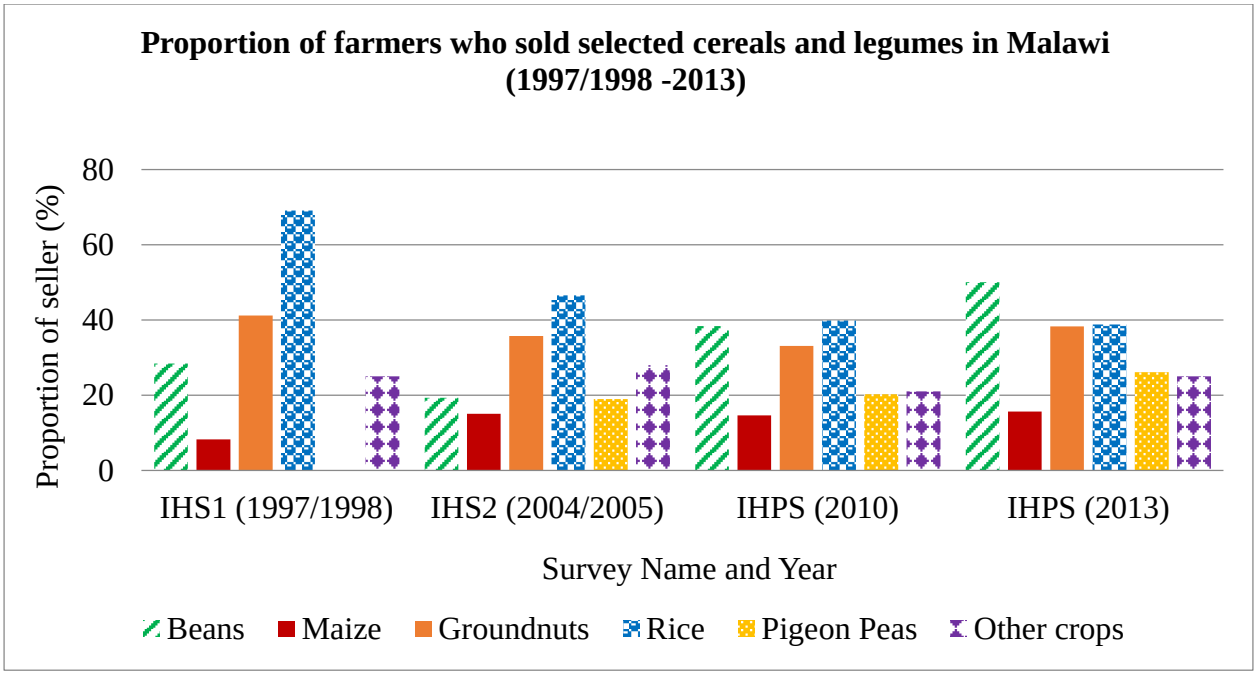

Figure 2.1: Proportion of farmers who sold selected cereals and legumes in Malawi (1997/1998 -2013)

Notes: IHS: Integrated Household Survey; IHPS: Integrated Household Panel Survey.

Source: Author based on IHS1 (1997/1998), IHS2 (2004/2005) data and NSO (2014b).

The low level of market participation by small farmers as sellers and the small quantities sold coupled with the low rates of commercialisation in cereals is a significant contributing factor towards the persistence of poverty among small farmers whose livelihoods are dependent on production of staple food crops. This raises doubts on the effectiveness of various agricultural policies aimed at facilitating commercialisation of major cereals and legumes in Malawi.

However, overall and at national level, the performance of the agricultural sector in Malawi has improved since the reintroduction of the large farm input subsidy programme (FISP) in the 2005/2006 agricultural season. In terms of agricultural production at national level, cereals production and productivity has improved since the implementation of FISP (Figure 2.2).

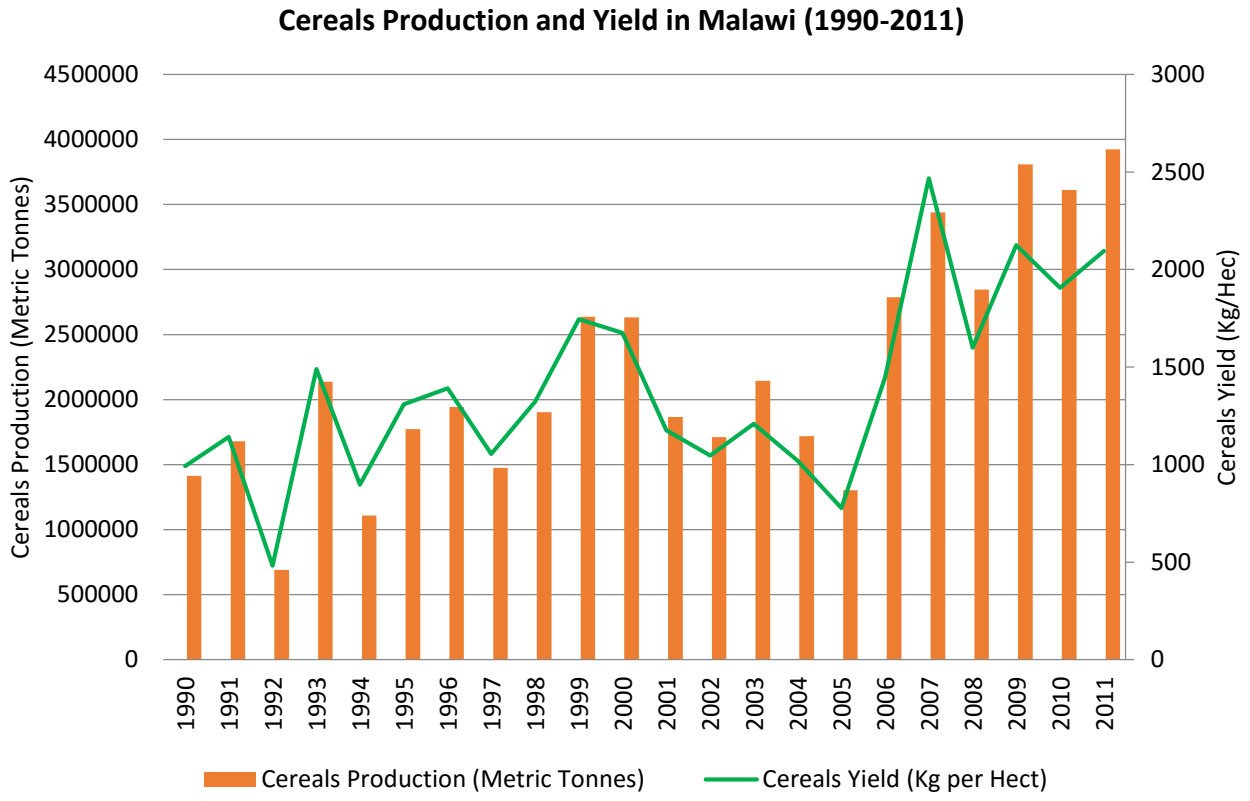

Figure 2.2: Cereals Production and Yield in Malawi (1990-2011)

Source: Author's calculations based on FAOSTATS Data (2014).

Similarly, Malawi's international trade balance of cereals shows significant improvement since the implementation of the FISP. The period 2006 to 2011 shows significant increase and decrease of exportation and importation of cereals, respectively, and consequently, significantly improving the cereals balance of trade (Figure 2.3). Although the statistics in Figures 2.2 and 2.3 do not indicate causality relationship between FISP and cereals production, productivity, exports and imports, they suggest improvement in cereals' marketing at national level in Malawi since the implementation of the FISP.

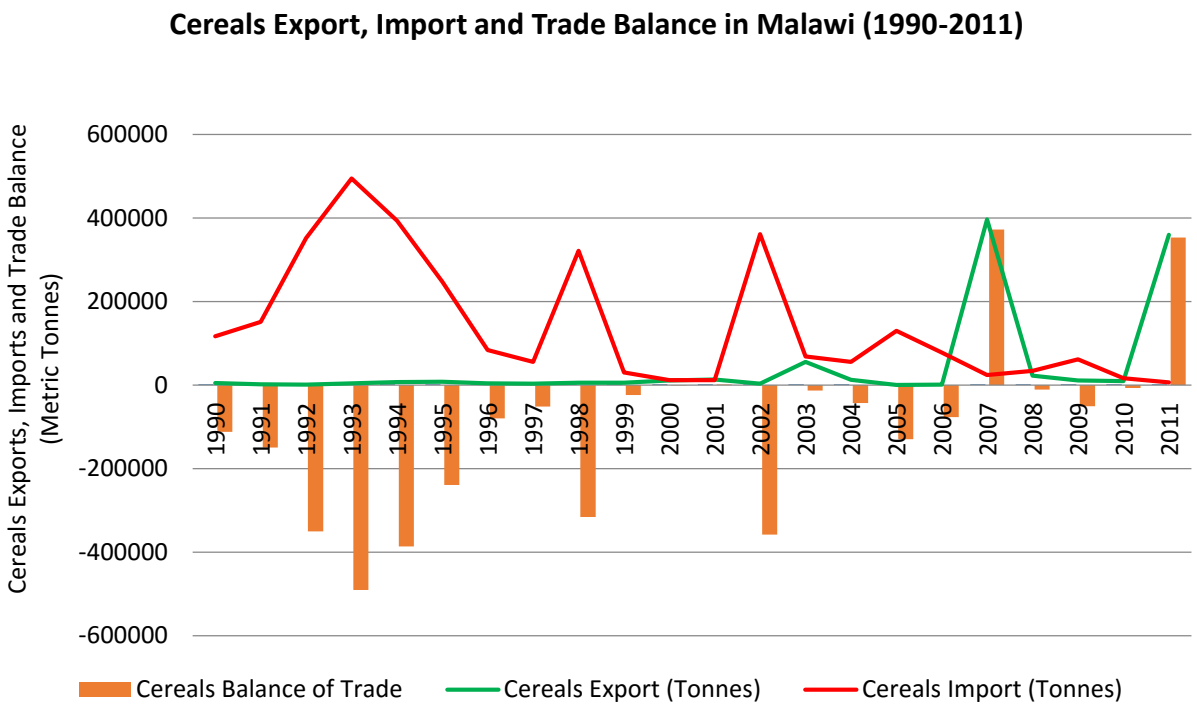

Figure 2.3: Cereals Export, Import and Trade Balance in Malawi (1990-2011)

Source: Author's calculations based on FAOSTATS Data (2014).

2.5 Conceptual framework

This study follows the analytical framework developed in Goetz (1992) in modelling the effects of subsidised fertilizer on farmers' maize market participation as sellers and on the quantities sold. On the supply side, the use of subsidised fertilizer is expected to increase maize production and productivity, and therefore, it is expected to increase maize market participation by farmers benefiting from the subsidy program. However, the farmer decides on the quantities devoted to household consumption not only based on the crop production levels, but also on output prices,

consumption characteristics, e.g. the number of household members, exogenous income sources and farm profits.

Production of cereals by most farmers in Malawi is rain-fed and consequently, has an annual production cycle. As a result, farmers also make decisions on production, consumption and sales levels taking into account the annual production cycle. In addition, due to poor storage facilities, the post-harvest losses of cereals and legumes are high. For simplification, in this study it is assumed that there are no inter-temporal decisions on consumption at household level.

It is also assumed that farmers' decision on whether to sell or not to sell (consume) part of the maize output is based on utility derived by the chosen regime. The farmer's decision is based on the expected benefits of either of the regimes (i.e. selling or consuming maize output), taking into account transaction costs. It is also assumed that only one marketing reg

Ds73ime is chosen by the famer at a time, thus making the decision binary.

Based on the expected increase in maize production and productivity as a result of the use of subsidised fertilizer, four hypotheses are formulated in relation to farm households' maize market participation; (1): There is positive relationship between the use of subsidised fertilizer and the decision to sell maize; (2): There is positive relationship between the use of subsidised fertilizer and quantities of maize the farm household sell; (3): There is positive relationship between the use of subsidised fertilizer and maize commercialisation (i.e. ratio of quantity sold to quantity harvested); (4) The more the frequency of benefit to subsidised fertilizer, the higher the magnitude of the positive effects on the decision to sell, quantities sold and commercialisation of maize.

The random utility theory proposed by Greene (2003) is employed in this study in modelling the choice of the marketing regime. Assuming that the i^{th} farmer is faced with two marketing

regimes, indexed m, the farmer maximises utility by choosing marketing regime m, which can be presented as:

$$MaxU_{im} = X_{im}^{'}\beta + \varepsilon_{im} \quad (2.1)$$

where U_{im} is the utility derived from choosing marketing regime m and m=1 if the farmer participates in the market, otherwise m=0; $X_{im}^{'}$ is a vector of attributes of farmer's characteristics; β is a vector of parameter coefficients; and ε_{im} is an idiosyncratic error term.

Suppose the farmer's utility of two choices is represented by U_m and U_c, where U_m is utility of market participation as a seller and U_c is utility of consumption (i.e. no market participation as a seller). If the farmer chooses one of the two regimes, this implies that the observed decision provides greater utility compared with the unobserved utilities. Therefore, the observed chosen marketing decision equals 1 if $U_m > U_c$, and 0 if $U_m < U_c$.

2.6 Empirical models

Three empirical models are employed with regard to: (i) farmers participation in maize market as sellers; (ii) quantities of maize sold; and (iii) commercialisation index (i.e. ratio of total quantity sold to total quantity harvested).

Since only a small proportion of farmers sell maize in Malawi, this makes the data on quantity sold of maize contain a large number of zero observations. The production of maize mainly for subsistence by most small farmers provides economic justification for the decision not to sell maize and this decision is strategic to the farmers' livelihoods. Therefore, this study does not consider

non-participation of famers in maize marketing as a pure selectivity issue as is the case with missing data sample selection models, but rather as a corner solution. The quantity sold of maize in this study has characteristics of truncated data, with large number of zeros and small number of continuous data units. For such dependent variables, the ideal models employed in estimations are the Tobit model for corner solution and the Double Hurdle model. In the case of incidental truncation of the data (missing data for non-participants), which causes the problem of sample selection bias, most empirical studies using cross-section data employ the Heckman model (Heckman, 1979) or the two stage sample selection model. The sample selection model is based on the assumption that the unobserved quantities sold by non-participants in the market as sellers is attributed to barriers to entry due to constraints conditional on household characteristics, such as assets endowments and transaction costs.

The farm input subsidy program (FISP) in Malawi provides coupons which entitle the recipient to purchase specified quantities of subsidised fertilizer and selected other inputs at subsidised prices. The allocation of these coupons is based on a set of targeting criteria set out by the government of Malawi. Since the coupons are not randomly distributed, the unobserved household heterogeneity factors influencing receipt of the coupons may also influence maize market participation and the quantity sold, consequently making subsidised fertilizer endogenous.

Therefore, empirical estimations have to address the potential endogeneity of subsidised fertilizer. In this study the dependent variables are non-linear. For market participation is binary; the commercialisation index variable is proportional bounded between zero and one; and for quantity sold of maize is discrete and includes zero quantity for non-maize sellers. The quantity of subsidised fertilizer redeemed by the beneficiaries is also discrete and includes zero quantity for non-beneficiaries. We therefore, estimate market participation, quantity of maize sold, and

commercialisation index using correlated random effects (CRE) models following Papke and Wooldridge (2008) and Wooldridge (2010, 2013).

2.6.*1 Model of farmers' participation in maize market a*s sellers (i.e. selling maize).

Farmers' market participation as sellers of maize is modelled using the pooled CRE Probit model, taking into account the potential endogeneity of subsidised fertilizer by using the Control Function (CF) approach as an instrumental variable (IV) method (Papke and Wooldridge, 2008; Wooldridge, 2010, 2013). Therefore, the participation equation to be estimated can be written as follows:

$$y_{it1} = hhc_{it1}\beta_1 + r_{it1}\beta_2 + mkt_{it1}\beta_3 + \beta_4 subfert_{it1} + \beta_5 v_{it2} + c_i + \overline{Z}_i\beta_6 + \mu_{it1} \qquad (2.2)$$

where y_{it1} is the binary dependent variable and equals one if the farmer participated in the market as a seller of maize, or zero otherwise; hhc_{it1} is a vector of household characteristics and includes gender, age and education of household head, total land, rural location, real value of durable assets, household size and crop diversification; r_{it1} is a vector of regional dummies representing north, south and central regions location of households; mkt_{it1} is a vector of marketing factors and includes ICT information on maize marketing and distance to daily market; $subfert_{it1}$ is a vector of subsidised fertilizer redeemed by the household; v_{it2} is a vector of the generalised residuals from the reduced form pooled CRE Tobit model of subsidised fertilizer, $subfert$; c_i is the time-invariant unobserved heterogeneity of the household; $\overline{Z}_i$ is the time averages of the time-variant explanatory variables; μ_{it} is an idiosyncratic error term; and β are the parameters to be estimated.

2.6.2 Model of quantity of maize sold.

Maize quantity sold by farmers is estimated using the pooled Double Hurdle CRE Model. We take into account the potential endogeneity of subsidised fertilizer by applying the Control Function (CF) approach of instrumental variables (IV) methods. Recent application of the pooled Double Hurdle CRE Model is by Mather et al., (2013) in estimating maize marketing by smallholder farmers in southern and eastern Africa.

We also estimate two other competing models to check the robustness of the empirical estimates: the pooled CRE Tobit Model for corner solution and the pooled CRE OLS Model, which takes into account both, sample selection bias and the potential endogeneity of subsidised fertilizer. The control function approach is used as an IV method to address the potential endogeneity of subsidised fertilizer (Semykina and Wooldridge 2010; Wooldridge, 2013). All other explanatory variables for the quantity equation are the same as in Eq. (2.2) with the exception of the ICT and crop diversification covariates, which are not included and are used as exclusions for selectivity into market participation in the pooled Double Hurdle CRE Model and pooled CRE OLS Model. In addition, the quantity equation in the pooled CRE OLS Model includes the inverse Mills ratio as an additional covariate. The quantity equation for estimation of the pooled Double Hurdle CRE Model is as follows:

$$y_{it1} = \mathrm{hhc}_{it1}\beta_1 + \mathrm{r}_{it1}\beta_2 + \beta_3 \mathrm{dis}_{it1} + \beta_4 \mathrm{subfert}_{it1} + \beta_5 v_{it2} + \mathrm{c}_i + \overline{\mathrm{Z}}_i\beta_6 + \mu_{it1} \qquad (2.3)$$

where y_{it1} is the discrete dependent variable representing quantity of maize sold by farmer i in natural logarithm; V_{it2} is a vector of the residuals from the reduced form pooled CRE Tobit model

of subsidised fertilizer subfert; and all other explanatory variables are the same as in Eq.(2.2) with the exception of the ICT and crop diversification covariates.

The selection of this model against the pooled CRE Tobit Model for corner solution and the pooled CRE OLS model is based on the test results on selecting non-nested models (Vuong, 1989). The Vuong test results have shown that the pooled Double Hurdle CRE Model fits better the data with p-value of 0.000 on the Likelihood Ratio statistic.

2.6.3 Model of maize commercialisation index

Estimation of the commercialisation index uses the pooled CRE Fractional Probit Model and estimators are obtained by using the generalised linear model (GLM) approach. The potential endogeneity of subsidised fertilizer is taken into account by using the control function approach as an IV method (Papke and Wooldridge, 2008; Wooldridge, 2010, 2013). The estimation equation is as follows:

$$y_{it1} = \text{hhc}_{it1}\beta_1 + \text{r}_{it1}\beta_2 + \beta_3\text{dis}_{it1} + \beta_4\text{subfert}_{it1} + \beta_5 v_{it2} + \text{c}_i + \bar{Z}_i\beta_6 + \mu_{it1} \qquad (2.4)$$

where y_{it1} is the fractional dependent variable and is a ratio of total quantity sold to total quantity harvested of maize - a continuous variable bounded between zero and one; and all other explanatory variables are the same as in Eq.(2.2) with the exception of the ICT and crop diversification covariates.

2.6.4 Estimation approach

In this chapter, the key covariate of interest is the subsidised fertilizer and therefore, estimation of its average partial effect (APE), represented by β_4 in Eq. (2.2-2.4) is the focus of this study. The use of panel data allows us to control for the unobserved time-invariant household heterogeneity. For the continuous dependent variables and without sample selection bias consideration, the most common estimation strategy would be to use the fixed effects (FE) estimator. However, as explained above, estimations include binary dependent variable in Eq. (2.2); discrete dependent variable in Eq. (2.3); and fractional dependent variable in Eq. (2.4). This makes the use of FE estimators inconsistent and unable to control for the time-invariant factors (Wooldridge, 2010, 2013). Furthermore, we suspect the covariate 'subsidised fertilizer', which is discrete to be endogenous in all the three equations and this requires estimation with IV method using the control function approach. For the estimators in this study to be consistent and the APEs to be identified, we apply the correlated random effects (CRE) approach (Wooldridge, 2010) following Mundlak (1978) and Chamberlain (1984).

We control for the correlation between the time-invariant unobserved household heterogeneity $\mathbf{c}_i$ and all the explanatory variables, represented by X_{it} in all the three equations (Eq. 2.2-2.4). Estimation assumes strict exogeneity of X_{it}. However, where we suspect endogeneity of X_{it}, an IV method is applied. The estimation of the CRE estimators allows the correlation between the time-invariant unobserved household heterogeneity $\mathbf{c}_i$ and the explanatory variables, X_{it}. In addition to the assumption of strict exogeneity, the application of the CRE estimator method also assumes that the correlation between $\mathbf{c}_i$ and X_{it} is of the form: $\mathrm{c}_i = \psi + \overline{\mathrm{X}}_i\zeta + \mathrm{a}_i$ and $\mathrm{c}_i \big| \mathrm{X}_i \sim$ Normal

$(\psi + \overline{X}_i\zeta, \sigma_a^2)$, where ψ is the constant, $\overline{X}_i$ are the time averages of the time-variant explanatory variables, and a_i is the error term (Wooldridge, 2010). Therefore, estimation of the CRE estimators requires the inclusion of $\overline{X}_i$ as an additional set of independent variables in order to control for the time-invariant unobserved household heterogeneity c_i. Post estimation inference of the APEs is performed using a panel bootstrapping of the standard errors.

The potential endogeneity of subsidised fertilizer in estimation of equations 2.2-2.4 has to be addressed. As mentioned before, under the FISP, beneficiaries of coupons for purchasing of subsidised farm inputs are not randomly selected. Furthermore, despite the program being designed to provide a standard package to all beneficiaries, the data suggests that households received heterogeneous packages. Consequently, the unobserved factors which influence the receipt of coupons for subsidised fertilizer may be correlated with the unobserved factors which influence maize marketing, and thus making subsidised fertilizer endogenous. Furthermore, since not all households in the sample received coupons for subsidised fertilizer, the covariate subsidised fertilizer has a corner solution characteristics, with zero quantity for non-beneficiaries. Since subsidised fertilizer is recorded as a discrete variable, we test and if necessary control for its endogeneity by using the control function approach (CF) of the IV methods, and employ the pooled CRE Tobit model for corner solution in the estimation of the reduced form equation (Wooldridge, 2010).

Application of the CF approach follows a two-step procedure. In the first step, a reduced form pooled CRE Tobit model of corner solution of the subsidised fertilizer is estimated and the generalised residuals, v_{it} is generated. We use as an IV a variable indicating whether a Member of

Parliament (MP) is a resident in or visited the particular community in the past three months. A community is defined by NSO (2014 a) as:

"the village or urban location surrounding the enumeration area selected for the inclusion in the sample and which most residents recognise as being their community."

The Integrated Household Panel Survey (IHPS) was conducted in 204 enumeration areas (EAs) of the total 768 EAs in the Integrated Household Survey of 2010/2011 (IHS3). The economic intuition of using this IV is that subsidy programs are prone to be used by MPs to gain political support, and therefore communities which have resident MPs or their MPs frequently visit them have a greater likelihood to receive more coupons than their counterparts.

The FISP in Malawi has undergone several implementation modifications based on lessons learnt from evaluations of previous years' implementation. Beneficiaries' targeting and subsidy coupons distribution strategies are some of the areas which have undergone several modifications in order to improve efficiency and targeting the right group of farmers based on the set criteria (Lunduka et al., (2013). Although allocation of subsidy coupons to districts is done at national level by the MoAFS Headquarters mainly based on the number of farm households among other criteria, allocations to villages is done at the district level and this is where MPs can influence allocation of more coupons to villages in their constituencies against the set criteria such as total number of farm families (Lunduka et al., (2013). Since MPs which reside in or frequently visit their communities are likely to attend more district level meetings, they may influence for more allocations of subsidy coupons to their constituencies than their counterparts. However, there is no reason to believe that the presence or frequent visit of an MP may affect farmer's decision on

maize marketing and empirical results in Table 2.A.1 in Appendix 2.A show that it is insignificant in all the three equations (2.2-2.4).

Since the instrument used is at a higher community level, we assume it is exogenous to the individual households[12]. Furthermore, t-test results in Table 2.2 on weighted mean differences on community characteristics between communities with and without MPs resident or visit in the past three months preceding the surveys show that are statistically insignificant. This suggests that there are no systematic differences between these two communities and the variable MP resident or visit to the community is exogenous. However, the chosen instrument might be weak and consequently, distorting the models' estimation results. But to the best knowledge of the author, there is no method of testing weak instrumental variables under the CF approach. Both model results with and without the use of the IV method are presented with the aim of checking the robustness of the results of the selected models.

[12]Ricker-Gilbert and Jayne (2011) use Member of Parliament resident in the community in Malawi; Mason and Ricker-Gilbert (2013) use ruling party victory of household's district presidential election results of 2004 in Malawi and ruling party victory of the household's constituency for last presidential election in Zambia as instruments. Both studies show that subsides are politicized in Malawi and Zambia.

Table 2.2: Community characteristics with and without resident MP or visited the past three months preceding the surveys in Malawi in 2010 and 2013

Community characteristic	Obs	Without resident MP or visit I)	With resident MP or visit (II)	Mean differences (I-II)
Household sold maize dummy	6172	0.13	0.15	-0.01
		(0.018)	(0.018)	(0.02)
Household sold maize (kg)	6172	28.27	29.30	-1.03
		(7.71)	(6.13)	(8.16)
Commercialisation index	6172	0.03	0.04	-0.01
		(0.004)	(0.01)	(0.01)
Real value of durable assets	6172	94024.8	36590.35	57434.46
		(40212.18)	(5162.21)	(39045.92)
Household head sex (female)	6172	0.23	0.25	-0.02
		(0.015)	(0.02)	(0.02)
Household head age (years)	6172	43.30	43.94	-0.63
		(0.33)	(0.64)	(0.69)
Household size	6172	4.86	5.01	-0.14
		(0.05)	(0.10)	(0.10)
Household head No education	6172	0.21	0.23	-0.02
		(0.03)	(0.03)	(0.04)
Household head primary educ.	6172	0.60	0.56	0.04
		(0.02)	(0.02)	(0.03)
Household head secondary edu	6172	0.16	0.18	-0.02
		(0.02)	(0.02)	(0.03)
Household head tertiary educ.	6172	0.02	0.03	-0.003
		(0.01)	(0.01)	(0.01)
Rural location	6172	0.89	0.94	-0.05
		(0.06)	(0.03)	(0.06)
Northern region location	6172	0.08	0.09	-0.02
		(0.04)	(0.05)	(0.03)
Central region location	6172	0.45	0.49	-0.04
		(0.11)	(0.12)	(0.09)
Southern region location	6172	0.47	0.41	0.06
		(0.11	(0.11)	(0.09)
Total land owned (hectares)	6172	0.71	0.70	0.01
		(0.05)	(0.05)	(0.05)
Distance to daily market (Km)	6172	6.79	7.69	-0.90
		(0.96)	(1.96)	(1.80)
Using ICT in marketing	6172	0.10	0.10	0.0002
		(0.01)	(0.02)	(0.02)
Crop diversification	6172	1.97	1.98	-0.003
		(0.08)	(0.07)	(0.09)

Notes: Weighted means and linearised standard errors are in parentheses.

Source: Author based on Integrated Household Panel Survey (IHPS) data (2010 and 2013).

The second step is the estimation of the structural equations (2.2-2.4) and includes the generated generalised residuals, v_{it}, as an additional covariate. The statistical significance of the generalised residuals, v_{it} (i.e. β_5) in the equations indicates that the subsidised fertilizer is not exogenous and therefore, requires to control for the endogeneity.

The use of the pooled Double Hurdle CRE Model in estimation of Eq. (2.3) allows us to use different covariates for the selection and quantity equations. This is important because the same covariates can be used in estimating the competing pooled OLS CRE model to check the robustness of the estimates[13]. The participation equation (2.2) is estimated by pooled CRE Probit model, using the receipt of maize marketing information through ICTs and crop diversification as exclusion variables.

The choice of these two exclusion covariates is based on the economic intuition that the acquisition and analysis of marketing information presents a fixed transaction cost to farmers, which only affects market participation decision and not the quantity sold (Key et al., 2000). This is because once farmers get marketing information such as location of buyers or prices, they can decide any quantities to sell without incurring further costs on the same information. The crop diversification (i.e. the number of crops grown) is also expected to only affect the market participation because the decision to produce crops for the market or only for consumption is made prior to production. Normally when the production is for self-consumption different types of crops are grown in order to satisfy the diversified nutritional needs of the household. The farmer decides on the quantities to sell later after the harvest. To test the validity of the chosen variables as good

[13] For details on the procedures of estimating a sample selection linear panel data model see Semykina and Wooldridge (2010).

exclusions in our estimations, we test their statistical significance in both participation and quantity equations and empirical results show that they have statistically insignificant effects on maize quantity sold. Inference of the average partial effects (APEs) follows panel bootstrapping of the standard errors.

2.7 Data source and descriptive statistics

This study uses the nationally representative two-wave Integrated Household Panel Survey (IHPS) data for Malawi from the World Bank Living Standards Measurement Study-Integrated Surveys on Agriculture (LSMS-ISA) Project. The first wave of the data was collected between March and November 2010; and the second wave between April and December 2013 by the National Statistics Office of Malawi. The IHPS data is a balanced panel sample of 4000 households with an overall attrition rate at household level of 3.78 per cent. However, this Chapter uses a balanced panel sample of 3086 households after excluding non-agricultural and households with incomplete information for main variables used in the empirical analyses.

Table 2.3 presents descriptive statistics of variables used in the empirical analyses and a comparison between fertilizer subsidy beneficiaries and non-beneficiaries. The data presented here are the household's averages for each variable calculated across the two-time periods included in the survey. We focus our discussion in this section on descriptive statistics for fertilizer subsidies and maize marketing variables.

The IHPS collected detailed information on the Government of Malawi's FISP covering the 2009/2010 and 2012/2013 agricultural seasons. Furthermore, the survey collected household historical information on maize seed and fertilizer coupon benefits from 2008/2009 to 2012/2013

agricultural seasons. This information has helped this study to identify and categorize households from those who have never benefited to those who have benefited in any of the five agricultural seasons.

Overall, 53 per cent of farmers nationwide were targeted with coupons to purchase subsidised fertilizer. On the average, subsidised fertilizer redeemed was 38 kg, while the average redeemed by beneficiaries only was 80 kg. This suggests that the government met the objective to reach at least 50 per cent of the farmers. The full standard program package was designed to support the purchase of 100 kg of subsidised fertilizer (50 kg bag NPK and 50 kg bag Urea); one pack of improved maize seed (5 kg hybrid or 8 kg open pollinated variety (OPV)); and one legume pack (Dorward, et al., 2013). Data also show that FISP beneficiaries received different coupon packages. These statistics are consistent with earlier studies (Chibwana et al., 2010; Holden and Lunduka, 2010; Ricker-Gilbert and Jayne, 2011).

In terms of maize marketing, overall, 13 per cent of the farmers sold maize. Furthermore, 17 per cent of fertilizer subsidy beneficiaries sold maize compared to 9 per cent non-beneficiaries and the difference is statistically significant at 1 % significance level. On quantity sold and for the whole sample, on average only 28 kg of maize is sold and fertilizer subsidy beneficiaries sell 19 kg more compared to non-beneficiaries and the difference is statistically significant. However, in terms of the average ratio of total output sold to total output produced (commercialisation index-CI), only three per cent of the maize produced is sold.

Table 2.3: Descriptive Statistics (Average of two-time periods – 2010/2011 and 2013)

Variable	All (Full Sample) (I)		Beneficiaries Only (II)		Non-Beneficiaries Only (III)		Mean Difference (II-III) (IV)
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean
Household head (female)	0.23	0.42	0.25	0.43	0.20	0.4	0.05***
Household head age (years)	43.56	16.05	46.09	16.3	40.74	15.28	5.35***
Head no formal education	0.19	0.39	0.21	0.41	0.16	0.37	0.05***
Head primary education	0.56	0.50	0.61	0.49	0.50	0.50	0.12***
Head second. education	0.21	0.41	0.17	0.37	0.26	0.44	-0.1***
Head tertiary education	0.04	0.20	0.01	0.10	0.08	0.26	-0.07***
Household size	5.02	2.33	5.34	2.3	4.66	2.31	0.69***
Rural location	0.83	0.38	0.92	0.27	0.72	0.45	0.2***
Northern region	0.20	0.40	0.20	0.42	0.17	0.38	0.05***
Central region	0.39	0.49	0.36	0.48	0.43	0.5	-0.07***
Southern region	0.40	0.49	0.42	0.49	0.4	0.49	0.02
Total land (hectares)	0.70	0.68	0.82	0.70	0.57	0.65	0.25***
Real durable asset ‘K1000’	427	24391	33.27	191.2	865.4	35458	-832.13
Distance to daily mkt‘Km’	8.14	17.82	10.71	22.05	5.27	10.68	5.44***
MP resident or visit	0.27	0.44	0.30	0.46	0.23	0.42	0.07***
Maize sold (kg)	27.94	148.5	36.92	172.7	17.93	114.9	18.99***
Sold maize dummy	0.13	0.34	0.17	0.38	0.09	0.28	0.08***
Commercialisation Index	0.03	0.11	0.04	0.12	0.02	0.10	0.01***
Subsidised fertilizer (Kg)	37.98	44.38	79.92	28.14	-	-	-
Number of obs.	6172		3252		2920		

Note: *** represents statistically significant at 1 % level; K=Malawi Kwacha; Km=Kilometres; MP=Member of Parliament; Mkt=Market

Considering only maize sellers (not included in Table 2.2), the average quantity of maize sold is 214 Kg, and there is a slight difference between beneficiaries and non-beneficiaries, 217 Kg and 210 Kg, respectively. The average CI for maize sellers only is 23 per cent and again there is a slight difference between the two groups with beneficiaries and non-beneficiaries selling 23 and 24 per cent of their maize produce, respectively.

2.8 Empirical results and discussion

This section discusses the empirical results. It focuses on the results of the subsidised fertilizer covariate, which is of central interest to this study. The discussion is divided into five sub-sections. Factors determining receipt of coupons and the quantity redeemed of subsidised fertilizer are discussed in section 2.8.1; market participation of farmers as sellers of maize in section 2.8.2; quantity of maize sold in section 2.8.3; commercialisation index of maize in section 2.8.4; and the effects of repeated benefit to subsidised fertilizer on market participation, quantity sold and commercialisation of maize in section 2.8.5.

2.8.1 Determinants of quantity redeemed of and receipt of coupons for subsidised fertilizer

We start by discussing the empirical results regarding the factors that determine the quantity of subsidised fertilizer redeemed of the pooled CRE Tobit model (model I) and receipt of coupons to purchase subsidised fertilizer of the pooled CRE Probit model (model II) presented in Table 2.4. The results show that having a resident Member of Parliament (MP) or having an MP visit the community in the past three months preceding the survey increases quantities of subsidised fertilizer redeemed (model I) and increases the probability of receiving coupons of subsidised fertilizer (model II). These results do appear to confirm that the subsidy programme in Malawi is

subject to a degree of politicisation even though there are clear guidelines for coupons distribution. Mason and Ricker-Gilbert (2013) also find that households in districts where the ruling party won the 2004 presidential election in Malawi redeemed more subsidised maize seed and fertilizer.

Female headed households do not benefit more from the subsidy program compared to male headed households. This is in contradiction to the design of the program which aims at reaching more poor households by among other criteria targeting more female headed households because they are considered to be the most financially constrained to purchase fertilizer at commercial prices. This finding is consistent with previous studies (Chibwana et al., 2010; Chirwa et al., 2013; Dorward and Chirwa, 2011; Fisher and Kandiwa, 2014; Holden and Lunduka, 2010; Ricker-Gilbert et al., 2013).

Those households headed by older farmers redeem more quantity of subsidised fertilizer and are found to have increased probability of being targeted for the subsidy program, and therefore, is consistent with the program design of targeting the elderly headed households. Households which are located in rural areas redeem 22 Kg more subsidised fertilizer and have an increased probability of being targeted by 31 percentage points compared with those in urban areas. These results suggest that households located in rural areas are more likely to be targeted and receive more coupons to redeem subsidised fertilizer than those in urban areas.

The education level of the household head is found to have no statistically significant effects on access to coupons for subsidised fertilizer. Results on regional location of households show that households located in the central region redeem less quantities of subsidised fertilizer and have lower probability of being targeted for the program compared to households located in the southern region.

Table 2.4: Factors determining quantity redeemed and receipt of coupons to purchase subsidised fertilizer.

Explanatory Variables	Dependent Variable: Quantity of subsidised fertilizer (Kg)		Dependent Variable: Received subsidised fertilizer coupon=1	
	Pooled CRE Tobit Model (I)		Pooled CRE Probit Model (II)	
	APE	P-Value	APE	P-Value
MP resident or visit	2.21**	0.020	0.03**	0.017
Household head (Female)	-1.79	0.408	-0.02	0.590
Household head age (years)	0.38***	0.000	0.01***	0.000
Household size	0.04	0.829	-0.002	0.440
Rural location	21.7***	0.000	0.31***	0.000
Household head primary education	-0.64	0.749	-0.004	0.892
Household head secondary education	-5.51*	0.067	-0.07	0.125
Household head tertiary education	-6.33	0.310	-0.07	0.343
Northern	-0.19	0.890	-0.03*	0.067
Central	-9.09***	0.000	-0.09***	0.000
Total land (hectares)	5.64***	0.000	0.07***	0.000
Log real durable asset value (MK)	0.77***	0.000	0.01***	0.005
Log distance to daily market (Km)	0.23	0.677	-0.001	0.903
Year 2013	-10.3***	0.000	-0.16***	0.000
No. of Observations	6172		6172	
F-Statistic/Wald χ^2: Joint sig. of all explanatory variables	46.81***	0.000	702.74***	0.0000
F-Statistic/ χ^2: Joint significance of time averages explanatory variables	4.28***	0.000	83.74***	0.0000
Sigma	74.60			
Log pseudo likelihood	-18961.794		-3841.823	
Correctly classified			66.82 %	

Note: ***, **, * represents statistically significant at 1 %, 5 % and 10 % levels, respectively; CRE represents Correlated Random Effects; Estimations include time averages of time-varying explanatory variables; APE represents average partial effect.

But households with more land and real durable assets value redeem more quantities of subsidised fertilizer and have increased probability of being targeted for the subsidy program. This may suggest that richer households are benefiting more than poor households, contrary to the program design.

2.8.*2. Impact of subsidised fertilizer on farmers' participation in maize market as sellers*

Table 2.5 presents four regression results on the determinants of farmers' participation in maize market as sellers. Models (I), (II) and (III) are presented to check the robustness of the estimates by applying different estimators. Since the results in model (IV) show that the generalised residuals are statistically significant, thus indicating and controlling for the endogeneity of subsidised fertilizer, our discussion in this section will be based on this model's results. In models (I) and (II) we do not control for the unobserved time-invariant household heterogeneity and the results show higher positive effects of subsidised fertilizer on maize market participation and is almost double the effects shown in model (III) using the pooled CRE Probit model. The results show that if we ignore the endogeneity of the subsidised fertilizer, the effects are overestimated. Furthermore, the results in model (IV) on the subsidised fertilizer covariate show slightly higher effects than just controlling for the unobserved time-invariant household heterogeneity in model (III). But the effects are still lower than in models (I) and (II), suggesting the importance of controlling for the unobserved time-invariant household heterogeneity in our estimations.

The results show that subsidised fertilizer is associated with increased probability of selling maize; and for model (IV), an additional kilogram of subsidised fertilizer increases the probability of selling maize by 0.05 percentage point. In other words, the program standard package of 100 kg of subsidised fertilizer increases the probability of maize market participation of farmers as sellers by five percentage points. These results support the notion that improving small farmers'

access to modern farm input technologies could lead to increased productivity and hence improve their market participation as sellers of agricultural produce. This is important to farmers who have limited sources of income and their engagement in marketing of maize could provide them incentives to diversify their income sources and commercialise agricultural activities through usage of the income from maize sales. Income from maize sales could also help the farmers to self-purchase improved farm inputs at commercial prices, which is vital for the sustainability of the subsidy program.

Receiving maize market information through electronic media increases the probability of farmers' maize market participation as sellers by four percentage points. This suggests the importance of information and communication technologies (ICTs) in reducing fixed market transaction costs such as market information searching costs. Growing different types of crops as indicated by the crop diversification covariate also increases the likelihood of selling maize. This may be due to availability of food from other food crops and therefore, enabling households to sell part of their maize produce.

Households with more land and high real durable asset value have higher probabilities of selling maize. An additional hectare of land increases the probability of maize market participation by five percentage points. These results support the notion that household productive resource endowments are a prerequisite for small farmer's market participation in developing countries.

Table 2.5: Regression results of factors determining farmers' maize market participation as sellers (Dependent variable: Binary-Sold Maize)

Explanatory Variables	Pooled Probit Model (I)	Probit RE Model (II)	Pooled CRE Probit (III)	Pooled CRE Probit & CF Residuals(IV)
	APE/SE	APE/SE	APE/SE	APE/SE
Generalised residuals				0.026***
				(0.009)
Subsidised fertilizer (Kg)	0.0007***	0.0006***	0.0003***	0.0005***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Electronic media market information	0.023	0.02*	0.036**	0.035**
	(0.015)	(0.012)	(0.014)	(0.014)
Crop diversification	0.018***	0.016***	0.011***	0.011***
	(0.006)	(0.004)	(0.004)	(0.004)
Household head (Female)	0.004	0.004	0.024	0.024
	(0.012)	(0.01)	(0.021)	(0.021)
Household head age (years)	-0.001***	-0.001***	-0.002**	-0.002**
	(0.0003)	(0.0002)	(0.001)	(0.001)
Household size	-0.009***	-0.008***	-0.017***	-0.017***
	(0.002)	(0.002)	(0.002)	(0.002)
Rural location	0.086***	0.078***	0.055*	0.053*
	(0.02)	(0.015)	(0.03)	(0.031)
Household head primary education	0.029*	0.026**	0.009	0.01
	(0.016)	(0.012)	(0.018)	(0.018)
Household head secondary education	0.05**	0.042***	-0.016	-0.014
	(0.02)	(0.015)	(0.028)	(0.028)
Household head tertiary education	-0.015	-0.01	0.034	0.035
	(0.029)	(0.027)	(0.059)	(0.058)
Northern	0.054**	0.051***	0.054***	0.055***
	(0.023)	(0.012)	(0.014)	(0.014)
Central	0.082***	0.074***	0.06***	0.053***
	(0.015)	(0.01)	(0.011)	(0.011)
Total land (hectares)	0.03***	0.029***	0.047 ***	0.046***
	(0.009)	(0.01)	(0.011)	(0.011)
Log real durable asset value (MK)	0.004***	0.004***	0.004**	0.004**
	(0.002)	(0.001)	(0.002)	(0.002)
Log distance to daily market (Km)	0.014**	0.012***	0.006	0.006
	(0.006)	(0.003)	(0.005)	(0.005)
Constant	0.13***	0.09***		
	(0.008)	(0.007)		
Number of observations	6172	6172	6172	6172
Correctly classified	86.86%		86.78%	86.78%
Wald χ^2 Joint sig. all variables	227.19***	262.99***	2380.71***	2369.06***
χ^2 Joint sig. time averages variables			67.62***	57.13***

Note: ***, **, * represents statistically significant at 1 %, 5 % and 10 % levels, respectively; CRE(Correlated Random Effects) estimations of models (III) and (IV) include time averages of time-varying explanatory variables; APE=average partial effect; SE=standard errors; MK=Malawi Kwacha; Km=Kilometres; CF=Control Function; Controls include Year 2013 dummy.

2.8.3. Impact of subsidised fertilizer on quantity sold of maize

Regression results on factors influencing the quantity of maize sold by farmers for models (I), (II), (III) and (IV) are presented in Table 2.6. Results for models (I), (II) and (III) are presented for robustness assessment of the estimates. Model (IV) results show that the generalised residuals are statistically significant and this indicates that subsidised fertilizer is endogenous. Therefore, the inclusion of the generalised residuals controls the endogeneity effects of subsidised fertilizer. The discussion in this section will focus on the results of this model. In all the four models we control for the unobserved time-invariant household heterogeneity. Model (I) is the pooled CRE Tobit with the generalised residuals from the reduced form pooled CRE Tobit model for subsidised fertilizer to test and control for its potential endogeneity. Model (II) is the pooled CRE OLS model which include the inverse mills ratio (IMR) from the pooled CRE Probit model on market participation and the generalised residuals from the reduced form pooled CRE Tobit model for subsidised fertilizer. Since these two additional variables are both statistically significant in this model, this suggests that the allocation of coupons for subsidised fertilizer is endogenous and there is sample selection bias. The inclusions of the generalised residuals and the IMR as additional covariates in estimations addresses these problems. Models (III) and (IV) are pooled Double Hurdle CRE and the difference between the two is that in model (IV) we include the generalised residuals from the reduced form pooled CRE Tobit model for subsidised fertilizer to test and control for its potential endogeneity.

Overall, the results show positive effects of subsidised fertilizer on quantity of maize sold. If endogeneity is not controlled for, the results on the subsidised fertilizer covariate for the model (III) are relatively of higher magnitude compared with results for model (IV). However, these

results are of slightly lower magnitude in comparison to those of the pooled Tobit CRE Model and the pooled OLS CRE Model with generalised residuals.

Results for model (IV) suggest that on average, an additional kilogram of subsidised fertilizer increases quantity of maize sold by 0.15 per cent. Considering the standard FISP fertilizer package of 100 kg, this means that on average an additional 100 kg of the program subsidised fertilizer increases quantity sold of maize by 15 per cent. These results suggest that maize market supply can significantly increase with the usage of improved farm inputs by small farmers to the benefit of maize net buyers and non-farmers. However, the low magnitude of effect of subsidised fertilizer on maize market supply might be the explanation of the minimal effects it has had on retail maize prices in Malawi and Zambia (Ricker-Gilbert et al., 2013) and on grain prices in Nigeria (Takeshima and Liverpool-Tasie, 2015). Furthermore, an income from such a small quantity of maize sold seems unlikely to enable subsidy beneficiary households to self-finance future purchases of fertilizer and improved seeds at commercial prices and consequently, cast doubt on the sustainability of the program in the absence of other sources of households' income and the claim that this policy is 'market smart'. These results also highlight the challenge of improving smallholder farmers' income through sales of staple food crops. Therefore, this calls for promotion of diversified sources of income for smallholder farmers in order to improve both household food and income security.

The results suggest that large household size has negative effects on quantity of maize sold. This is expected because households with bigger household size have to commit more quantity of maize to consumption. Regional covariates have the expected effects. Households located in the northern and central region sell more quantity of maize than those located in the southern region. This effect is due to regional differences in climatic conditions, which affects maize production.

Northern and central regions are considered important maize producing regions compared to the southern region.

Household resource endowment plays a significant role in maize market supply, especially landholding size, and the results show that an additional hectare of land increases quantity of maize sold by 24 per cent. Households with more durable assets also sell more quantity of maize, which suggest the effects on production levels. Rural location of households is associated with more quantity of maize sold. This is expected since most rural households have limited non-farm sources of income and therefore, their households income depend more on crops sales compared with those in urban areas. Since more land is relatively allocated for maize production for most small farmers, relatively more quantity of maize is sold to meet household income demand.

However, we find no evidence of effects of the level of education or gender of the household head and distance to daily market on quantities of maize sold. This may suggest that the maize market is already well integrated, such that access to information on marketing is not dependent on education level of the household head and maize market is accessible to both male and female headed households. This may be due to the presence of small private traders in maize markets, who buy maize directly from small farmers, and consequently reducing transportation costs for the farmer due to long distance to central markets.

Table 2.6: Regression results of factors determining farmers' maize quantity sold (Dependent variable: Quantity of Maize sold in Log Kg)

Explanatory Variables	Pooled Tobit CRE Model With CF Residuals (I)	Pooled OLS CRE Model With IMR and CF Residuals (II)	Pooled Double Hurdle CRE Model (III)	Pooled Double Hurdle CRE with CF Residuals (IV)
	APE/SE	APE/SE	APE/SE	APE/SE
Generalised residuals	0.173***	0.219***		0.132***
	(0.056)	(0.075)		(0.044)
Inverse Mills Ratio (IMR)		1.677***		
		(0.118)		
Subsidised fertilizer (Kg)	0.0029***	0.0023**	0.0017**	0.0015**
	(0.0008)	(0.0011)	(0.0007)	(0.0007)
Household head (female)	0.152	0.408**	0.149	0.148
	(0.124)	(0.189)	(0.121)	(0.121)
Household head age (years)	-0.009**	-0.005	-0.007*	-0.006*
	(0.004)	(0.006)	(0.004)	(0.004)
Household size	-0.098***	-0.05**	-0.039***	-0.037***
	(0.013)	(0.017)	(0.009)	(0.010)
Rural location	0.35*	0.045	0.225	0.232*
	(0.183)	(0.284)	(0.152)	(0.141)
Household head primary educ.	0.061	0.024	0.031	0.031
	(0.111)	(0.2)	(0.108)	(0.108)
Household head secondary ed.	-0.087	0.025	-0.081	-0.082
	(0.168)	(0.265)	(0.143)	(0.151)
Household head tertiary educ.	0.214	0.305	0.137	0.138
	(0.357)	(0.556)	(0.327)	(0.338)
Northern	0.314***	0.487***	0.275***	0.281***
	(0.083)	(0.094)	(0.072)	(0.069)
Central	0.351***	0.816***	0.454***	0.423***
	(0.065)	(0.091)	(0.054)	(0.053)
Total land (hectares)	0.323***	0.495***	0.241***	0.244***
	(0.065)	(0.108)	(0.054)	(0.058)
Log real durable asset MK	0.027**	0.042*	0.022*	0.022*
	(0.012)	(0.022)	(0.011)	(0.012)
Log distance to daily Km	0.027	0.118***	0.002	0.002
	(0.033)	(0.042)	(0.002)	(0.002)
Number of observations	6172	804	6172	6,172
Log pseudo likelihood	-4132.75	-3361.576	-3232.842	-3231.367
Wald χ^2/F-Stat.: Joint sig. (all)	44.25***	870.13***	193.13***	210.90***
Sigma	6.41		0.898	0.898
F-Stat: Joint sig. time averages	6.14***		46.73***	46.10***
Pseudo R-square /R-square		0.96	0.0902	0.0906

Note: ***, **, * represents statistically significant at 1 %, 5 % and 10 % levels, respectively; CRE(Correlated Random Effects) estimations include time averages of time-varying explanatory variables; APE=average partial effect; SE= standard errors; MK=Malawi Kwacha; Km=Kilometres; CF=Control Function; Controls include Year2013 dummy.

2.8.4. Impact of subsidised fertilizer on commercialisation index of maize (i.e. ratio of quantity sold to quantity harvested).

We present regression results of models (I), (II), (III) and (IV) on factors determining commercialisation of maize in Table 2.7. Results for models (I), (II) and (III) are presented to check the robustness of the estimates and refer to the preceding two sections for a discussion on the generalised residuals. Therefore, this section's discussion will focus on the results of model (IV).

Subsidised fertilizer has positive effects on commercialisation of maize and an additional kilogram of subsidised fertilizer increases the commercialisation index of maize by 0.01 per cent. Considering the program standard package, an additional 100 kg of subsidised fertilizer increases the commercialisation index of maize by one per cent. This suggests subsidised fertilizer has marginal effects on maize commercialisation and maize remains a crop which is produced mainly for subsistence at household level even when farmers purchase subsidised production inputs. The small magnitude of effect shows that the level of maize production at household level is likely in many cases to be lower than that required to meet household food demand before which a marketable surplus is produced. Since FISP is targeting small farmers, the question is whether this is an appropriate strategic group of farmers to be targeted if the objective is to increase maize market supply and consequently, reduce maize prices to the benefit of maize net buyers and non-farmers.

Table 2.7: Regression results of factors determining farmers' maize commercialisation (Dependent variable: Commercialisation Index of Maize)

Explanatory Variables	Pooled OLS Model (I)	Linear RE Model (II)	Pooled CRE Fractional Probit Model (III)	Pooled CRE Fractional Probit Model with CF (IV)
	APE/SE	APE/SE	APE/SE	APE/SE
Generalised residuals				0.005*
				(0.003)
Subsidised fertilizer Kg	0.00014***	0.00013***	0.00004	0.00011**
	(0.00003)	(0.00003)	(0.00005)	(0.00004)
Household head (Female)	-0.001	-0.0003	0.004	0.004
	(0.003)	(0.003)	(0.007)	(0.007)
Household head age (years)	-0.0004***	-0.0004***	-0.001**	-0.001**
	(0.0001)	(0.0001)	(0.0003)	(0.0003)
Household size	-0.002***	-0.002***	-0.005***	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)
Rural location	0.015***	0.015***	0.001	-0.0002
	(0.004)	(0.004)	(0.009)	(0.009)
Household head primary educ.	0.002	0.002	0.004	0.004
	(0.004)	(0.004)	(0.008)	(0.008)
Household head secondary ed.	0.015***	0.014**	0.002	0.003
	(0.006)	(0.006)	(0.01)	(0.01)
Household head tertiary educ.	0.0002	0.0000	0.002	0.003
	(0.008)	(0.008)	(0.018)	(0.018)
Northern region	0.013***	0.013***	0.016**	0.016**
	(0.004)	(0.004)	(0.007)	(0.008)
Central region	0.016***	0.016***	0.008*	0.006
	(0.003)	(0.003)	(0.005)	(0.005)
Total land (hectares)	0.017***	0.017***	0.015***	0.014***
	(0.004)	(0.004)	(0.005)	(0.005)
Log real durable assets value	0.001***	0.001***	0.001	0.001
	(0.0004)	(0.0004)	(0.001)	(0.001)
Log distance to daily market	0.003**	0.003***	-0.001	-0.001
	(0.001)	(0.001)	(0.002)	(0.002)
Year 2013 dummy	-0.007***	-0.007***	-0.016***	-0.015***
	(0.003)	(0.003)	(0.003)	(0.003)
cons	0.004	0.005		
	(0.007)	(0.007)		
Number of observations	6172	6172	6172	6172
F-Stat./Wald χ^2 : Joint sig.	9.58***	131.62***	3610.27***	3610.32***
χ^2: Joint sig. time averages			104.00***	92.12***
Log pseudo likelihood			-744.49	-741.75
R-square	0.04			

Note: ***, **, * represents statistically significant at 1 %, 5 % and 10 % levels, respectively; CRE (Correlated Random Effects) Estimations of models (III) and (IV) include time averages of time-varying explanatory variables; APE represents average partial effect; SE represents standard errors; MK=Malawi Kwacha; Km=Kilometres; CF=Control Function.

Age of the household head and household size covariates have negative effects on maize commercialisation, although the magnitudes of the effects are also very small. Landholding size has the expected positive effects where an additional hectare of land is estimated to increase the maize commercialisation index by one percent. Such a small magnitude of effect also corroborates the earlier conjecture that maize is mainly produced by farm households for consumption in Malawi.

2.8.5. Impact of repeated benefit to subsidised fertilizer on market participation as seller, quantity sold and commercialisation index of maize.

Overall, the results in sections 2.8.2 - 2.8.4 show that use of subsidised fertilizer increases small farmers' participation in maize markets as seller, quantities they sell and commercialisation of maize. However, regression results in Table 2.8 on the effects of repeated benefit to subsidised fertilizer on the decision to sell maize, quantity sold and commercialisation of maize show that overall has no statistically significant effects. This may suggest that repeated benefit to subsidised fertilizer has marginal effects on maize production. These results also underscores the premise that for staple food crops, which are produced mainly for subsistence, marginal increase in production may not lead to subsequent increase in small farmers' market participation as sellers, quantities sold and commercialisation of the produced crops.

Table 2.8: Regression results of factors determining farmers' maize market participation as sellers, quantity of maize sold (Kg) and Commercialisation Index of maize

Explanatory Variables	Pooled CRE Probit (I)	Pooled CRE Double Hurdle Model (II)	Pooled CRE Fractional Probit Model (III)
	APE/SE	APE/SE	APE/SE
One-time benefit to subsidy	0.02	0.12	0.01
	(0.02)	(0.15)	(0.01)
Two-times benefit to subsidy	0.05	0.24	0.01
	(0.03)	(0.18)	(0.01)
Three-times benefit to subsidy	-0.004	-.01	0.001
	(0.03)	(0.18)	(0.01)
Four-times benefit to subsidy	0.03	0.20	-0.003
	(0.04)	(0.23)	(0.02)
Five-times benefit to subsidy	0.08**	0.49*	0.02
	(0.04)	(0.28)	(0.02)
Household head (Female)	0.02	0.15	0.004
	(0.02)	(0.12)	(0.01)
Household head age (years)	-0.001**	-0.01	-0.001*
	(0.001)	(0.004)	(0.0003
Household size	-0.01***	-0.04***	-0.002***
	(0.002)	(0.01)	(0.001)
Rural location	0.07*	0.24**	0.004
	(0.04)	(0.12)	(0.01)
Northern	0.05***	0.28***	0.1*
	(0.01)	(0.08)	(0.1)
Central	0.08***	0.42***	0.2***
	(0.01)	(0.06)	(0.004)
Total land (hectares)	0.05 ***	0.24***	0.01***
	(0.01)	(0.07)	(0.005)
Log real durable asset value (MK)	0.004**	0.02*	0.001
	(0.002)	(0.01)	(0.001)
Log distance to daily market (Km)	0.01	0.002	0.0002
	(0.01)	(0.002	(0.002)
Year 2013 dummy	-0.02	-0.10*	-0.01**
	(0.01)	(0.06)	(0.004)
Electronic media market information	0.02*		
	(0.01)		
Crop diversification	0.02***		
	(0.004)		
Number of observations	6172	6172	6172
Correctly classified	86.88%		
Wald χ^2 Joint sig. all variables	2710.70***	562.52***	
χ^2 Joint sig. time averages variables	32.78 ***	246.27***	
Log pseudolikelihood	-2174.50	-3243.41	-685.08

Note: ***, **, * represents statistically significant at 1 %, 5 % and 10 % levels, respectively; controls include education covariates.

2.9 Conclusion and policy implications

Farm input subsidy programs have enjoyed a resurgence in sub-Saharan Africa as a policy tool for addressing the problems of food insecurity and poverty by improving agricultural production and productivity. Much of this renewed interest has been promoted under the guise of 'Market Smart' policies designed to kick start market engagement by small farmers in rural areas with a view to increasing the volume of trade and promoting private sector market activity in order to both generate static and dynamic efficiency gains.

This study has estimated the effects of farm input subsidies on the marketing of maize in Malawi using the nationally representative two-wave Integrated Household Panel Survey (IHPS) data of 2010 and 2013 for Malawi, which also collected information on the farm input subsidy program of 2009/2010 and 2012/2013 agricultural seasons. However, due to small number of households in the panel sample who grew and sold other cereal and legume crops apart from maize, this study has been unable to analyse the effects of the subsidised fertilizer program on the overall household food crops marketing. But since maize is the main target crop in the FISP, the empirical analyses on the effects on maize marketing are equally more important. Moreover, the less than uniform manner in which the Government of Malawi has been distributing input subsidy coupons to households has allowed us to investigate the effect of the program within a pseudo experimental setting.

After controlling for the endogeneity of subsidised fertilizer, the empirical results suggest that subsidised fertilizer increases the probability of selling, quantity sold and the commercialisation index of maize. Based on these empirical results, this Chapter suggests several policy implications and avenues for improvements of the farm input subsidy program. First, these results highlight the

challenge of increasing household income from staple food crop sales when the households' priority for producing such crops is subsistence. Consequently, this cast doubt on the sustainability and success of the program's objective to achieving household food security and increasing household income from food crop sales concurrently. This is due to the fact that for most small farmers food crops are mainly produced for household consumption. Therefore, apart from food crops, the program improvement should include targeting the same households with subsidised coupons for market oriented crops such as cotton, legumes and other high value food crops. Production of market oriented crops in addition to staple maize could be strategic to farmers with relatively adequate land and they can use income from sales of these crops to finance future farm input purchases at commercial prices and sustainably exit from the subsidy program.

Second, the positive effects on maize market participation, quantity sold and commercialisation index suggest that increasing crop productivity should be the main strategy to increase maize market supply. Therefore, complementary interventions to subsidised fertilizer are critical. Such interventions include use of conservation agricultural technologies and recommended crop husbandly practices.

Third, designing programs to suit climatic conditions of specific regions may be more beneficial than the standard program for all regions. Despite maize being the staple food for the majority of the population, some districts are not suitable for its production, such as Lower Shire Valley and mountainous districts in the southern region. Therefore, programs focusing on other interventions and types of crops might have more positive effects on households' income.

Fourth, the small magnitude of effects of landholding size on commercialisation of maize suggests that maize is not considered a viable commercial crop by farm households. This may have

implication on household resource allocation, where more resources may be located to cash than food crops in order to make profit and increase household income at the expense of food crops production. The political intervention in the marketing of maize in Malawi, in which the government ban exportation of maize during acute food shortage months or when estimates show national food deficit, might have contributed to the commercial unviability of maize.

Overall, the results in this chapter suggest that the input subsidy program, as implemented in Malawi, has contributed toward an increased level of maize market engagement for some farm households within the sample. In this sense, the policy has the potential to provide the wider external benefits espoused by the proponents of 'Market Smart' policies. It remains to be seen whether this policy can deliver reduced transactions costs and risks and allow the private sector to take over the delivery of inputs at a price small farmers can benefit from in the future. Further research is also suggested on the effects of subsidised fertilizer on maize market participation and quantity sold and bought by maize net sellers and buyers, respectively; and effects on other cereal and legume crops.

Appendix 2.A

Table 2.A.1: Regression results of factors determining farmers' maize market participation as sellers, quantity sold and commercialisation of maize

Explanatory Variables	Sold Maize	Quantity Sold (Log-Kilogram)	Commercialisation Index
	Pooled CRE Probit Model (I)	Pooled CRE Double Hurdle Model (II)	Pooled CRE Fractional Probit Model (III)
	APE/SE	APE/SE	APE/SE
MP residence or visit in the community	0.01	0.04	0.01
	(0.01)	(0.08)	(0.01)
Household head (Female)	0.02	0.12	0.004
	(0.02)	(0.11)	(0.01)
Household head age (years)	-0.001**	-0.01*	-0.001**
	(0.001)	(0.003)	(0.0002)
Household size	-0.01***	-0.04***	-0.01***
	(0.002)	(0.001)	(0.001)
Rural location	0.07*	0.24*	0.001
	(0.03)	(0.14)	(0.01)
Household head primary education	0.01	0.02	0.004
	(0.02)	(0.11)	(0.01)
Household head secondary education	-0.02	-0.09	0.002
	(0.03)	(0.14)	(0.01)
Household head tertiary education	0.03	0.14	0.003
	(0.06)	(0.32)	(0.02)
Northern	0.05***	0.29***	0.02**
	(0.01)	(0.07)	(0.01)
Central	0.08***	0.41***	0.01
	(0.01)	(0.05)	(0.01)
Total land (hectares)	0.05***	0.23***	0.01***
	(0.01)	(0.05)	(0.01)
Log real durable asset value (MK)	0.004**	0.02**	0.001*
	(0.002)	(0.01)	(0.001)
Log distance to daily market (Km)	0.01	0.002	-0.001
	(0.01)	(0.002)	(0.002)
Electronic media market information	0.03*		
	(0.01)		
Crop diversification	0.02***		
	(0.004)		
Number of observations	6172	6172	6172
Correctly classified	86.89%		
Wald χ^2 Joint sig. all variables	2687.12***	195.46***	2369.06***
χ^2 Joint sig. time averages variables	19.83**	42.56***	94.52***
Log pseudolikelihood/Log likelihood	-2200.62	-3271.88	-750.69

Note: ***, **, * represents statistically significant at 1 %, 5 % and 10 % levels, respectively; CRE(Correlated Random Effects) estimations of all models include time averages of time-varying explanatory variables; APE=average partial effect; SE=bootstrap standard errors (500 replications); MK=Malawi Kwacha; Km=Kilometres; ; Controls include Year 2013 dummy.

Chapter 3

THE IMPACT OF FARM INPUT SUBSIDIES ON HOUSEHOLD WELFARE

3.1 Introduction

Most smallholder farmers in developing countries are subsistence oriented, cultivating food crops mainly for household consumption and growing a small proportion of cash crops to meet non-food household needs. Furthermore, 75 per cent of rural people in developing countries are poor and food insecure, and therefore, improvement of agricultural production is the main strategy to reduce rural poverty and food insecurity (World Bank, 2007). Among several factors that impede such a livelihood strategy is the low use of improved farm inputs in crop production, especially fertilizer and hybrid seeds (Morris et al., 2007). Druilhe and Barreiro-Hurle (2012) argue that with low household incomes and limited income sources most smallholder farmers, especially in Africa, are unable to self-finance the purchase of adequate improved farm inputs to produce enough food and cash crops to meet household food and income security requirements. In order to promote the use of fertilizer and hybrid seeds, subsidies are one of the most pervasive policy instruments used by most governments in developing countries (World Bank, 2007).

Prior to the implementation of structural adjustment and stabilization programs in the 1980s and early1990s, which were promoted by the World Bank and the International Monetary Fund (IMF), most governments in sub-Saharan Africa (SSA) implemented farm input subsidies, which were phased out to conform to the agreements with the World Bank and IMF (Druilhe and Barreiro-Hurle, 2012; Morris et al., 2007). However, in recent years, many countries in SSA have reintroduced these subsidies, including Malawi (DANIDA, 2011; Druilhe and Barreiro-Hurle, 2012; Ricker- Gilbert et al., 2013).

Recent studies on the reintroduced farm input subsidies in SSA have focused on their direct and general equilibrium impact. Direct impact studies include effects on: (i) maize output (Chibwana, et al., 2010; Dorward et al., 2013; Holden and Lunduka, 2010; Ricker-Gilbert and Jayne, 2011;); (ii) input markets (Chibwana et al., 2010; Ricker-Gilbert, et al., 2011; Xu, et al., 2009); (iii) land allocation (Chibwana, et al., 2012; Holden and Lunduka, 2010) and (iv) household welfare, including food security (Dorward and Chirwa, 2011); income from crops production, livestock and asset worth (Ricker-Gilbert and Jayne, 2011; 2012); school attendance, health, household shocks and stress (Chirwa, et al., 2013). Studies investigating general equilibrium effects have focused on maize prices, GDP and agricultural sector growth (Chirwa et al., 2013; Ricker-Gilbert et al., 2013; Takeshima and Liverpool-Tasie., 2015).

The Malawi Government reintroduced a large scale farm input subsidy program since the 2005/06 agricultural season and use it as a policy tool to improve maize production, productivity, food security and household income from crop sales. However, despite the implementation of the program, food insecurity and poverty are still wide-spread among smallholder farmers. This raises doubts about the effectiveness and sustainability of the program. Recent studies show that poverty rate has only decreased by two percent from 52.4 percent in 2004/05 to 50.7 percent in 2010/2011 (GoM, 2012b). A comparison of household food security during the same period shows slight improvement. According to the GoM (2005; 2012b), 57 percent of households subjectively assessed themselves to be food insecure in 2004/2005, while in 2010/2011, 42 percent felt food insecure.

As mentioned previously, a number of studies have been carried out on the impact of farm input subsidies, however, there are still gaps in the literature on their effects on household welfare. Since farm input subsidies increase the purchasing power of beneficiaries, they may have direct household welfare effects, which may affect households' annual consumption expenditure and food security. These effects have not been fully analysed in the previous

studies. Chirwa et al., (2013); Dorward and Chirwa (2011); Ricker-Gilbert and Jayne (2011, 2012) are four recent studies which analyse the effects of fertilizer subsidizes on household welfare. However, the current study estimates the effect of input subsidies on a different set of household welfare indicators.

The main objective of this study is to estimate the effects of fertilizer subsidy on household food security and consumption expenditure in Malawi, based on the nationally representative two-wave Integrated Household Panel Survey (IHPS) data of 2010 and 2013. Specifically, the study aims to: (i) assess the impact of subsidised fertilizer on kilocalories available per capita per day and number of household food secure months; (ii) assess the impact of subsidised fertilizer on household food security status; (iii) assess the impact of subsidised fertilizer on annual per capita consumption expenditure; (iv) assess the heterogeneous impact of subsidised fertilizer on household food security and consumption expenditure; and (v) assess the impact of repeated benefit to fertilizer subsidies on household food security and consumption expenditure.

Differently from previous studies, which use subjective self-assessment food security indicators (Chirwa et al., 2013; Dorward and Chirwa, 2011; and Dorward et al., 2013), this study empirically quantifies the effects of subsidised fertilizer on household food security by calculating household calorific requirements and the kilocalories available from own cereals and legumes production. This helps to more accurately determine annual household food security status and the number of household food secure months for smallholder farmers who are mainly subsistence farmers. Furthermore, this study uses total annual per capita consumption expenditure as a proxy for household income, which is the indicator that is used in calculating poverty in the World Bank Living Standards Measurement Study-Integrated Surveys on Agriculture (LSMS-ISA) Project. Consequently, examining the effects of farm input subsidies using this indicator provides direct estimates on poverty alleviation

implications, which is important for developing countries since one of the objectives of implementing farm input subsidies is to reduce poverty.

The next section of the study presents an overview of agricultural policy reform in Malawi. A review of empirical studies on the impact of farm input subsidies in the post-structural adjustment period is discussed in section three. The conceptual and empirical strategy is included in section four. Section five presents the empirical model. Data source, descriptive statistics and endogeneity tests are discussed in section six. The discussion of empirical results is incorporated in section seven and section eight concludes.

3.2 An overview of agricultural reforms in Malawi

Malawi's population is predominantly rural, with 85 per cent living in rural areas. Agricultural activities are the main livelihood strategy. The reliance on agriculture by 80 per cent of the labour force makes it a strategic sector in addressing food insecurity and poverty at household and national levels. The agricultural sector is also considered as the main engine of economic growth through its contribution to about 30 per cent of gross domestic product (GDP) and 75 per cent of foreign exchange income (GoM, 2012).

Farm structure in Malawi is divided into two sub-sectors - the estate and the smallholder. The estate sub-sector is mainly involved in the production of high value crops for the market, while the smallholder sub-sector is mainly involved in subsistence farming (Chirwa et al., 2008; GoM, 2011). Due to the economic importance of agriculture, the government uses agricultural policies as the main tool to achieve economic growth and alleviate poverty (GoM, 2011).

Several policy reforms have taken place in the agricultural sector since independence. Chirwa et al., (2008) categorize agricultural policies into three periods: pre-reform, reform and post-reform. During the pre-reform period (between 1964 and 1979), the focus on the smallholder sector was to increase agricultural production and productivity, mainly for maize, in order to meet food security requirements at household and national levels, and generate cash income. The government used a range of policy instruments including input subsidies, and assessment of the performance of agriculture during this period provides evidence of improved crop production and productivity, mainly for maize, and better food security (Chirwa et al., 2008).

The reform period, between 1980s and early 1990s, followed the implementation of structural adjustment and stabilization programs, promoted by the World Bank and IMF. Agricultural policy reforms during this period involved liberalization of prices and marketing of agricultural commodities; and phasing out fertilizer subsidies. Agricultural performance assessment during this period suggests poor crop yields and severe food shortages among smallholder farmers (Chirwa et al., 2008). These negative developments have been mainly attributed to the low use of fertilizer due to the higher prices after the removal of fertilizer subsidies and the low access to agricultural credit by smallholder farmers (World Bank, 2003).

The post-reform period, which is the period from 1995 to to-date, has also experienced several agricultural policy reforms. They include the introduction of an input subsidy program from 1998/99-1999/2000 agricultural seasons called Starter Pack Scheme (SPS), which was later scaled-down and changed into Targeted Input Program (TIP) (2000/01-2004/05 agricultural seasons) (Harrigan, 2003; Levy, 2005). Beneficiaries to these programs were smallholder farmers and each received 15 kg of fertilizer and 2 kg of maize seed to cultivate a 0.1 hectare (ha) of crop area (Levy, 2005).

The impact evaluations (Levy, 2005; Levy and Barahona, 2002) suggest that these programs contributed to increased production of maize and promoted food security. However, implementation shortfalls and the perceived fiscal burden had led to criticism by donors (Harrigan, 2008; Levy, 2005). This was followed by the scaling down of the TIP in 2004/2005 agricultural season. This season was characterized by poor rainfall and resulted into low agricultural yields and severe food shortage (Levy, 2005). In order to address these challenges, in the 2005/06 agricultural season the government reintroduced a large scale Malawi Farm Input Subsidy Program (MFISP), which was later renamed Farm Input Subsidy Program (FISP), with the aim of improving smallholder farmers' crop production, productivity, food security and income from crop sales (Dorward and Chirwa, 2011).

The FISP beneficiaries are selected based on the following indicators: farm households which are classified as poor and cannot manage to self-finance purchases of improved farm inputs such as fertilizer and hybrid seeds at commercial prices; households headed by the elderly or females; households with agricultural land and are permanently resident in the village (Lunduka et al., 2013). For the 2012/2013 agricultural season FISP, the selected household was expected to receive a standard package of four coupons to be used to redeem two 50 kg bags of fertilizer (for NPK and Urea); one pack of improved maize seed (5 kg if hybrid or 8 kg if open pollinated variety); and one legume pack (Dorward, et al., 2013).

3.3 The impact of farm input subsidies in the post-structural adjustment period: a review of previous studies

As mentioned previously, there are several studies investigating the impact of the reintroduced farm input subsidies in sub-Saharan Africa (SSA). Concerning crop output effects, studies have found statistically significant and positive effects on maize production and productivity in

Malawi. Ricker-Gilbert and Jayne (2011) find that an additional kg of subsidised fertilizer increases maize production by 1.82 kg in the first year and 3.16 kg in the third year of using subsidised fertilizer. Similar results are found in a study by Mason et al. (2013) who analyse the effects of subsidised fertilizer on maize production in Zambia and find that an additional kg of subsidised fertilizer increases maize production by 1.88 kg.

Analysing maize yield response, Chibwana et al. (2010) find that using subsidised fertilizer only increases maize yield by 249 kg per hectare, while using both subsidised hybrid maize seeds and fertilizer increases maize yield by 447 kg per hectare. Dorward et al. (2013) evaluate the 2012/2013 FISP. Based on simulation results they report that a full FISP package increases maize production by at least 500 kg, while only a 50 kg bag of subsidised fertilizer or together with hybrid maize seed increases maize production between 200 kg and 400 kg. Clearly, all these studies indicate improved food availability due to the use farm input subsidies.

Studies on the household welfare effects of farm input subsidies in Malawi, using subjective self-assessment indicators, all find improvement in adequacy of food availability at household level (e.g. Chirwa et al., 2013; Dorward and Chirwa, 2011; Dorward et al., 2013). Concerning income and poverty, a study by Ricker-Gilbert and Jayne (2011) reveals that on average an additional kg of subsidised fertilizer increases farm net crop income by US$1.16, but there is no evidence of effects on asset worth. Ricker-Gilbert and Jayne (2012) also investigate the effect on crop income by employing a quantile regression model. They find that subsidised fertilizer results in increased crop income in richer households (those at the top percentiles) and lack of statistically significant effect on poor households. Chirwa et al. (2013) analyse the effects of farm input subsidies on poverty, primary school enrolment and sickness of under-five year old children and they report an overall increase in primary school enrolment and reduced probability of having sick under-five year old children, but this study finds no

statistically significant effects on the subjective self-assessed poverty at household level. Dorward et al. (2013) find no significant differences in school attendance, sickness of a household member or of and under-five year old children based on the number of times of receipt of subsidies.

The effects of farm input subsidies on input market has also been analysed by several researchers. Ricker-Gilbert et al. (2011) and Mason and Ricker-Gilbert (2013) find that an additional kg of subsidised fertilizer and hybrid maize seed in Malawi crowd-out commercial purchases by 0.22 kg and 0.58 kg, respectively. A similar effect of crowding-out of commercial fertilizer is reported in a study by Chirwa et al. (2013), who find a decrease in purchase of commercial fertilizer of between 0.15 per cent and 0.21 per cent for a 1 per cent increase in subsidised fertilizer. However, Xu et al, (2009) find both crowding-out and crowing-in effects on commercial fertilizer purchases in Zambia.

Other recent studies are on equilibrium effects focusing on food prices and macroeconomic indicators. Ricker-Gilbert et al. (2013) find small effects on maize prices in Malawi and Zambia. Similar results are found by Takeshima and Liverpool-Tasie (2015) in Nigeria. These results suggests that the benefit of farm input subsidies to net food grain buyers through reduced prices is marginal.

This short literature review indicates relatively consistent positive direct effects on beneficiaries although their implications for commercial transactions are questionable. Farm input subsidies help improve the purchasing power of beneficiaries. However, the level of incremental benefit may differ among beneficiaries depending on their economic characteristics. The poor who could not afford to purchase improved inputs at all without subsidies is expected to benefit more from the program than a non-poor beneficiary.

For the poor, the direct benefit arises from either selling the received coupons for subsidised purchases or buying the inputs and using them in production (SOAS, 2008). The use of improved farm inputs is expected to lead to three positive effects: increased yields that could result in improved food security; increased market participation of poor farmers as sellers and, therefore, increased farm income from crop sales; and reduced market participation as buyers of food crops resulting in savings of household cash income. The cash income from sales and the income savings from purchased food could be invested in farming or in non-agricultural enterprises, and or used to increase the consumption of non-food commodities. If the savings are invested in farming, this could lead to a further increase in purchases of farm inputs in subsequent agricultural seasons and boost of future agricultural production. Purchase of durable assets and consumption of food and non-food commodities could lead to reduced poverty levels and possibly to increased investment in human, social and physical capital - essential for future sustainable production and smooth exit from subsidy programs.

Similarly, the direct impact of farm input subsidies on non-poor beneficiaries could be through direct savings on purchases of farm inputs and or through the purchase of additional farm inputs due to the increased purchasing power. However, FISP can also lead to a displacement of commercial fertilizer purchases by non-poor beneficiaries which may undermine the development of the private input traders.

Based on the above review, four hypotheses are formulated and will be tasted in this study:

Hypothesis 1: There is a positive relationship between FISP and household food security.

Hypothesis 2: There is a positive relationship between FISP and household consumption expenditure.

Hypothesis 3: The poorer and less food secure a household is, the higher the incremental effect of FISP is.

Hypothesis 4: Repeated benefit to FISP increases the magnitude of the effect on food security and household consumption expenditure.

3.4 Households food security and consumption expenditure indicators

In order to test these hypotheses, the study focuses on two household welfare indicators: food security and consumption expenditure.

For food security, the main indicator used are the kilocalories available per capita per day. We have constructed it by adding up the kilocalories available from cereals and legumes grown by the household and dividing them by the household adult equivalent. The food security proxies of household food security status (secure or insecure) and the number of household food secure months are determined by comparing the household calorific requirements and the kilocalories available from own crop production (cereals and legumes). For this comparison, the recommended daily requirements per adult equivalent of 2,100 kilocalories per day and the Tanzanian Food Composition Tables of calorific content of food commodities are used (Lukmanji et al., 2008).

The focus is on household produced cereals and legumes because most farmers in developing countries produce food crops for subsistence. Furthermore, cereals contribute to about 54 percent of kilocalories in developing countries, while in Asia and Africa they account for about 70 percent of energy intake (Kearney, 2010). The inclusion of legumes makes the combined kilocalories contribution from own production much larger. The use of produced cereals and legumes in calculating proxies of household food security indicators for small

farmers chosen in this study provides more realistic measures of available food, covering the whole year, compared to the use of subjective and self-assessment indicators such as in Chirwa et al. (2013) and Dorward and Chirwa (2011), in which food consumed may actually be below the recommended daily intake during lean food supply periods of the year. The lack of information on quantities of food accessed through purchases and other sources that supplements households' own production means that we underestimate the household annual food supply. The only available information in the data used in this study is on the food quantities consumed at household level from all sources, but the information covers a recall period of only seven days. This information is considered inadequate in this study to estimate household annual food security.

Furthermore, we have not included roots and tubers such as cassava and potatoes in the calculations of household available calories from own household production despite being main sources in some districts in Malawi. This is because of the perceived high measurement errors in estimating quantities harvested since most of the time roots and tubers are harvested when they are required for consumption or for sell. As such, these crops remain unharvested if not required, which may greatly contribute to measurement errors in calculation of total harvests and therefore, available kilocalories.

Concerning consumption expenditure, the aggregate household consumption expenditure is determined by summing up household consumption expenditure on food, non-food, durable goods and housing covering a period of one year (GoM, 2012b; NSO, 2014b). The food consumption expenditure component is comprised of all food items which were consumed in the household based on a recall period of seven days (i.e. the last seven days preceding the survey) and from all sources. The calculated consumption expenditure is then converted into an annual value. In order to take into account only food that was consumed at household level in the calculation of food consumption expenditure, only food items which were actually

consumed were included in the calculations instead of the total food purchases and household own total produced food (GoM, 2012b; NSO, 2014b).

The survey collected consumption information on a total of 124 food items, which were grouped into eleven food categories of: (i) cereals, grains and cereals products; (ii) roots, tubers and plantains; (iii) nuts and pulses; (iv) vegetables; (v) meat, fish and animal products; (vi) fruits; (vii) cooked food from vendors; (viii) milk and milk products; (ix) sugar, fats and oil; (x) beverages; and (xi) spices and miscellaneous.

The non-food consumption expenditure component is calculated based on a list of several non-food items consumed in the household and using various recall periods depending on the average frequency of purchases, which is then converted into an annual value. For example, transport consumption, mobile phone and clothing expenses are calculated based on a recall period of seven days, one month and three months, respectively (GoM, 2012b).

Household consumption expenditure on durable goods is calculated based on the services the household receive from the use of the durable goods. The survey collected information on ownership of thirty-two durable goods. However, only twenty-two of them were included in the calculation of the durable good consumption expenditure based on various reference periods. The calculated consumption expenditure is then converted into an annual expenditure. NSO (2014b) provide details on the calculation of this consumption expenditure component.

The housing consumption expenditure component is calculated based on either the actual rent the household received for letting out the house or the estimated rent they would have received if the house was let out. The final value used is the predicated rent from the estimated hedonic rental regression, which is used to replace outliers of reported rent values and missing values for unreported rent values (GoM, 2012b, NSO, 2014b).

3.5 Empirical models

The effect of farm input subsidies on household food security and consumption expenditure is estimated using the quantity of subsidised fertilizer a farmer redeemed in order to capture only the subsidised fertilizer used and, thus, the direct impact of the program. Fertilizer subsidies are chosen since they form the largest share of the total FISP (Lunduka et al., 2013) and 99 per cent of FISP beneficiaries received and redeemed a fertilizer coupon in the 2009/2010 and 2012/2013 agricultural seasons. Furthermore, we do not use a binary variable indicating whether a household is a subsidy recipient or not because beneficiaries received heterogeneous subsidy coupon packages and, therefore, have different degree of benefit from the program.

3.5.1 Model for estimating the continuous outcome variables

The continuous household food security and consumption expenditure outcome variables are modelled in relation to food security as: (i) kilocalories available per capita per day and (ii) food annual per capita consumption expenditure; (iii) non-food annual per capita consumption expenditure and (iv) total annual per capita consumption expenditure. In this study we estimate the conditional mean effects of subsidised fertilizer on the continuous food security and consumption expenditure indicators by employing fixed effect (FE) models, and the heterogeneous effects by employing CRE quantile regression models. The estimation is of the following form:

$$\log_{\text{welfare}_{it1}} = \text{hhc}_{it1}\beta_1 + \text{rain}_{it1}\beta_2 + \beta_3\text{dist}_{it1} + \beta_4\text{subfert}_{it1} + \varphi_i + \mu_{it1} \qquad (3.1)$$

where $\log_{\text{welfare}_{it1}}$ denotes household food security indicator (kilocalories available per capita per day) and consumption expenditure indicators (food, non-food and total annual per capita consumption expenditure) for farmer i in natural logarithm. The model's control variables are as follows: hhc_{it1} is a vector of household and farm characteristics and include sex, age and

education of the household head, total land owned, location in rural areas; crop diversification; $rain_{it1}$ is a vector of annual average district rainfall; $dist_{it1}$ is a vector representing distance to daily market in natural logarithm; $subfert_{it1}$ is a vector of quantity of subsidised fertilizer redeemed; φ_i is the time-invariant unobserved heterogeneity of the household; μ_{it} is an idiosyncratic error term; and β are the parameters to be estimated.

3.5.2 Model for estimating the binary household food security indicator

The binary outcome of household food security in relation to annual food security status is modelled by applying the pooled correlated random effect (CRE) Probit model, following Papke and Wooldridge, (2008); Wooldridge (2010). Therefore, the estimation equation is as follows:

$$y_{it1} = hhc_{it1}\beta_1 + rain_{it1}\beta_2 + dist_{it1}\beta_3 + \beta_4 subfert_{it1} + \varphi_i + \bar{w}_i\beta_5 + \mu_{it1} \quad (3.2)$$

where y_{it1} is the binary dependent variable and equal to one if the household has adequate kilocalories from cereals and legumes from one harvest season to the next (i.e. 12 months or more) or zero otherwise. The model's control variables are the same as described in Eq. (3.1); φ_i is the time-invariant unobserved heterogeneity of the household; $\bar{w}_i$ is a vector of the time averages of the time-variant explanatory variables; μ_{it1} is an idiosyncratic error term; and β are the parameters to be estimated.

3.5.3 Model for estimating heterogeneous effects of subsidised fertilizer on continuous household food security and consumption expenditure indicators

Hypothesis 3 implies heterogeneous welfare effects of FISP on different segments of the farm households' distribution. In order to test it, this study employs a correlated random effects (CRE) quantile regression approach. The heterogeneous effects of subsidised fertilizer on

continuous household food security and consumption expenditure outcomes are modelled in relation to (i) kilocalories available per capita per day; (ii) food annual per capita consumption expenditure; non-food annual per capita consumption expenditure and (iii) the total annual per capita consumption expenditure. CRE quantile regression approach is employed in a number of studies, e.g. Ricker-Gilbert and Jayne (2012)

The estimation is of the following form:

$$\log \mathrm{H}_{\mathrm{welfare}_{\mathrm{it1}}} = \mathrm{Z}^{'}\lambda_{1(\tau)} + \xi_1 \mathrm{Fert}_{\mathrm{it1sub}(\tau)} + \varphi_{\mathrm{i}} + \overline{\mathrm{w}_{\mathrm{i}}}\psi_1 + \mu_{\mathrm{it1}} \qquad (3.3)$$

where $\mathrm{H}_{\mathrm{welfare}}$ denotes household welfare indicator; $\mathrm{Fert}_{\mathrm{sub}}$ represents quantity of subsidised fertilizer in kilograms; $\mathrm{Z}^{'}$ is a vector of exogenous variables which are the same as described in Eq. (3.1); φ_{i} is the time-invariant unobserved heterogeneity of the household; $\overline{\mathrm{w}_{\mathrm{i}}}$ is a vector of the time averages of the time-variant explanatory variables; λ_1, ξ_1 and ψ_1 are vectors of parameters of interest to be estimated in the structural Eq. (3.3) and $0<\tau<1$. The estimations are carried out at 10th, 25th, 50th, 75th and 90th percentiles.

3.5.4 Empirical estimation strategy

The use of panel data in this study enables us to control for the unobserved time-constant household heterogeneity. For the continuous food security and consumption expenditure indicators, estimations use the fixed effects (FE) estimator to examine the conditional mean effects (Eq. 3.1) and CRE quantile regression to analyse the heterogeneous effects of subsidised fertilizer (Eq. 3.3). Since the study includes a binary dependent food security indicator, (the annual food security status in Eq. (3.2), and a quantile regression in (Eq. 3.3), the use of FE estimators and standard quantile regression, respectively, are inconsistent (Wooldridge, 2010).

For the estimators of Eq. (3.2) and the quantile regression in Eq. (3.3) to be consistent and the APEs to be identified, we use the correlated random effects (CRE) approach (Wooldridge, 2010) following Mundlak (1978) and Chamberlain (1984). This approach allows to control for the correlation between the time-invariant unobserved household heterogeneity φ_i and the explanatory variables in Eq. (3.2) and Eq. (3.3), here represented by W_{it}. Wooldridge, (2010) provides more details on the application of CRE estimators.

3.6. Data sources and descriptive statistics

Data used is the same as described in section 2.7 of chapter 2 of this thesis. However, for the current analyses, households which did not have agriculture as a livelihood strategy and did not grow cereals or legumes, and households with missing key information are excluded. As a result this study uses a balanced panel sample of 2,474 households.

Table 3.1 present averages of available kilocalories per capita per day and the number of months of food security from own production of cereals and legumes. These averages are based on quantiles of per capita annual consumption expenditure. The results show a positive correlation between available kilocalories per capita per day and months of food security, on the one hand, and the quantile of per capita annual consumption expenditure. Households with higher per capita annual consumption expenditure in the 4th and 5th quantiles meet both the standard requirement of kilocalories per capita per day and annual food security of at least 12 months of adequate available kilocalories. This suggests that the top richest 40 percent of the households are food secure, while the bottom 60 per cent are food insecure. Furthermore, the results show that households belonging to the 1st quantile have available kilocalories per capita per day which only meet about half of the standard requirement and are food secure only half of the year.

Table 3.1: Average available kilocalories and number of months of food security by quantiles of per capita annual consumption expenditure (the mean represents the two-survey waves)

Food security Indicator	Quantiles of per capita annual consumption expenditure				
	1st Quantile	2nd Quantile	3rd Quantile	4th Quantile	5th Quantile
Kilocalories per capita per day	1116	1602	1946	2424	3183
Months of food secure	6.46	9.36	10.99	14.06	17.72

Source: Calculated by author based on IHPS (2010 and 2013) data

A similar situation is observed in Table 3.2 where data are presented by poverty status of the household as non-poor, poor and extremely poor. A household whose individuals have a total annual per capita consumption expenditure below the total poverty line (MK85,852 in 2013) is defined as poor, while those with total annual per capita consumption expenditure of below the food poverty line (MK53,262 in 2013) are defined as extremely poor (NSO, 2014). The results show that poor and extremely poor households are food insecure. While poor households are food secure for about eight months, the extremely poor meet calorific requirements from own production of cereals and legumes for only six months. These results suggests a positive association between poverty status and food security of the household.

Table 3.2: Average available kilocalories and number of months of food security by poverty status of the household (the mean represents the two-survey waves)

Food security Indicator	Poverty status of the household		
	Non-poor	Poor	Extremely Poor
Kilocalories per capita per day	2455	1318	1013
Months of food secure	13.92	7.67	5.84

Source: Calculated by author based on IHPS (2010 and 2013) data

Descriptive statistics of the variables used in this study are presented in Table 3.3. Concerning the input subsidies, the data show that overall, 54 per cent of the farmers received a coupon for fertilizer subsidy during the two agricultural seasons under the study. Since the government target in FISP is to reach at least 50 per cent of smallholders, these results suggest that this target was met. However, the beneficiaries received heterogeneous coupon packages instead of the full standard package of four coupons to redeem two 50 kg bags of subsidised fertilizer (NPK and Urea); one pack of maize seed (5 kg if the farmer chose hybrid or 8 kg for open pollinated variety); and one legume pack (Dorward, et al., 2013). Only 24 per cent of the beneficiaries received the full standard package. Some of the remaining beneficiaries received coupons for different quantities of fertilizer and maize seeds, and some received either fertilizer or maize coupons only. In terms of quantities of redeemed fertilizer, the sample average is 43 kg, while considering beneficiaries only the average is 80 kg per beneficiary.

Food security indicators show that most of the households run out of adequate food supply from own production before the next harvesting season. The results indicate that only 32 per cent are food secure throughout the year. Fertilizer subsidy beneficiaries have higher probability of being food secure with a mean difference of five percentage points; have 302 available kilocalories per capita per day and two months of food secure more than non-beneficiaries. However, the average of 2,053 kilocalories per capita per day suggests that many households in Malawi do not meet the standard of 2,100 kilocalories from own production of cereals and legumes. This highlights the importance of alternative sources of food for household consumption, i.e. through market purchases. The statistics on household consumption expenditure shows that fertilizer subsidy beneficiaries have lower total annual per capita consumption expenditure compared to non-beneficiaries, which indicates that FISP is targeting relatively poor farm households.

The average age of the household head is 44 years and the subsidy beneficiaries are relatively older than non-beneficiaries, indicating that the FISP is targeting more elderly headed households. Although 23 per cent in the sample are female headed households, there is no much difference on proportion of female headed households between subsidy beneficiaries and non-beneficiaries. Education level of most household heads is low and the results show that most of them have primary education (about 60 per cent) and about 20 per cent have no formal education.

The results show that land, which is one of the most important productive assets in agricultural production, is a constraint for most of the households in this study. The average landholding size is 0.8 hectare and subsidy beneficiaries own relatively large landholdings and grow more crops (higher crop diversification) than non-beneficiaries. Overall, about 90 per cent of the households are located in rural areas, and it is 94 per cent of the subsidy beneficiaries and 85 per cent of non-beneficiaries who reside in rural areas. Daily markets are located far from where the farmers reside and the average distance is 9 km. However, subsidy beneficiaries reside further away than non-beneficiaries.

Table 3.3. Descriptive statistics (the mean represents the two-survey waves' average)

Variable	All (Full Sample) (I)		Subsidy Beneficiaries Only (II)		Subsidy Non-Beneficiaries Only (III)		Difference (II)-(III)
	Obs	Mean	Obs	Mean	Obs	Mean	Mean /SE
Head (female)	4948	0.23	2693	0.24	2255	0.22	0.02*
							(0.01)
Head age (years)	4948	44.27	2693	46.28	2255	41.86	4.43***
							(0.46)
Head no education	4948	0.2	2693	0.21	2255	0.2	0.013
							(0.01)
Head primary educ	4948	0.59	2693	0.61	2255	0.56	0.06***
							(0.01)
Head secondary edu	4948	0.1	2693	0.17	2255	0.20	-0.04***
							(0.01)
Head tertiary educ	4948	0.03	2693	0.01	2255	0.05	-0.04***
							(0.01)
Land total (hectares)	4948	0.79	2693	0.85	2255	0.71	0.14***
							(0.02)
Rural location	4948	0.9	2693	0.94	2255	0.85	0.1***
							(0.01)
Crop diversification	4948	2.13	2693	2.26	2255	1.98	0.28***
							(0.03)
Distance daily mkt	4948	9.05	2693	10.74	2255	7.03	3.71***
							(0.54)
Irrigation scheme	4948	0.16	2693	0.18	2255	0.13	0.05***
							(0.01)
No. of households	4948	984	2693	967	2255	1005	-38.03
							(44.44)
Agricultural Officer	4948	0.37	2693	0.37	2255	0.37	-0.001
							(0.01)
Microfinance institu	4948	0.11	2693	0.1	2255	0.13	-0.03***
							(0.01)
Rainfall amount	4948	967.96	2693	988.01	2255	944.01	44.01***
							(8.01)
Percapita annual exp	4948	142213	2,693	130262	2255	156486	-26223***
							(3840)
Percapita/day calorie	4948	2053.9	2693	2191.6	2255	1889.4	302.24***
							(49.36)
Months food secure	4948	11.72	2693	12.6	2255	10.66	1.94***
							(0.37)
Annual food secure	4948	0.32	2693	0.34	2255	0.29	0.05***
							(0.01)
Subsidised fertilizer	4948	43.43	2693	79.8			

Note: *, **, *** represents statistically significance at 10 %, 5 % and 1 % levels; SE represents standard errors.

Source: Author based on IHPS 2010 and 2013 data

Irrigation scheme availability in the community is reported by 16 per cent of the households and more FISP beneficiaries are located in communities where irrigation schemes are available. Lack of access to microfinance institutions shows is a challenge facing most farmers in this study as the results show that only 11 per cent have a microfinance institution in their communities. In addition, more non-beneficiaries of subsidies than beneficiaries are located in communities where microfinance institutions are available. Since the subsidies are targeting the poor and vulnerable groups, this highlight the challenge they have in accessing microfinance loans. The average number of households in each of the communities is 984 and 37 per cent of the households report to have a resident agricultural extension officer. However, a comparison between subsidy beneficiaries and non-beneficiaries shows no statistically significant differences on these two factors.

3.6.1 Endogeneity Tests of subsidised fertilizer

Since fertilizer coupons are distributed to households non-randomly (i.e. to only targeted households), the unobserved time-invariant household heterogeneity which influences receipt of subsidy coupons may also influence household income potentials and production levels of cereals and legumes for household food consumption. This will make subsidised fertilizer endogenous in the estimations. We use the control function approach of the instrumental variables method to test for the endogeneity of subsidised fertilizer. We employ the residence or visit of the Member of Parliament (MP) in the community as an instrument following Ricker-Gilbert and Jayne (2011).

Section 2.6.4 of Chapter 2 provides details on the application of the CF approach and a discussion on the choice of MP residence or visit to the community as an IV. The results suggest that the quantity of subsidised fertilizer is endogenous in all our estimations, with the exception of the 75^{th} and 90^{th} percentiles of the total annual per capita consumption

expenditure. The estimation of the heterogeneous effects of subsidised fertilizer on continuous food security and consumption expenditure indicators is carried out semi-parametrically by employing the control function approach to the structural quantile regression model Eq. (3.3) following Lee (2004). As mentioned in Chapter 2, the chosen instrument might be weak and therefore, having significant effect on the results. But to the best knowledge of the author there is no method of testing weak instrumental variables under the CF approach. Presentation of the model results without the use of the IV method alongside model results with the use of the IV method helps in checking the robustness of the results of the selected models.

3.7 Results and discussion

This section discusses the empirical results and the focus is on the effects of the subsidised fertilizer on household food security and consumption expenditure. The results of the random effect (RE) model (I) and fixed effect (FE) model (II) in Table 3.4 are presented to check the robustness of the results of the instrumental variable fixed effect (IV-FE) model (III). This is because the robust Hausman model selection test based on the Sargan-Hansen statistic rejects the RE model and the statistically significant generalised residuals indicates that subsidised fertilizer is endogenous. Regression results concerning factors determining available per capita calories per day are presented in Table 3.4 and the discussion is based on the results of the IV-FE model (III).

The results show that subsidised fertilizer has positive effects on available per capita calories and on average, an additional kilogram of subsidised fertilizer increases available per capita calories per day by 0.18 per cent. Since the FISP standard package includes 100 kg of subsidised fertilizer, it means that the program effect is 18 per cent. Estimation in levels shows that available per capita calories per day increases by 372 kilocalories for an additional FISP

standard package of 100 kg of subsidised fertilizer. Linear transformation of these results into household food secure months suggests that in levels, on average the FISP standard package of 100 kg of subsidised fertilizer increases number of months of household food secure by 2.5. The positive effect of subsidised fertilizer on available per capita calories per day and number of months of household food secure are consistent with previous studies such as Holden and Lunduka (2012) who find that farm input subsidy program beneficiaries were less likely to be net buyers of maize and more likely to be net sellers and that the beneficiary households had 43 per cent higher maize production. A study by Dorward and Chirwa (2011) also find that the subsidy program has significantly contributed to improved national food self-sufficiency.

Age of the household head has statistically significant and positive effects on available per capita calories per day, suggesting elderly headed households have more available food. An increase in age by one year increases available per capita calories per day by one per cent. More crop production experience and accumulation of productive assets over the years may be the explanation of the positive effects of old age. Higher education of the household head is associated with increased available per capita calories per day. Households whose heads have secondary and tertiary education levels have 17 and 41 per cent increased available per capita calories per day, respectively, compared with those without formal education. This effect is expected because higher education is associated with adoption of modern technologies, which results into higher production and productivity.

As expected, large landholding size is associated with more available per capita calories per day due to high production levels from larger areas under cultivation. An additional hectare of land increases available per capita calories per day by 31 per cent. Similarly, crop diversification has statistically significant and positive effects on available per capita calories per day with an additional crop grown having a 21 per cent effect. The impact of crop

diversification might be due to the effect of legumes which are grown in addition to maize and have higher calorific content.

Availability of agricultural production information and advice to farmers has positive effects on available per capita calories per day. The results show that households in communities which have a resident agricultural extension officer have 15 per cent more available per capita calories per day compared with those in communities which have no such officers. This highlights the importance of access to agricultural production information and services in increasing productivity.

Much as rainfall is important in crops production, however, too much or too little rainfall has adverse effects. The results show that receiving double the average district rainfall decreases available per capita calories per day by 18 per cent. Therefore, households in areas which receive high annual average rainfall are less likely to have cereals and legumes as their main source of calories from own production.

However, the study finds no evidence of effects on available per capita calories per day of sex and primary education level of the household head; rural location; distance to daily market; availability of an irrigation scheme, micro-credit institution and number of households in the community.

Table 3.4: Regression results on factors influencing available per capita calories. Dependent variable: Log per capita kilocalories.

Explanatory Variables	RE (I)	FE(II)	IV-FE (III)
	Coef./SE	Coef./SE	Coef./SE
Generalised residuals			-0.24***
			(0.04)
Subsidised fertilizer quantity in Kg	0.0014***	0.0012***	0.0018***
	(0.0003)	(0.0004)	(0.0004)
Household head (female)	0.03	-0.05	-0.08
	(0.04)	(0.06)	(0.06)
Household head age (years)	0.004***	0.01***	0.01***
	(0.001)	(0.002)	(0.002)
Household head primary education	0.09**	0.05	0.02
	(0.04)	(0.05)	(0.05)
Household head secondary education	0.28***	0.2***	0.17**
	(0.05)	(0.08)	(0.08)
Household head tertiary education	0.48***	0.43***	0.41***
	(0.1)	(0.17)	(0.17)
Total landholding size (hectares)	0.35***	0.29***	0.31***
	(0.03)	(0.04)	(0.04)
Rural location of the household	0.01	-0.07	-0.003
	(0.06)	(0.13)	(0.13)
Crop diversification	0.22***	0.22***	0.21***
	(0.01)	(0.02)	(0.02)
Log distance to daily market (Km)	-0.02	-0.004	0.004
	(0.01)	(0.02)	(0.01)
Irrigation scheme in the community	0.07**	0.06	0.06
	(0.03)	(0.05)	(0.05)
Log number of households in the community	0.01	0.02	0.02
	(0.01)	(0.01)	(0.01)
Agricultural Extension Officer in the community	0.14***	0.16***	0.15***
	(0.03)	(0.04)	(0.03)
Micro-finance institution in the community	0.01	0.03	0.03
	(0.04)	(0.05)	(0.05)
Log annual average district rainfall	-0.19***	-0.18*	-.12
	(0.06)	(0.10)	(0.10)
Constant	13.09***	13.02***	6.53***
	(0.4)	(0.75)	(0.74)
Number of observations	4948	4948	4948
Wald chi2(15)/ F-Statistic	688.59	20.42	22.65
Prob > chi2/ F	0.0000	0.0000	0.0000
R-squared	0.1687	0.1572	0.1812
Rho	0.4081	0.5485	0.5472
Robust Hausman test: Sargan-Hansen statistic	25.743**		

Note: *, **, *** represents statistically significant level at 10%, 5% and 1%, respectively; robust cluster standard errors (SE) are in parentheses.

Regression results on factors determining household annual food security status are presented in Table 3.5. The discussion in this section is based on the average partial effects (APEs) results of the pooled CRE Probit model (III), which controls for the household time-invariant unobserved heterogeneity and endogeneity of subsidised fertilizer. This model is chosen because the joint statistical significance of the added time averages of the time-variant explanatory variables cannot be rejected, indicating the need of controlling for the household time-invariant unobserved heterogeneity in the estimation. Furthermore, the generalised residuals are statistically significant indicating that subsidised fertilizer is endogenous in the estimations and hence requires controlling the effects of endogeneity.

The results show that subsidised fertilizer has statistically significant and positive effects on household annual food security status. An additional kilogram of subsidised fertilizer increases the probability of a household being annual food secure by 0.07 percentage point. This represents seven percentage points increase for the 100 Kg fertilizer of the standard subsidised fertilizer program package. The positive effect of the subsidised fertilizer on food security status is consistent with a study by Chirwa et al., (2013), who find that the receipt of subsidised fertilizer coupons continuously for six times increases the probability of the household reporting adequate food consumption by 22 percentage points compared with non-beneficiaries and that an additional 100 kg of subsidised fertilizer increases the probability of household food consumption adequacy by seven percentage points.

Old age of household head has statistically significant and positive effects on household annual food security, but the magnitude is very small. Land holding size has the expected positive effect and an additional hectare of land increases the probability of annual household food secure by 15 percentage points. This is because more landholding size is associated with more total output and therefore, providing more food for household consumption. The results also suggest that growing more crops is associated with increased food security.

Table 3.5: Regression results on factors influencing the probability of household annual adequate calories availability. Dependent variable: Annual food secure=1

Explanatory Variables	Pooled Probit (I)	Pooled CRE Probit (II)	Pooled CRE & CF Residuals Probit (III)
	ME/SE†	APE./SE††	APE./SE††
Generalised residuals			-0.12***
			(0.02)
Subsidised fertilizer quantity in Kg	0.0003*	0.0004**	0.0007***
	(0.0002)	(0.0002)	(0.0002)
Household head (female)	0.04**	-0.01	-0.02
	(0.02)	(0.03)	(0.03)
Household head age (years)	0.001	0.002***	0.004***
	(0.001)	(0.001)	(0.001)
Household head primary education	0.03	-0.01	-0.02
	(0.02)	(0.03)	(0.03)
Household head secondary education	0.12***	0.04	0.02
	(0.03)	(0.04)	(0.04)
Household head tertiary education	0.18***	0.12	0.12
	(0.05)	(0.08)	(0.07)
Total landholding size (hectares)	0.19***	0.14***	0.15***
	(0.01)	(0.02)	(0.02)
Rural location of the household	0.01	-0.08	-0.04
	(0.02)	(0.06)	(0.05)
Crop diversification	0.06***	0.06***	0.06***
	(0.01)	(0.01)	(0.01)
Log distance to daily market (Km)	-0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)
Irrigation scheme in the community	0.03	0.01	0.002
	(0.02)	(0.02)	(0.02)
Log number of households in com.	0.0002	0.003	0.004
	(0.01)	(0.01)	(0.01)
Agricultural Extension Officer in co.	0.04***	0.06***	0.06***
	(0.01)	(0.02)	(0.02)
Micro-finance institution in the com.	0.04**	0.02	0.02
	(0.02)	(0.02)	(0.03)
Log annual average district rainfall	-0.03	0.02	0.04
	(0.03)	(0.05)	(0.05)
Number of observations	4948	4948	4948
Wald chi2(15)	514.48	542.15	593.17
Prob > chi2	0.0000	0.0000	0.0000
Pseudo R-squared	0.1225	0.1288	0.1457
Log-pseudolikelihood	-2714.925	-2695.376	-2643.265
Chi2: Joint stat sig of time averages		42.49***	45.21***
Correctly classified	72.15 %	72.64 %	73.73 %

Note: *, **, *** represents statistically significant level at 10%, 5% and 1%, respectively; SE† = cluster standard errors; SE††= bootstrap standard errors (1000 reps); estimation of model (II) include time averages of time-variant regressors and year dummy.

Results in Table 3.6 show the effects of repeated benefit to subsidised fertilizer on household food security. The results suggest positive heterogeneous effects of repeated benefit to subsidised fertilizer on available per capita per day calories. Accessing subsidised fertilizer once increases available calories per capita per day by 11 per cent and the magnitude of the effects increases by about five times to 54 per cent for a continuous five times benefit. However, it is only after accessing subsidised fertilizer continuously for five times that has positive effects on household annual food security status, which increases by 11 percentage points.

Overall, the results in Tables 3.4, 3.5 and 3.6 indicate that the farm input subsidies could be useful in contributing to improved food security among farming households in Malawi. However, the magnitude of the effects suggests that they alone are not a magic bullet solution to food insecurity, but only one tool that has to be built-in in a more comprehensive agricultural policy package facilitating agricultural and rural development.

Table 3.6: Regression results on factors influencing available per capita calories and household annual food security status

Explanatory Variables	FE Model Log per capita/day calories (I)	CRE Probit Model (Annual food secure) (II)
	Coef./SE	APE/SE
One-time benefit to fertilizer subsidy	0.11*	-0.05*
	(0.06)	(0.03)
Two-times benefit to fertilizer subsidy	0.22***	0.02
	(0.07)	(0.04)
Three-times benefit to fertilizer subsidy	0.25***	-.06
	(0.08)	(0.04)
Four-times benefit to fertilizer subsidy	0.45***	0.02
	(0.09)	(0.06)
Five-times benefit to fertilizer subsidy	0.54***	0.11**
	(0.08)	(0.05)
Household head (female)	-0.07	-0.03
	(0.06)	(0.03)
Household head age (years)	0.01***	0.002**
	(0.002)	(0.001)
Total landholding size (hectares)	0.31***	0.14***
	(0.04)	(0.02)
Rural location of the household	-0.08	-0.07
	(0.13)	(0.05)
Crop diversification	0.20***	0.06***
	(0.02)	(0.01)
Log distance to daily market (Km)	0.02	0.01
	(0.02)	(0.01)
Irrigation scheme in the community	0.09**	0.01
	(0.05)	(0.02)
Log number of households in the community	0.02*	0.003
	(0.01)	(0.01)
Agricultural Extension Officer in the community	0.12***	0.06***
	(0.04)	(0.02)
Micro-finance institution in the community	0.04	0.02
	(0.05)	(0.03)
Log annual average district rainfall	-0.08	0.03
	(0.10)	(0.05)
Constant	6.35***	0.32***
	(0.75)	(0.01)
Number of observations	4948	4948
Wald chi2(15)/ F-Statistic	21.59***	593.51***
R-squared/Pseudo R2	0.1647	0.1350
Rho	0.5572	
Correctly classified		72.98%
Log pseudolikelihood		-2676.34

Note: *, **, *** represents statistically significant level at 10%, 5% and 1%, respectively; robust cluster standard errors (SE) are in parentheses; controls include education covariates.

In relation to the food, non-food and total annual per capita consumption expenditure, the results are presented in Table 3.7. All the three models' results do not show a statistically significant effect of subsidised fertilizer. One possible explanation is that since the FISP main target crop is maize, which most farm households grow for subsistence, has little contribution to sales and consequently to household's income and to the overall food, non-food and total household consumption expenditure. Although the annual per capita food consumption expenditure component represents 60 per cent of the annual total per capita consumption expenditure, the share of the maize consumption expenditure in food and total consumption expenditure might be minimal due to its lower unit value. However, due to data limitations, we are unable to estimate this. Since the main target crop in FISP is maize, the share of maize consumption expenditure in food and total consumption expenditure could have provided an idea of the expected effects of FISP on household consumption expenditure. The policy implication is that when the main subsistence crop is targeted, the subsidised fertilizer may hardly have significant effects on poverty alleviation calculated based on consumption expenditure. To a certain extent, these results explain the persistence of high poverty levels of above 40 per cent of the population in Malawi despite the implementation of the FISP. However, it should be taken into account that the data used in the calculations of household consumption expenditure in this study did not include consumption information for the months of January and February, which are considered as severe lean food availability months in Malawi (NSO, 2014). Therefore, the results in this study might underestimate the overall contribution of the FISP to food, non-food and total household consumption expenditure.

Higher education level of household head, more total land owned, crop diversification and having more households in the community are associated with increased food, non-food and total annual per capita consumption expenditure due to their positive effects on household income. Of these factors, education level of the household heads has the most significant effect.

Table 3.7: Regression results on determinants of food, non-food and total annual per capita consumption expenditure. Dependent variable: Log food, non-food and total annual per capita consumption expenditure.

Explanatory Variables	Food Consumption Expenditure	Non-Food Consumption Expenditure	Total Consumption Expenditure
	IV-FE (I)	FE (II)	IV-FE (III)
	Coef./SE	Coef./SE	Coef./SE
Generalised residuals	-0.05**		-0.04*
	(0.02)		(0.02)
Subsidised fertilizer quantity in Kg	-0.0001	-0.0002	-0.0002
	(0.0003)	(0.0003)	(0.0002)
Household head (female)	-0.04	-0.06	-0.05
	(0.05)	(0.05)	(0.04)
Household head age (years)	-0.01***	-0.01***	-0.01***
	(0.001)	(0.001)	(0.001)
Household head primary education	0.01	0.07*	0.03
	(0.04)	(0.04)	(0.03)
Household head secondary education	0.18***	0.34***	0.26***
	(0.06)	(0.06)	(0.05)
Household head tertiary education	0.39***	0.70***	0.53***
	(0.09)	(0.14)	(0.11)
Total landholding size (hectares)	0.04*	0.11***	0.07***
	(0.03)	(0.03)	(0.02)
Rural location of the household	0.01	-0.37***	-0.18*
	(0.09)	(0.11)	(0.09)
Crop diversification	0.04***	0.02	0.03***
	(0.01)	(0.01)	(0.01)
Log distance to daily market (Km)	-0.03**	-0.02*	-0.02**
	(0.01)	(0.01)	(0.01)
Irrigation scheme in the community	-0.02	0.02	0.01
	(0.03)	(0.03)	(0.03)
Log number of households in the community	0.03**	0.01	0.03***
	(0.01)	(0.01)	(0.01)
Agricultural Extension Officer in the community	0.04	-0.01	0.01
	(0.03)	(0.03)	(0.02)
Micro-finance institution in the community	0.01	-0.01	0.001
	(0.04)	(0.04)	(0.03)
Constant	10.89***	7.99**	11.75***
	(0.24)	(0.56)	(0.48)
Number of observations	4948	4948	4948
Wald chi2(15)/ F-Statistic	6.09***	8.88***	8.03***
R-squared	0.04	0.16	0.12
Rho	0.48	0.58	0.55

Note: *, **, *** represents statistically significant level at 10%, 5% and 1%, respectively; robust cluster standard errors (SE) are in parentheses; controls include rainfall covariate.

Regression results on the effects of repeated benefits to subsidised fertilizer on annual food, non-food and total per capital consumption expenditure are presented in Table 3.8. The results show positive statistically significant and increased magnitude of effects of repeated benefit to subsidised fertilizer on annual food and total per capita consumption expenditure. Using subsidised fertilizer once has statistically insignificant effect on all the three types of consumption expenditure and this is consisted with results in Table 3.7, which show the effects of one-off benefit. For food consumption expenditure, two-times benefits has statistically significant positive effects and increases annual per capita food consumption expenditure by 11 per cent and the magnitude of the effects increases to 28 per cent for a five-times continuous benefit. However, the results show that repeated benefit to subsidised fertilizer has statistically insignificant effects on annual non-food per capita consumption expenditure. Furthermore, only after using subsidised fertilizer for four and five times has statistically significant positive effects and increases annual total per capita consumption expenditure by 12 and 19 per cent, respectively.

Overall, the regression results on the effects of repeated benefit to subsidised fertilizer suggests positive statistically significant and increased magnitude of effects on food security, food and total consumption expenditure. This supports the theory of change espoused by the government of Malawi in the implementation of the FISP. Promoting access to, adoption and use of improved farm inputs such as inorganic fertilizer and hybrid seeds are some of the expected effects of the FISP as a 'smart subsidy programme'. Accumulation of residual fertilizer in the soil due to continuous use of inorganic fertilizer from the FISP is also attributed to the positive effects of repeated benefit to subsidised fertilizer on crop production (Chirwa et al., 2013; Ricker-Gilbert and Jayne, 2011).

Table 3.8: Regression results on determinants of food, non-food and total annual per capita consumption expenditure. Dependent variable: Log food, non-food and total annual per capita consumption expenditure.

Explanatory Variables	Food Consumption Expenditure	Non-Food Consumption Expenditure	Total Consumption Expenditure
	FE (I)	FE (II)	FE (III)
	Coef./SE	Coef./SE	Coef./SE
One-time benefit to fertilizer subsidy	0.06	0.01	0.03
	(0.04)	(0.05)	(0.04)
Two-times benefit to fertilizer subsidy	0.11**	0.04	0.07
	(0.05)	(0.06)	(0.05)
Three-times benefit to fertilizer subsidy	0.11**	-0.08	0.02
	(0.05)	(0.06)	(0.05)
Four-times benefit to fertilizer subsidy	0.19***	0.05	0.12**
	(0.07)	(0.08)	(0.06)
Five-times benefit to fertilizer subsidy	0.28***	0.08	0.19***
	(0.06)	(0.07)	(0.06)
Household head (female)	-0.04	-0.06	-0.05
	(0.05)	(0.05)	(0.04)
Household head age (years)	-0.01***	-0.01***	0-.01***
	(0.001)	(0.001)	(0.001)
Total landholding size (hectares)	0.04	0.10***	0.07***
	(0.03)	(0.03)	(0.02)
Rural location of the household	-0.02	-0.37***	-0.20**
	(0.09)	(0.11)	(0.09)
Crop diversification	0.03**	0.02	0.03**
	(0.01)	(0.01)	(0.01)
Log distance to daily market (Km)	-0.02	-0.02*	-0.02*
	(0.01)	(0.01)	(0.01)
Irrigation scheme in the community	-0.002	0.02	0.02
	(0.04)	(0.03)	(0.03)
Log number of households in the community	0.03***	0.01	0.03***
	(0.01)	(0.01)	(0.01)
Agricultural Extension Officer in the community	0.02	-0.01	-0.001
	(0.03)	(0.03)	(0.02)
Micro-finance institution in the community	0.02	-0.01	0.003
	(0.04)	(0.04)	(0.03)
Constant	10.72***	7.94**	11.65***
	(0.53)	(0.56)	(0.48)
Number of observations	4948	4948	4948
Wald chi2(15)/ F-Statistic	7.17	7.27	7.86
Prob > chi2/ F	0.0000	0.0000	0.0000
R-squared	0.04	0.16	0.12
Rho	0.49	0.58	0.56

Note: *, **, *** represents statistically significant level at 10%, 5% and 1%, respectively; robust cluster standard errors (SE) are in parentheses; controls include education and rainfall covariates.

As previously mentioned, the analysis of the heterogeneous effects of subsidised fertilizer employs CRE quantile regression models and estimations are carried out at 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} percentiles of the continuous dependent variables (i.e. kilocalories available per capita per day, and annual per capita consumption expenditure). Table 3.9 presents the CRE quantile regression model results on factors affecting the kilocalories available per capita per day; and Table 3.10 – the effect on consumption expenditure.

The results in Table 3.9 show that an additional standard package of subsidised fertilizer increases the kilocalories available per capita per day by 25 per cent at the 10^{th} and 50^{th} percentiles, compared to 22 per cent at the 90^{th} percentile. Therefore the percentage incremental effect is slightly larger at the lower percentiles. However, in terms of the impact in levels, the results indicate that an additional 100 kg of subsidised fertilizer increases the per capita kilocalories by 113 kilocalories at the 10^{th} percentile, 378 kilocalories at the median (50^{th} percentile) and 977 kilocalories at the 90^{th} percentile.

Age of the household head has similar positive effects across the percentiles, but the magnitude of the effect is very small. However, total land owned has heterogeneous positive effect and the results show smaller effect at the lower percentile compared with the upper percentiles. An additional hectare of total land increases available per capita calories per day by 28 per cent at the 10^{th} percentile and 44 per cent at the 90^{th} percentile. This suggest that the upper percentile (food secure) households are more efficient in land usage compared with the lower percentile (food insecure) households. This could be due to economies of scale as more food secure households are associated with more total land ownership.

Table 3.9: CRE Quantile Regression Model results on factors influencing available per capita calories. Dependent variable: Log per capita kilocalories.

Explanatory Variables	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile
	Coef./SE	Coef./SE	Coef./SE	Coef./SE	Coef./SE
Generalised residuals	-0.43***	-0.46***	-0.39***	-0.33***	-0.24***
	(0.06)	(0.05)	(0.04)	(0.04)	(0.07)
Subsidised fertilizer in Kg	0.0025**	0.0032***	0.0025***	0.0028***	0.0022***
	(0.0011)	(0.0007)	(0.0007)	(0.0005)	(0.0008)
Household head (female)	-0.15	-0.01	-0.12**	-0.14	-0.04
	(0.16)	(0.12)	(0.06)	(0.09)	(0.13)
Household head age (years)	0.010***	0.013***	0.014***	0.011***	0.010**
	(0.004)	(0.003)	(0.003)	(0.003)	(0.005)
Household head primary educ	0.04	0.08	0.02	-0.04	-0.03
	(0.15)	(0.08)	(0.07)	(0.09)	(0.11)
Household head secondary ed	0.24	0.24*	0.15	0.05	0.12
	(0.18)	(0.14)	(0.11)	(0.15)	(0.20)
Household head tertiary educ	0.26	0.69**	0.38	0.22	0.51*
	(0.29)	(0.32)	(0.26)	(0.30)	(0.30)
Total landholding size (hec)	0.28***	0.31***	0.39***	0.45***	0.44***
	(0.08)	(0.08)	(0.06)	(0.07)	(0.08)
Rural location of the house	0.40	0.18	0.06	-0.15	-0.25
	(0.26)	(0.23)	(0.21)	(0.20)	(0.22)
Crop diversification	0.24***	0.27***	0.17***	0.13***	0.12***
	(0.04)	(0.03)	(0.03)	(0.03)	(0.04)
Log distance daily market	0.01	0.06**	0.03	0.03	0.04
	(0.04)	(0.03)	(0.02)	(0.02)	(0.04)
Irrigation scheme in the com	0.27**	0.13**	0.03	0.002	-0.05
	(0.13)	(0.07)	(0.06)	(0.07)	(0.10)
Log number of households	0.03	0.05*	0.01	0.03	0.02
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
Agricultural Extension Office	0.05	0.13*	0.15**	0.06	0.19**
	(0.09)	(0.07)	(0.06)	(0.06)	(0.08)
Micro-finance institution	0.08	-0.08	0.07	0.13**	0.05
	(0.11)	(0.10)	(0.09)	(0.06)	(0.10)
Log average district rainfall	-0.24	0.07	0.01	0.18	-0.14
	(0.30)	(0.24)	(0.14)	(0.18)	(0.30)
Year dummy 2013=1	0.13***	0.13***	0.13***	0.15***	0.16***
	(0.04)	(0.05)	(0.03)	(0.04)	(0.04)
Constant	5.86***	6.56***	7.01***	7.06***	7.69***
	(0.65)	(0.63)	(0.46)	(0.53)	(0.70)
Number of observations	4,948	4,948	4,948	4,948	4,948
Pseudo R-squared	0.1158	0.1155	0.1235	0.1336	0.1257

Note: *, **, *** represents statistically significant level at 10%, 5% and 1%, respectively; bootstrap standard errors (SE) are in parentheses (1000 reps); estimation includes time averages of time-variant regressors.

However, crop diversification is found to have larger positive effects at the lower percentiles compared to the top percentiles. Growing an additional crop increases available per capita calories per day by 24 per cent at the 10^{th} percentile and 12 per cent at the 90^{th} percentile. These results reflect the different types of crops grown in addition to maize. For households at the lower percentiles, legumes for food consumption are likely to be the additional crops to be grown, while it is likely to be non-food cash crops for the upper percentile households.

Availability of irrigation scheme in the community is found to have positive effects only on the food insecure households at the lower 10^{th} and 25^{th} percentiles. Since food crops dominate the type of crops grown in irrigation schemes, most of the targeted households are the food insecure with the objective of supplementing their rain fed food crops production. Interestingly, availability of agricultural extension officer and microfinance institution in the community is found to have positive effects on available per capital calories per day only among the more food secure households. This suggests that the food insecure households are not benefiting much from such services and highlight the importance of participation and inclusiveness of the poor and food insecure households in public and private services aimed at improving rural livelihoods.

Concerning consumption expenditure, similar to results in Table 3.7, the CRE quantile regression model results in Table 3.10 show no evidence of statistically significant effects across the farm households' distribution on annual total per capita consumption expenditure. Furthermore, this study also finds no evidence of statistically significant effects across the farm households' distribution on annual food and non-food per capita consumption expenditure. This also explains the marginal reduction in poverty during the period of FISP implementation in Malawi.

Table 3.10: CRE Quantile Regression Model results on determinants of total annual per capita consumption expenditure. Dependent variable: Log total annual per capita consumption expenditure

Explanatory Variables	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile
	Coef./SE	Coef./SE	Coef./SE	Coef./SE	Coef./SE
Generalised residuals	-0.09***	-0.05*	-0.05**		
	(0.03)	(0.03)	(0.03)		
Subsidised fertilizer in Kg	0.0003	0.0003	0.0002	0.0001	0.0005
	(0.0004)	(0.0003)	(0.0004)	(0.0004)	(0.0005)
Household head (female)	0.04	-0.11*	-0.03	-0.06	-0.06
	(0.09)	(0.06)	(0.05)	(0.07)	(0.10)
Household head age (years)	-0.01**	-0.01**	-0.01**	-0.01***	-0.01**
	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)
Household head primary educ	0.10*	0.07	0.02	0.07	-0.08
	(0.06)	(0.05)	(0.05)	(0.06)	(0.08)
Household head secondary ed	0.08	0.23***	0.24***	0.28***	0.26**
	(0.09)	(0.09)	(0.07)	(0.10)	(0.11)
Household head tertiary educ	0.54***	0.63***	0.52***	0.52**	0.52**
	(0.15)	(0.17)	(0.15)	(0.26)	(0.24)
Total landholding size (hec)	0.11***	0.08*	0.07*	0.06*	0.03
	(0.04)	(0.05)	(0.04)	(0.04)	(0.05)
Rural location of the house	-0.21	-0.12	-0.10	-0.24	-0.39
	(0.13)	(0.15)	(0.14)	(0.16)	(0.24)
Crop diversification	0.03	0.02	0.02	0.01	0.06**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Log distance to daily market	0.01	0.01	0.01	-0.02	-0.04*
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Irrigation scheme in the com	-0.01	0.04	-0.002	-0.06	-0.06
	(0.06)	(0.04)	(0.04)	(0.06)	(0.07)
Log number of households	0.05***	0.02	0.02	0.01	0.04*
	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)
Agricultural Extension Office	-0.07*	0.01	0.01	0.02	-0.04
	(0.04)	(0.05)	(0.03)	(0.05)	(0.07)
Micro-finance institution	-0.05	-0.004	-0.03	0.06	-0.03
	(0.06)	(0.05)	(0.04)	(0.07)	(0.07)
Log average district rainfall	0.20	0.16	-0.04	-0.09	-0.003
	(0.13)	(0.12)	(0.10)	(0.14)	(0.18)
Year dummy 2013	0.09**	0.05**	0.07***	0.04	0.07**
	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)
Constant	10.35***	10.80***	10.80***	11.50***	11.45***
	(0.34)	(0.35)	(0.30)	(0.43)	(0.42)
Number of observations	4948	4948	4948	4948	4948
Pseudo R-squared	0.1006	0.1019	0.1150	0.1202	0.1512

Note: *, **, *** represents statistically significant level at 10%, 5% and 1%, respectively; bootstrap standard errors (SE) are in parentheses (1000 reps); estimation includes time averages of time-variant regressors.

Results in Table 3.10 also show that old age is associated with lower total annual per capita consumption expenditure and the magnitude of the effects are the same across the percentiles, but they are very small. Education level of the household head is found to have positive effects and the magnitude of the effects are similar across the percentiles. These results highlight the negative and positive effects of old age and higher education on household income, respectively. However, total land has statistically significant positive effects only on the lower percentiles, suggesting that crop production is the main source of income for households in the lower percentiles of total consumption expenditure.

3.8 Conclusion

Agriculture is the main livelihood strategy for most rural households in Malawi, and in sub-Saharan Africa in general, and consequently, agricultural policies are vital for achieving economic growth, food security and poverty alleviation. Farm input subsidy programs are one of the pervasive policy tools used to address the problems of food insecurity and poverty through improvement of agricultural production and productivity. This study has estimated the effects of a fertilizer subsidy program on kilocalories available per capita per day; household annual food security status; food, non-food and the total annual per capita consumption expenditure in Malawi.

The study finds that fertilizer subsidy has a positive impact on food security and its effect is heterogeneous across the farm households' distribution. Even though the percentage incremental effect is higher for the poorest and most food insecure household, measured in levels the effect is higher among the most food secure households. Furthermore, the magnitude of the effects of subsidised fertilizer on food security are not large enough to eradicate food insecurity among poor households in isolation, and this underscores the importance of

integrated livelihood approach in development interventions. The study also finds no evidence of effects of one-off benefit to subsidised fertilizer on annual food, non-food and total per capita consumption expenditure. However, repeated benefit to subsidised fertilizer is found to have positive statistically significant and increased magnitude of effects on available per capita per day calories, annual food and total per capita consumption expenditure. This supports the theory of change of farm input subsidies as espoused by its proponents.

From the policy point of view, these results provide several important insights. First, farm input subsidy programs could be beneficial for some improvement of food security, based predominantly on subsistence agriculture where food security is achieved through consumption of own production. Such programs are less useful when the main policy objective is to decrease consumption expenditure poverty due to the marginal contribution of fertilizer subsidies to income from crop sales and the lack of contribution to development of non-farm income sources.

Second, a fertilizer subsidy program has a higher positive impact on the most food secure, raising the question of whether targeting households in the lowest food crops production percentiles offers value for money in order to achieve the objective to improve food security. However, since households in lower food crops production percentiles are the most food insecure, provision of subsidised fertilizer to these groups of farmers can be justified on the basis to achieve social protection objectives.

Third, the results highlight the need for promoting complementary policy interventions in addition to fertilizer subsidies in order to achieve sustainable household food and income security. Implementing policies which promote family planning to slow down population growth and farm household sizes would be important in order to improve available kilocalories and total consumption expenditure per capita, consequently, reducing poverty and food

insecurity. Also an increase in land holdings can substantially improve household food security and reduce poverty. Fourth, policies which support crop diversification and access to agricultural extension services would also significantly contribute to improved household food security.

Overall, the input subsidies could be useful for food insecure and poor households in some locations in Malawi, but they alone are not a solution to food insecurity and poverty. They are only one tool that has to be built-in in a more comprehensive agricultural policy package facilitating agricultural and rural development.

Chapter 4

THE IMPACT OF FARM INPUT SUBSIDIES ON INTERNAL MIGRATION OF FARM HOUSEHOLD MEMBERS

4.1 Introduction

Increasing urban food insecurity and poverty due to rapid urbanisation are some of the challenges facing most governments in developing countries (UN-Habitat, 2007; 2012; Rhoda, 1983; Todaro, 1969). Migration of household members from locations of low to high economic opportunities, especially from rural to urban areas, has been for decades used as a livelihood strategy in both developed and developing countries.

Africa and Asia are the continents experiencing the highest rates of urbanisation in the 21st century, with sub-Saharan Africa (SSA) having the world's highest annual urban growth rate of 4.58 per cent, compared to 0.75 per cent for developed countries (UN-Habitat, 2007;2012). This is a major challenge because it has led to high urban food insecurity and poverty. SSA has the highest level of urban poverty in the world equal to about 50 per cent in some countries and 71.8 per cent of the population live in slums (UN-Habitat, 2007).

Several studies on the effects of migration of household members on household wellbeing have shown a positive impact on several indicators such as improved food and income security, poverty reduction, improved nutrition and general health of household members, and investment in productive enterprises and education of children (Harris and Todaro, 1970). However, negative effects have also been reported in areas where the available economic opportunities do not match the rate of immigration, resulting into an increased rate of urbanisation, urban food and income insecurity, urban poverty, environmental degradation, pollution, spread of diseases, and severe malnutrition (UN-Habitat, 2007; Garcia et al., 2014).

Malawi is one of the countries currently experiencing rapid urbanisation, and having high rates of urban food insecurity and poverty. Malawi's annual slum growth rate is estimated to be at 3.9 per cent, and in 2007, 68 per cent of the country's population was living in slums (UN-Habitat, 2014). Similar to other developing countries, Malawi is expected to continue experiencing rapid urbanisation in the next decades because the seasonal, rural to rural and rural to urban migration of household members helps in smoothing food and income security for the rural population whose main livelihood strategy is agriculture. It is therefore, assumed that improving agricultural production and productivity, and thus improving household food security and income in rural areas, will reduce rural out-migration and consequently reduce urban food insecurity and poverty.

Recently some governments in SSA, including Malawi, have reintroduced farm input subsidy programmes with the main aim of addressing food and income insecurity at both household and national levels. Differently from the previous farm input subsidies, most of the current programmes are targeted and are labelled 'market smart' (World Bank, 2007). These programmes are expected to improve the economic returns of agricultural production due to reduced input costs of subsidised farm inputs, especially fertilizers and hybrid seeds and consequently, improve crop production and productivity. This might act as incentive to stay in agricultural activities and as a result, slowing down the migration of household members. While slowing down migration might help to reduce the negative effects of urbanisation, it might also result into loss of economic opportunities which could have contributed to reducing rural poverty and food insecurity of the migrants' households. On the other hand, improved income from crops sales and savings on farm input purchases due to the use of farm input subsidies may be used to finance migration costs and hence facilitate migration of household members. As a result, farm input subsidies do not have a priori impact on migration.

The main objective of this study is to estimate the effects of subsidised fertilizer on rural to urban, rural to rural and seasonal migration of farm household members. To the author's best knowledge, this is the first study to analyse the effects of subsidised fertilizer on seasonal, rural to rural and rural to urban migration in SSA, and in particular, Malawi. This study is also the first to analyse the effects of repeated subsidy benefits on farm household members' migration and this helps to assess the effects of sustainable flow of intervention benefits on migration decisions and contribute to the analysis of the theory of change associated with farm input subsidies as espoused by its proponents. Meng (2012) is the only study which analyses similar aspects (i.e. the effects of grain subsidies on rural to urban migration) in China. There are substantial differences on the subsidy programmes in Malawi and China. In Meng (2012), subsidies are in form of cash, which beneficiaries receive after harvesting and the amount depends on the quantity of grain harvested, while in this study the subsidies are in the form of farm inputs to be used in production. It is interesting to see whether the differences in the type and timing of delivering the subsidies between Malawi and China have implications on the decision to migrate from rural to urban areas.

The structure of this section is as follows. The next section discusses types of migration and effects on household welfare and agricultural development. Population distribution and migration trend in Malawi are discussed in section 4.3. Sections 4.4 and 4.5 present the conceptual framework and the estimation of empirical models, respectively. Section 4.6 discusses data sources, presents the descriptive statistics and endogeneity tests results. Estimation results and discussions are presented in section 4.7. Section 4.8 concludes.

4.2 Types of migration and effects on household welfare and agricultural development

This section discusses some common types of migration, the role of migration in the process of agricultural development and its impact on household welfare, especially on poverty and income.

4.2.1 Types of Migration: Push and Pull factors

Migration literature categorises motivation for migration under the push and pull factors (ILO, 2010). The push factors include low employment opportunities, drought, civil conflicts and poverty in the location of origin, while the pull factors include favourable agricultural climatic conditions, higher employment opportunities and better working conditions in the destination location, family reunion and political stability (ILO, 2010).

The main migration push factors in SSA are drought (World Bank, 2009, 2010) and the lack of adequate public services, especially in rural areas, while the main pull factor is the economic growth in urban areas, which increases employment opportunities, and thus, household income (World Bank, 2009). Internal and international migration are the two main broad types of migration. Internal migration is the most common form of labour flows worldwide and recent statistics indicate that there are about 740 million internal migrants, which is four times the number of international migrants (World Bank, 2014). In most of the developing countries, internal migration is dominated by temporary rural to urban movement of people, and thus, the seasonal migration is the most common type (World Bank, 2014). The World Bank (2009) also highlights the importance of rural to rural migration from areas of low to high economic activities.

According to the World Bank, (2003), rural out-migration will continue in developing countries as they progress in the development process despite of any interventions in the rural

economy. Due to rapid urbanisation as a result of rural to urban migration, most policy makers in developing countries implement policies and contemplate ways of slowing down and even reversing this trend based on the premise that it contributes to high urban poverty, food and nutrition insecurity (World Bank, 2009). However, trying to reduce and reverse rural to urban migration might not be effective and the World Bank (2009) suggests the really effective way is to focus at eliminating push factors such as effects of climate change, especially drought, the lack of adequate public services and low income opportunities in rural areas. This will improve the quality of migrants and contribute to economic growth.

4.2.2 Migration Effects on Household welfare

Currently, about 746 million people live below the poverty line (i.e. on less than $2 per day), and furthermore, a quarter of the population in developing countries is extremely poor (i.e. live on less than $1.25 per day), and also a quarter of the children are malnourished (World Bank, 2010). This is the reason why most developing countries' policies focus on improving economic growth and alleviating poverty (World Bank, 2010).

The literature on migration indicates that in the process of economic development, rural out-migration is inevitable. One of the main reasons for migration of household members is to maximise their net present value of income and for household members left behind through receipt of remittances. There is a wide range of literature on the positive effects of remittances on poverty and food security in developing countries. However, the amount of remittances also depends on income levels of migrants. Due to differences in economic growth and employment opportunities of migrants' destinations, amounts of remittances may also vary among the migrants.

Figure 4.1 presents cumulative distribution of remittances by types of migration in Malawi based on the third nationally representative integrated household survey 2010/2011 (IHS3)

data. There is no significant difference in the amounts of remittances among seasonal, rural to rural and rural to urban migrants below the 40th percentile of the migrants. Significant differences on remittances are observed above the 40th percentile and the figure shows that rural to urban migrants remit the highest amounts while rural to rural migrants remit the lowest amounts annually. However, a comparison of annual per capita consumption expenditure and annual remittances in Figure 4.1 shows that only the top 90th percentiles of seasonal and rural to urban migrants remit amounts equivalent to the poverty line amount required to reduce poverty of one adult equivalent person per annum in 2011. This could be one of the explanations for the continued observed increase in the rural to urban migration trends in Malawi.

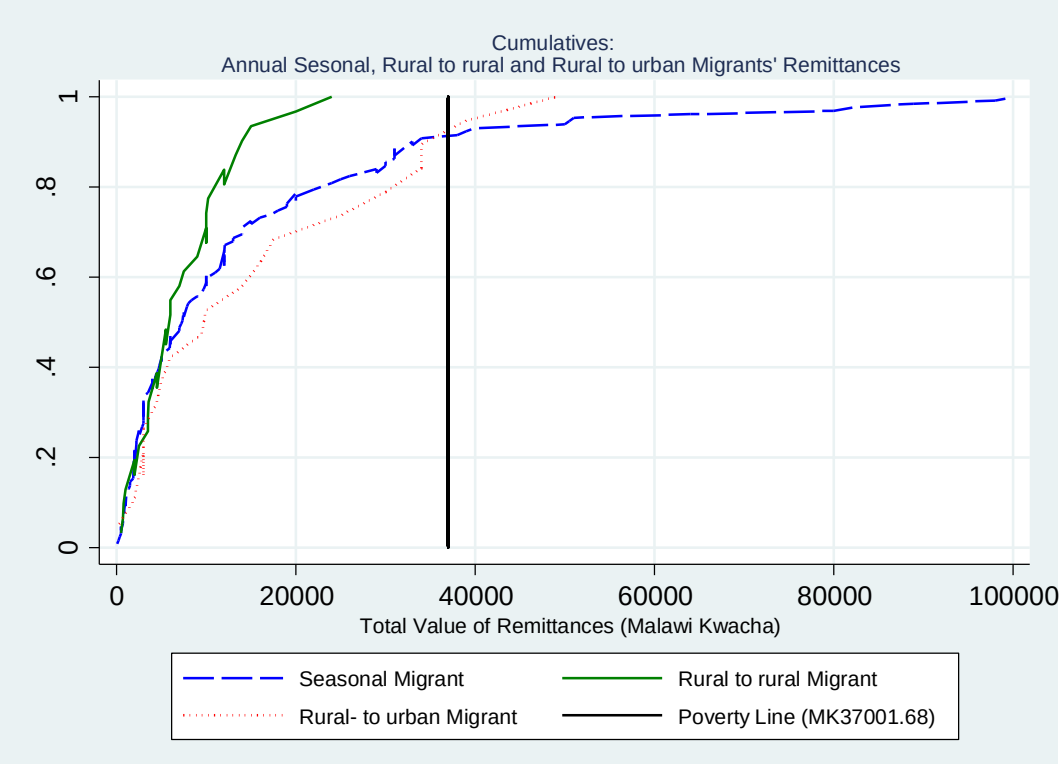

Figure 4.1: Cumulative annual seasonal, rural to rural and rural to urban migrants' remittances in Malawi.

Source: Author based on IHS3 (2010/2011) data.

The World Bank (2007, 2013) argues that migration is one of the important pathways to poverty alleviation in developing countries and that the positive effects of migration include increased income of migrants and their respective households through their wages and remittances and emphasises that the positive benefits of migration is only achieved if migrants find jobs in their migration destinations. According to the World Bank (2009), the positive effects of migration also include reduced unemployment in rural areas, where employment opportunities are mainly in agriculture; increased income for migrants' household members in communities of origin; and economic improvement in communities of origin through use of improved skills and capital of returning migrants. The World Bank (2014) underlines the importance of migration for households risk diversification, and increasing the resilience against household shocks.

The evidence from empirical studies on the effects of migration on household welfare is rather mixed. Gibson et al., (2013) review recent studies in the Pacific and Southeast Asia, and conclude that seasonal and temporary migration boosts per capita income by over 30 per cent and increases per capita expenditure, savings and purchase of durable assets. A study by Vathara et al. (2013) on the effects of emigration on households' livelihoods, using data from Cambodia, finds that poverty decreases by three percentage points if a household receives remittances from one migrant household member; and reduces consumption inequality based on Gini coefficient by 1.4 percentage points. Their study also finds that remittances increase dependency syndrome by inducing a reduction in the weekly hours worked by remaining household members and household income from salary work by 18 per cent. However, the authors find mixed results on the overall effect on household income and on crop production.

The ILO (2010) reports that labour migration can support development through remittances and return migration and this is evident in the amount of remittances migrants send to their countries of origin. The World Bank (2009) reports that in 2007 the value of remittances

received by most developing countries exceeded the total value of foreign direct investment and equity. Theoretically, such remittances can significantly contribute to the economic development through financing of education, infrastructure development and enterprise investment. However, it is found that larger proportion of the remittances is used for subsistence rather than investment, which reduces the potential developmental effects of remittance on receiving countries (ILO, 2010).

A study by Taylor et al., (2003) on the impact of migration on the income in migrants' communities of origin in China finds that the migrant raises household income through remittances. But migration of a household member results in significant reduction in crop income in the absence of remittances. However, the authors also find that remittances increases crop income, and they argue that remittance may be reducing the negative effects on crop income due to the loss of labour as a result of migration of an active household member. Deshingkar and Start (2003) analyse the effects of seasonal migration on livelihoods in India and find that income from seasonal migration is used as a copping strategy, improves standard of living, increases savings accumulation, and is invested in agriculture and children's education.

Despite the expected positive effects of internal migration on economic growth and poverty alleviation, un-coordinated urbanisation in developing countries has resulted into high rate of urban poverty, pollution, spread of diseases and severe malnutrition (World Bank, 2010). This is supported by the World Bank (2007), which argue that migration to cities is not the major contributor to rural and world poverty reduction, and reports that 81 per cent reduction in rural poverty is attributed to better conditions in rural areas rather than to rural out-migration.

4.2.3 Migration Effects on Agricultural Development

Adaku (2013) studies the effects of rural to urban migration on agricultural production in the northern region of Ghana and reports that temporary migration reduces farm production and this is mainly attributed to the loss of labour; whilst permanent migration is found to have no effects of farm production. A study by Rozelle et al., (1999) analyses the effects of migration and remittances on agricultural productivity in China and reports that migration of a household member reduces maize yield due to the loss of labour required to perform farm operations. However, their study also finds that migration increases remittances, which, in turn, is also found to increase maize yield. But the study on the effects of seasonal migration on agriculture in Vietnam by De Brauw (2007) finds no effects on aggregate production; weak evidence of move from rice production to other crops and a decrease in input use. The author also reports that the effect on agriculture is mainly as a results of a move from labour intensive into land intensive crops, rather than productivity changes. Another study by Brainoh (2004) on seasonal migration and land use change in the Volta Basin in Ghana finds an increase in the conversion of woodland to agricultural land and general transition to less vegetation cover.

4.3 Population distribution and migration trend in Malawi

Malawi's population is mainly rural based with over 80 percent of the people living in rural areas. But overtime the population distribution has been changing with the urban population showing a steady increase. Figure 4.2, based on census data (GoM, 2008) shows that the urban population increased by three percentage points from 10.7 per cent during the 1987 census to 14.4 per cent during the 1998 census. However, later on the trend slowed down, as the urban population increased by only one percentage point from 14.4 during the 1998 census to 15.3

percent during the 2008 census. Overall, the trend suggests increasing urbanisation in Malawi, but still the vast majority of the population lives in rural areas.

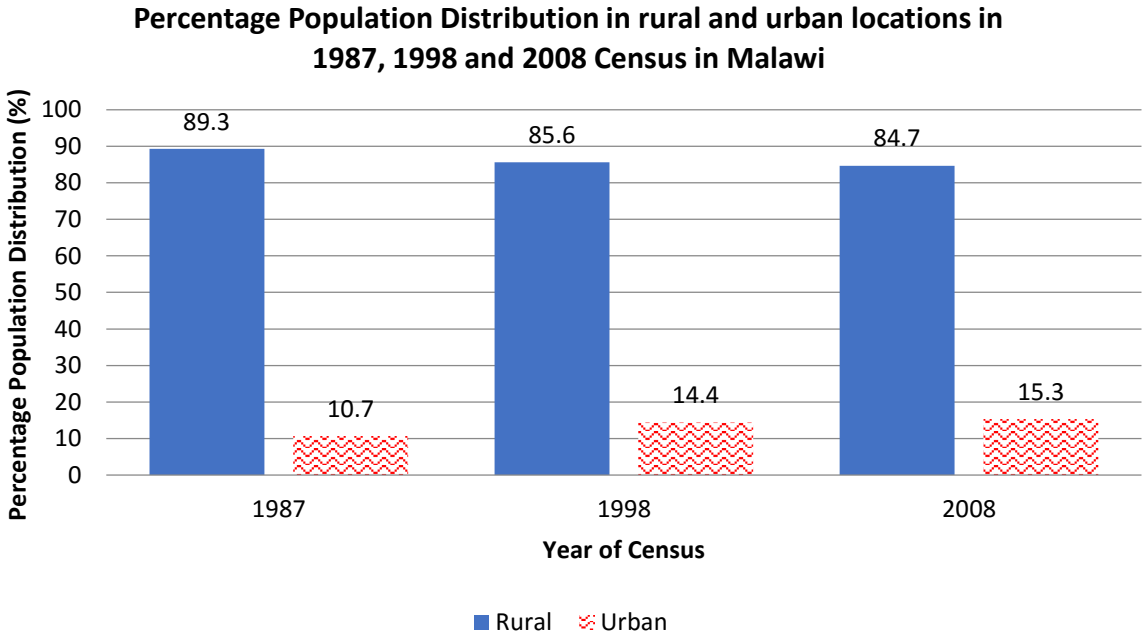

Figure 4.2: Percentage of population distribution in rural and urban locations in 1987, 1998 and 2008 Census in Malawi

Source: Author based on Census data (GoM, 2008)

The dynamics in the population distribution in Malawi suggest that people are migrating. This study focuses on internal migration- rural to urban, rural to rural and seasonal for employment purposes. In this study, seasonal migrants refer to those who moved out of their main residential areas for a period of between one and twelve months for employment purposes and returned; while rural to rural and rural to urban migrants refer to those who migrated for employment purposes for a period of between one and three years and had not returned by the time of the surveys. The maximum three year period is chosen to correspond with the survey periods for the data used and the available information on households' benefit to farm input subsidies in Malawi. Section 4.6 provides more details on the data and selection of migration periods used in the empirical analyses.

Figure 4.3 illustrates migration trends of household members for employment purposes between 2005 (before the implementation of the large farm input subsidy programme, FISP), 2010, and 2013 (during the implementation of FISP) based on the second integrated household survey (IHS2) and integrated household panel surveys (IHPS) data, respectively.

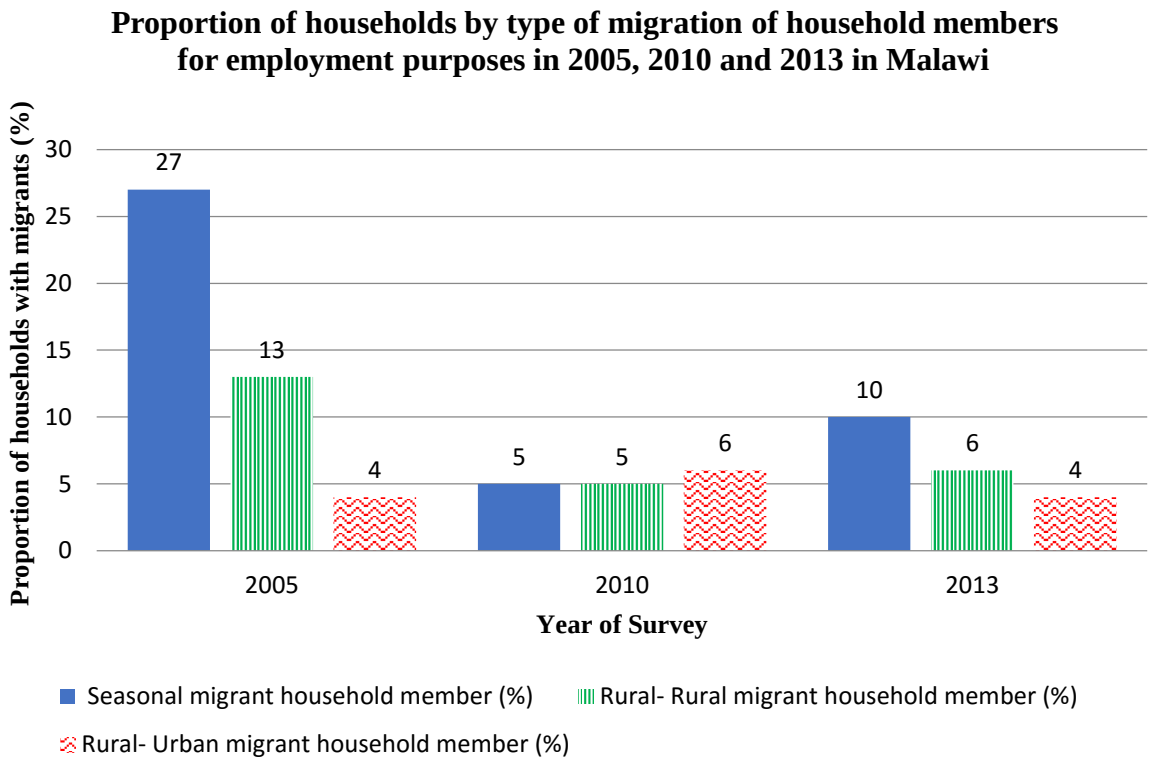

Figure 4.3: Proportion of households by type of migration of household members for employment purposes in 2005, 2010 and 2013 in Malawi.

Source: Author based on IHS2 and IHPS data.

The seasonal migration of household members decreased by 22 percentage points, from 27 per cent in 2005 to 5 per cent in 2010 and then increased by 5 percentage points to 10 per cent in 2013. Rural to rural migration also decreased by 8 percentage points from 13 per cent in 2005 to 5 per cent in 2010 and then increased to 6 per cent in 2013. During the same period rural to urban migration increased by two percentage points from four per cent to six per cent;

and then decreased by again two percentage points to four percent in 2013. However, the report by the UN-Habitat shows that Malawi's urban population is growing at a much faster rate. The average decade rate of Malawi's urban population growth for the period 2000 to 2010 was 3.45 per cent and is projected to increase to 4.9 percent for the period 2020 to 2030 (UN-Habitat, 2014).

4.4 Theoretical framework

This section presents the model of decision to migrate out of the farm. The model is based on the new economics of labour migration (NELM) theory (Stark and Bloom, 1985), in which migration decision is assumed to be a collective household decision, rather than an individual's decision as is the case in the expected income model (Todaro, 1969). In the expected income model, it is assumed that the individual's decision to migrate or not is based on the net difference of discounted expected income between the present location and the migrant destination (Todaro, 1969).While in the NELM theory, the household as a whole is assumed to share the costs of migration and benefits of migration of a household member through remittances, and thus, reducing the risks involved in migration and facilitating migration as a household livelihood strategy (Stark and Bloom, 1985).

In this study, the focus is on migration motivated by both push and pulls factors. The model of migration accounts also for other factors which play significant role in migration decisions by households. Risks associated with agricultural production, such as drought and floods, access to public facilities such as hospitals and schools, and probabilities of employment have all been found to have significant effects on the decision to migrate (Meng, 2012; United Nations, 2011). Since most households in the dataset in this study are based in rural areas and agricultural production is the main livelihood strategy, migration decisions are based on

expected utility differentials between having a household member staying on the farm (from a combination of consumption of own production, income from sales of agricultural produce, rural off-farm wages and non-farm income, access to public services) and having a household member migrating (mainly from a combination of non-farm wages, reduced risks (Stark and Levhari, 1982) , access to improved public and private facilities, increased household income through remittances).

Based on the expected positive impact of farm input subsidies on household food security and income from crop sales, two hypotheses are formulated in relation to the internal migration of farm households' members:

(1): There is a negative relationship between FISP and household's members rural to urban, rural to rural and seasonal migration;

(2): The benefits from more cycle of farm input subsidy disbursement, the higher the magnitude of the negative effects on household's members rural to urban, rural to rural and seasonal migration.

Let U_M and U_S represent overall expected utility to members of household i after migration M of a household member and if the household member stays on the farm S, respectively. A rational household will choose either of the two by aiming at maximising the expected utility and the observed choice signify greater utility. Following Greene (2003), the household's optimisation problem is to make a decision that maximises the expected utility:

$$Max\{E[U_S(X, S_S, L_S)], U_M(X, S_M, L_M) - C\} \quad (4.1)$$

where X represent a vector of household characteristics, S_S and S_M represent vectors of quantities of subsidised fertilizer redeemed with coupons if a household member stays on the farm household and migrates, respectively, L_S and L_M represent vectors of present farm household and migration destination locations characteristics, respectively, and C represents the costs of migration. The expected utility if the household member stays on the farm is

determined by a function $U_S(X, S_S, L_S)$ while the expected utility if a household member migrates is determined by a function $U_M(X, S_M, L_M) - C$. However, the probability of households getting coupons for subsidised fertilizer after a household member has migrated might be low because of the community expectation that such households might be receiving remittances and therefore, do not meet some of the subsidy targeting criteria such as being poor and unable to self-finance the purchase of farm inputs at commercial prices.

The household's decision to have a household member migrate or not is

$M = 1$ if $U_M > U_S$

and

$$M = 0 \text{ if } U_M \leq U_S \tag{4.2}$$

4.5 Estimation of empirical model

Empirical analyses are carried out to investigate the impact of subsidised fertilizer on migration of farm household members at two levels: (i) the effects of one-off benefit on rural to urban, rural to rural, and seasonal migration; (ii) the effects of repeated benefits on rural to urban, rural to rural, and seasonal migration.

Estimation of the model of migration decision for household i is carried out by applying the Probit Model. The estimation equation is as follows:

$$M_{i1} = \beta_0 + h_{i1}\beta_1 + region_{i1}\beta_2 + \beta_3 fertilizer_{i1} + \mu_{i1} \tag{4.3}$$

where M_{i1} is the binary dependent variable and equal to one if a household member migrated (rural to urban; rural to rural; seasonal) or zero otherwise; h_{i1} is a vector of household characteristics, including sex, and age of household head, total land owned, household size and distance to the district centre; $region_{i1}$ is a vector of regional location of the household in southern, central or northern region; $fertilizer_{i1}$ is a vector of quantity of subsidised fertilizer redeemed by the household using subsidy coupons during the 2009/10 agricultural season (in the analyses of the effects of repeated benefit of subsidised fertilizer, frequency dummies are used and are represented by one, two, three, and four times benefits); μ_{i1} is an idiosyncratic error term; and β are the parameters to be estimated. The use of household characteristics rather than the individual migrant's characteristics in modelling the decision of a farm household member's migration conforms to the new economics of labour migration (NELM) theory of household collective decision making (Stark and Bloom, 1985).

4.6 Data source, descriptive statistics and endogeneity test

The empirical analyses of the migration models use the same data source as described in section 2.7 of Chapter 2 of this thesis. However, for this study, households which did not engage in agricultural activities during the two survey periods are excluded in order to ensure that only households with similar production function are used as control and treatments in the empirical analyses.

Furthermore, causality assessment of the impact of subsidised fertilizer on migration decisions entails that we cannot use the two wave panel data because we do not have information on access to subsidised fertilizer the period before the 2008/2009 agricultural season. Since the rural to urban and rural to rural migration of household members in this study

is categorised as long term migration of one year or more, causality assessment of the impact of subsidies can only be carried out by using information on past benefit to subsidised fertilizer for at least more than a year based on the preceding surveys and on the observed migration decisions based on information in the recent survey. Therefore, in this study we use quantity of subsidised fertilizer the household redeemed in the 2009/2010 agricultural season to assess its impact on rural to urban and rural to rural migration of farm household members for a period of between one to three years; and on seasonal migration for a period of between one and twelve months.

The migration decisions which took place between one to three years are used in this study because the information on migration decisions after receipt of the fertilizer subsidy coupons during the 2009/2010 agricultural seasons was collected in the second wave of the panel data surveys in 2013. However, for the analysis of the effects of the repeated benefits to subsidised fertilizer on migration decision, we use the maximum of four times benefit because the household historical subsidy coupons' access only dates back to the 2008/2009 agricultural season. As a result, this study uses a cross section sample of 3,155 households.

4.6.1 Descriptive statistics

Table 4.1 presents the descriptive statistics of variables used in the empirical analyses. Concerning the targeted farm input subsidy programme (FISP), the overall sample average of the redeemed subsidised fertilizer is 42 kg for the 2009/10 agricultural seasons. Considering the beneficiaries only, the average redeemed fertilizer is 79 kg per household, which is less than the standard FISP programme package of 100 kg of subsidised fertilizer. With respect to the frequency of benefit to the subsidisation programme, the results show that for most households there is no continuity of benefit. Although about 50 per cent of the households received coupons and redeemed them with subsidised fertilizer, only 25 per cent of the sampled

households received coupons four times continuously from 2008/09 to 2011/12 agricultural seasons. Consequently, the fertilizer subsidy programme may have differing effects on different households depending of the number of repeated benefits. It is expected that the effect will be larger for households which have benefited from the programme more repeatedly and continuously than for those which were targeted once in a while.

Concerning the migration of household members, the descriptive statistics show that the most popular type of migration for work related purposes is the seasonal migration involving ten per cent of the sample, while rural to rural and rural to urban migration is at five and two per cent, respectively. This is expected due to differences in migration costs involved in different types of migration. Since in seasonal migration the migrant relocates temporarily to a new location between periods of one to twelve months, it might involve lower migration costs than long-term migration such as rural to urban and rural to rural, and therefore, making it a more attractive type of migration. Furthermore, the average differences between fertilizer subsidy beneficiaries and non-beneficiaries show higher incidences of farm household members' migration among non-beneficiary households compared with beneficiaries, suggesting the potential negative effects of access to farm input subsidies on farm household members' migration.

Statistics show that 76 per cent of the households are headed by males and that the average age of the household head is 43 years. However, the mean differences between fertilizer subsidy beneficiaries and non-beneficiaries show there is no statistically significant differences on sex of the household head, while beneficiary households are headed by older household heads than non-beneficiaries. Several migration studies have shown that males and younger household members have higher probabilities of migrating than females and older household members (Lewin et al., 2012). The educational level of household heads shows that 69 per cent have no formal education qualifications, while 10 per cent, 9 per cent, 8 per cent and 4 per cent

have Primary School Leaving Certificate, Junior Certificate of Education, Malawi School Certificate of Education and Diploma or Degree, respectively. The statistics also show that fertilizer subsidy beneficiary households have less educated household heads compared with non-beneficiary households. In migration literature, education level of the potential migrant is found to be one of the key factors determining the probability of migrating. (Lewin et al., 2012).

Data on household size show that on average a household has five members. This highlight the challenge farm households have of meeting food and income security for household members. Inadequate agricultural land area seems to be one of the constraints faced by most farmers as the descriptive statistics show that the average landholding size is only 0.6 hectares, with fertilizer subsidy beneficiary households owning relatively larger landholdings than non-beneficiary households. Coupled with a large household size, such landholdings may not be able to produce enough food to feed the household and provide surplus to sell to meet household income requirements. It is such types of challenges that force households to smooth their food consumption and income through migration of household members.

The average distance to the district centre is 31 km and such a distance acts as a barrier to commuting for household members from remote areas because of high transport and transaction costs. The statistics also show that fertilizer subsidy beneficiary households are located further away from the district centres compared with non-beneficiary households, which also act as a barrier to access farm input and output markets. Overall, 27 per cent of the sampled households indicates that MPs reside in or visited their communities in the past three months preceding the survey, and 32 per cent of fertilizer subsidy beneficiaries reported to have a resident MP or were visited by the MP compared with only 22 percent of the non-beneficiary households. This suggests the potential political influence of MPs on coupon distributions of subsidised farm inputs in Malawi.

Table 4.1: Descriptive Statistics

Variable	All (Full Sample) (I)		Beneficiaries Only (II)		Non-Beneficiaries Only (III)		Mean Difference (II-III) (IV)
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean/SE
Household head (male)	0.76	0.42	0.76	0.42	0.77	0.42	-0.02 (0.02)
Household head age (years)	42.53	15.96	43.92	16.48	40.9	15.17	3.02*** (0.57)
Head no formal educ qualification	0.69	0.46	0.74	0.44	0.63	0.48	0.11*** (0.02)
Head primary educ qualification	0.1	0.30	0.1	0.3	0.09	0.29	0.01 (0.01)
Head junior second educ qualification	0.09	0.29	0.09	0.29	0.1	0.3	-0.01 (0.01)
Head Malawi secondary educ qual	0.08	0.27	0.06	0.23	0.11	0.31	-0.05*** (0.01)
Head tertiary educ qualification	0.04	0.19	0.01	0.11	0.07	0.25	-0.05*** (0.01)
Household size	4.99	2.29	5.03	2.28	4.96	2.31	0.06 (0.08)
Northern region	0.20	0.40	0.22	0.42	0.18	0.38	0.04*** (0.01)
Central region	0.39	0.49	0.37	0.48	0.41	0.49	-0.04** (0.02)
Southern region	0.41	0.49	0.41	0.49	0.41	0.49	-0.004 (0.02)
Total land (hectares)	0.64	0.7	0.69	0.7	0.58	0.69	0.11*** (0.02)
Distance to district (Km)	31.23	36.34	33.93	33.64	28.09	39.04	5.84*** (1.29)
MP resident or visit	0.27	0.45	0.32	0.47	0.22	0.41	0.10*** (0.02)
Rural-urban migrant	0.02	0.15	0.01	0.12	0.03	0.18	-0.02*** (0.01)
Rural-rural migrant	0.05	0.21	0.04	0.18	0.06	0.23	-0.02*** (0.01)
Seasonal migrant	0.1	0.3	0.08	0.27	0.11	0.32	-0.03*** (0.01)
Subsidised fertilizer (Kg)	42.41	44.16	78.71	28.14			
One-time benefit	0.08	0.27	0.11	0.31			
Two-times benefit	0.09	0.29	0.12	0.33			
Three-times benefit	0.05	0.22	0.07	0.25			
Four-times benefit	0.25	0.44	0.36	0.48			
Number of obs.	3155		1700		1455		

Note: ***, ** represents statistically significant at 1 % and 5 % level; Beneficiaries only=2010 FISP; Km=Kilometres; MP=Member of Parliament; SE=standard errors in parentheses.

4.6.2 Endogeneity test of subsidised fertilizer

Distribution of subsidised fertilizer coupons under the farm input subsidy programme is not random and only those targeted receive the coupons. Therefore, the unobserved time-invariant household heterogeneity may be correlated with the household members' decision to migrate and hence making the subsidised fertilizer in the estimations endogenous. The endogeneity of subsidised fertilizer is tested in all estimations using a Member of Parliament (MP) residence or visit in the past three months preceding the surveys in the community as an instrument for subsidised fertilizer. Section 2.6.4 of Chapter 2 in this thesis provides details on the application of the control function (CF) approach of the IV methods and a discussion on the rationally of using a Member of Parliament (MP) as an IV and the test results of its exogeneity at a community level.

Endogeneity test results on migration decisions are incorporated in the tables of results in Tables 4.2-4.5 and the results show that subsidised fertilizer is endogenous only on rural to urban migration of household members. Table 4.A1 in Appendix 4A presents identification test results of MP residence or visit in the community as an IV and show that it has statistically insignificant effects on rural to urban, rural to rural and seasonal migration decision of farm household members. Similar to discussions in Chapters 2 and 3, the chosen instrument might be weak, however, according to the best knowledge of the author, currently there is no method of testing weak instrumental variables under the CF approach.

4.7 Results and discussion

This section presents and discusses the regression results on factors determining rural to urban, rural to rural and seasonal migration of household members. The focus of the discussion is on the effects of subsidised fertilizer. Results on factors determining rural to urban migration are

discussed in section 4.7.1; rural to rural migration in section 4.7.2; and seasonal migration in section 4.7.3. Results on the effects of subsidised fertilizer based on repeated benefits are discussed in section 4.7.4.

4.7.1 The impact of subsidised fertilizer on rural to urban migration.

Table 4.2 presents the regression results of factors which influence the migration of household members from rural to urban area. Model I is a Probit model and is presented to check the robustness of the results because it does not take into account the potential endogeneity of subsidised fertilizer. Model II is the Probit model with CF residuals to test the IV and control for the potential endogeneity of subsidised fertilizer. Since the generalised residuals are statistically significant in Model II, indicating the endogeneity of subsidised fertilizer, the discussion in this section is based on the results of this model.

The results show that the subsidised fertiliser has negative effects on rural to urban migration. An additional 100 kg of subsidised fertiliser decreases the probability of household members to migrate to urban area by six percentage points. This supports the hypothesis that there is a negative relationship between FISP and the migration of household members.

Education has the expected effects and higher educational attainment of the household head increases the likelihood of rural to urban migration of household members. Households with household heads having tertiary education have three percentage points higher probability of having household members migrating from rural to urban area than those with household heads who have no any qualification. In this study, 75 per cent of the rural to urban migrants are household heads, and therefore, these results underline the importance of education on migration since those with higher qualifications are more likely to be employed in the migration destination area than those with no qualification.

Table 4.2: Regression results on factors determining Rural to Urban Migration of farm household members

Independent Variables	Dependent variable: Rural-Urban Migration. Probit Model (I)	Dependent variable: Rural-Urban Migration. Probit Model with CF Residuals (II)
	ME/SE	ME/ SE†
Generalised residuals		0.02**
		(0.01)
Subsidised fertilizer (100Kg)	-0.02**	-0.06***
	(0.01)	(0.02)
Primary School Certificate	0.01	0.01
	(0.01)	(0.01)
Junior Secondary Certificate	0.01	0.01
	(0.01)	(0.01)
Malawi Secondary Certificate	0.02**	0.01
	(0.01)	(0.01)
Diploma/Degree Certificate	0.04***	0.03***
	(0.01)	(0.01)
Central region location	0.001	0.001
	(0.01)	(0.01)
Northern region location	-0.01	-0.01
	(0.01)	(0.01)
Household head (male)	0.02***	0.02***
	(0.01)	(0.01)
Household head age (years)	-0.001**	-0.001**
	(0.0002)	(0.0002)
Household size	0.002*	0.002*
	(0.001)	(0.001)
Landholding size (hectares)	-0.05***	-0.05***
	(0.01)	(0.01)
Distance to district centre	-0.0001	-0.00004
	(0.0001)	(0.0001)
Constant	0.02***	0.02***
	(0.003)	(0.003)
Number of observations:	3155	3155
Wald chi2	130.85	120.87
Prob > chi2 [p-value]	[0.0000]	[0.0000]
Log pseudolikelihood	-283.32	-280.87
Correctly classified	97.69%	97.69%
Pseudo R2	0.18	0.19

Notes: *, **, and *** represents statistically significant at 10%, 5% and 1% significance level, respectively; ME=Average Marginal Effects (AME); SE=robust standard errors are in parentheses (); SE† =bootstrap standard errors (1000 reps); CF=Control Function.

The results show that households with large size have higher probabilities of having a rural to urban migrant, but the magnitude of the effect is small. This is expected as such households usually face food deficit and low incomes, consequently, migration of household members could be one of the strategies of smoothening household food availability and income.

The results on the size of the landholding covariate show statistically significant and negative effects. An increase in landholding size by one hectare decreases rural to urban migration by five percentage points. Household with male head have higher probability of having a rural to urban migrant than female headed households. This is consistent with several studies which show that males have higher probability of migrating than females and this is expected in this study since the majority of the rural to urban migrants are males and from male headed households.

4.7.2 The impact of subsidised fertilizer on rural to rural migration.

Regression results on factors affecting rural to rural migration of household members are presented in Table 4.3. Model I is the Probit model and the discussion is based on the results of this model. Model II is presented for robustness assessment because the generalised residuals in this model are statistically insignificant, suggesting that subsidised fertilizer is exogenous in the rural to rural migration decision of farm household members.

The results show that subsidised fertilizer has statistically significant and negative effects on rural to rural migration. An additional 100 kg of subsidised fertilizer reduces the probabilities of migration by two percentage points at 10 % level of significance. Relative to the effects on rural to urban migration, the magnitude of the effect on rural to rural migration is much smaller.

Table 4.3: Regression results on factors determining Rural to Rural Migration of farm household members

Independent Variables	Dependent variable: Rural-Rural Migration. Probit Model (I)	Dependent variable: Rural-Rural Migration. Probit Model with CF Residuals (II)
	ME/SE	ME/ SE†
Generalised residuals		-0.01
		(0.01)
Subsidised fertilizer (100Kg)	-0.02*	-0.002
	(0.01)	(0.02)
Primary School Certificate	0.002	0.002
	(0.01)	(0.01)
Junior Secondary Certificate	0.04***	0.04***
	(0.01)	(0.01)
Malawi Secondary Certificate	0.04***	0.04***
	(0.01)	(0.01)
Diploma/Degree Certificate	0.06***	0.06***
	(0.02)	(0.02)
Central region location	-0.002	-0.001
	(0.01)	(0.01)
Northern region location	0.004	0.003
	(0.01)	(0.01)
Household head (male)	0.02**	0.02*
	(0.01)	(0.01)
Household head age (years)	-0.001**	-0.001**
	(0.0003)	(0.0003)
Household size	0.004**	0.004**
	(0.002)	(0.002)
Landholding size (hectares)	-0.01	-0.01
	(0.01)	(0.01)
Distance to district centre	0.0002**	0.0002**
	(0.0001)	(0.0001)
Constant	0.05***	0.05***
	(0.004)	(0.004)
Number of observations:	3155	3155
Wald chi2	75.55	77.43
Prob > chi2 [p-value]	[0.0000]	[0.0000]
Log pseudolikelihood	-541.93	-541.75
Correctly classified	95.50%	95.50%
Pseudo R2	0.06	0.07

Notes: *, **, and *** represents statistically significant at 10%, 5% and 1% significance level, respectively; ME=Average Marginal Effects (AME); SE=robust standard errors are in parentheses (); SE† =bootstrap standard errors (1000 reps); CF=Control Function.

Due to the similarities in economic characteristics of most rural areas, i.e. their dependence on agricultural interventions, farm input subsidies may not have much effects since migrants may still benefit from the subsidy programme in the new location. Furthermore, there might be little differences on discounted future utility between two rural locations because of similar sources of income and accessibility to public services in rural areas.

Education is also found to increase the probability of having a rural to rural migrant in the household. Households with household heads having secondary and diploma or degree qualification have higher probability of having rural to rural migration of household members by four and six percentage points, respectively compared with those with household heads who have no any qualification. Old age of household head and increased distance to district centres are associated with reduced probability of household members' migration from one rural area to another. However, the magnitude of the effects are very small. As expected and similar to results in Table 4.2, male headed households and those with large household size have increased probability of have rural to rural migrating household members.

4.7.3 The impact of subsidised fertilizer on seasonal migration.

Regression results on factors influencing seasonal migration of household members are presented in Table 4.4. As in the previous section, the discussion is based on the results of Model I, the Probit model.

The results show that subsidised fertilizer has negative effects on seasonal migration, but it is statistically insignificant. One plausible explanation for this finding is that in seasonal migration, household members can migrate after receiving subsidised fertilizer coupons and thus subsidies have no effect on the decision of the household member to migrate. Household members may also migrate after harvesting period, and therefore, the household may still benefit from the farm input subsidy despite having a seasonal migrant member. Thus, seasonal

migration is not necessarily related to the exclusion of the household from benefiting from public interventions.

Higher education of household heads has the expected positive effects on the probability of having a seasonal migrant. Having a household head with a junior secondary school qualification increases the probability of seasonal migration of household members by five percentage points, and it increases by six percentage points for those having tertiary qualification, compared to those with no qualification. Old age is found to negatively affect seasonal migration, although with minimal effects.

Having larger landholding size has the expected negative effects on seasonal migration since large landholdings are associated with higher income from crop sales and household food security. Therefore, such households have higher discounted expected utility from agricultural activities than seasonal migration, especially through differences in expected income. Increased agricultural labour demand for households with larger landholding size also explains the negative effects large landholding size has on migration of household members. The results show that an additional hectare of land decreases the probability of seasonal migration by four percentage points.

Regional characteristics is found to have significant effects on seasonal migration of household members. Household located in the central and northern regions have lower probabilities of having seasonal migration of household members by six and eleven percentage points, respectively compared with households located in the southern region. This could be attributed to differences among the regions on economic development and demand and supply of seasonal labour. The central and northern regions have more tobacco estates and consequently, have higher demand of seasonal farm labour, while the southern region is associated with lower landholdings per capita and has high seasonal labour supply.

Table 4.4: Regression results on factors determining Seasonal Migration of farm household members

Independent Variables	Dependent variable: Seasonal Migration. Probit Model (I)	Dependent variable: Seasonal Migration. Probit Model with CF Residuals (II)
	ME/SE	ME/ SE†
Generalised residuals		-0.01
		(0.01)
Subsidy fertilizer (100Kg)	-0.02	-0.02
	(0.01)	(0.01)
Primary School Certificate	0.02	0.02
	(0.02)	(0.02)
Junior Secondary Certificate	0.05***	0.05***
	(0.02)	(0.02)
Malawi Secondary Certificate	0.03*	0.03*
	(0.02)	(0.02)
Diploma/Degree Certificate	0.06***	0.07***
	(0.02)	(0.03)
Central region location	-0.06***	-0.06***
	(0.01)	(0.01)
Northern region location	-0.11***	-0.11***
	(0.02)	(0.02)
Household head (male)	0.01	0.01
	(0.01)	(0.01)
Household head age (years)	-0.002***	-0.002***
	(0.0004)	(0.0004)
Household size	0.001	0.001
	(0.003)	(0.003)
Landholding size (hectares)	-0.04***	-0.04***
	(0.01)	(0.01)
Distance to district centre	0.0001	0.00004
	(0.0002)	(0.0002)
Constant	0.10***	0.10***
	(0.01)	(0.01)
Number of observations:	3155	3155
Wald chi2	141.93	144.04
Prob > chi2 [p-value]	[0.0000]	[0.0000]
Log pseudolikelihood	-933.80	-933.39
Correctly classified	90.30%	90.30%
Pseudo R2	0.07	0.07

Notes: *, **, and *** represents statistically significant at 10%, 5% and 1% significance level, respectively; ME=Average Marginal Effects (AME); SE=robust standard errors are in parentheses ();SE† =bootstrap standard errors (1000 reps); CF=Control Function.

4.7.4 The impact of repeated benefits to subsidised fertilizer on rural to urban, rural to rural and seasonal migration.

Table 4.5 presents the regression results of Probit Models (I), (II) and (III) on the effects of subsidised fertilizer based on repeated benefits on household members' rural to urban, rural to rural, and seasonal migration, respectively.

Model (I) in Table 4.5 presents regression results of factors affecting rural to urban migration decisions. The results show that only four times benefit to fertilizer subsidies has statistically significant and negative effects on rural to urban migration by three percentage points compared to non-beneficiaries. Repeated subsidisation ensures a consistent flow of support to the household engaging in agricultural activities and reduces the dependency on other forms of livelihood strategies, such as migration.

The regression results of the determinants of rural to rural migration are presented in model (II) in Table 4.5. The results indicate that only after benefiting twice from the subsidised fertilizer has statistically significant and negative effects on rural to rural migration of household members by four percentage points.

All other covariates have signs and magnitudes which are similar to those reported in section 4.7.2. However, the distance to the district centre has unexpected positive effect of rural to rural migration. This may suggest that long distance to the district centres, which are some of the major urban areas, may discourage rural to urban migration and households faced with this challenge may prefer migrating to other rural areas.

Regression results of factors influencing seasonal migration are presented in model (III) in Table 4.5. The results on the repeated benefits to subsidised fertilizer show no statistically significant effects on household members' decision on seasonal migration.

Table 4.5: Regression results on factors influencing household members' migration.

Independent Variables	Probit Model-Dependent Variables:		
	Rural-Urban Model (I)	Rural-Rural Model (II)	Seasonal Model (III)
	ME/SE	ME/SE	M/SE
One time fertilizer benefit	-0.01	-0.001	0.002
	(0.01)	(0.01)	(0.02)
Two times fertilizer benefit	-0.01	-0.04**	-0.0001
	(0.01)	(0.02)	(0.02)
Three times fertilizer benefit	-0.1	-0.02	-0.03
	(0.01)	(0.02)	(0.03)
Four times fertilizer benefit	-0.03***	-0.02*	0.001
	(0.01)	(0.01)	(0.01)
HH Head (male)	0.02***	0.02*	0.01
	(0.01)	(0.01)	(0.01)
HH Head age (years)	-0.001**	-0.001**	-0.002***
	(0.0002)	(0.0002)	(0.0004)
Household size	0.002*	-0.003*	0.002
	(0.001)	(0.002)	(0.002)
Land total (hectares)	-0.05***	-0.003	-0.04***
	(0.01)	(0.01)	(0.01)
Distance to district	-0.0001	0.0002**	0.00003
	(0.0001)	(0.0001)	(0.0002)
Central region	-0.0004	-0.002	-0.06***
	(0.01)	(0.01)	(0.01)
Northern region	-0.01	0.004	-0.11***
	(0.01)	(0.01)	(0.02)
Primary Sc Cert.	0.01	0.003	0.02
	(0.01)	(0.01)	(0.02)
Junior Sec. Cert.	0.01	0.04***	0.05***
	(0.01)	(0.01)	(0.02)
Malawi Sec. Cert	0.02**	0.04***	0.03*
	(0.01)	(0.01)	(0.02)
Diploma/Degree	0.04***	0.06***	0.07***
	(0.01)	(0.02)	(0.02)
Control	0.02***	0.05***	0.10***
	(0.003)	(0.004)	(0.01)
No. of observations	3155	3155	3155
Wald chi2	113.93	80.91	142.42
Prob > chi2 [p-value]	[0.0000]	[0.0000]	[0.0000]
Log pseudolikelihood	-281.43	-539.02	-933.72
Correctly classified	97.69%	95.50%	90.30%
Pseudo R2	0.19	0.07	0.07

Notes: *, **, and *** represents statistically significant at 10%, 5% and 1% significance level, respectively; ME=Average Marginal Effects; SE =robust standard errors.

This is consistent with the result in section 4.7.3, indicating that subsidised fertilizer has no effect on seasonal migration of farm household members. Since seasonal migration is temporary, this may mean that households of seasonal migrants can still be targeted and benefit from fertilizer subsidies before migrating or after returning from their migration destinations. Based on the theory of migration, this may also mean that seasonal migration provides a significant alternative source of livelihood to some rural households despite their dependence on agriculture and receipt of subsidies.

4.8 Conclusion

This study has analysed the impact of subsidised fertilizer on rural to urban, rural to rural and seasonal migration of farm household members in Malawi. The study has also investigated the effects of repeated subsidisation on migration of household members.

The results reveal that fertilizer subsidy decreases the probabilities of farm household members' migration from rural to urban and rural to rural areas and that repeated benefits does not increase the magnitude of the negative effects on migration. However, the study finds no evidence of effects on seasonal migration

The negative effects on rural to urban migration suggest that the fertilizer subsidy policy might be one of the tools of controlling rural to urban migration in developing countries and thereby, contributing to the reduction in urban unemployment, food insecurity and poverty.

Concerning policies, these results suggests that policies aimed at reducing urbanisation should ensure implementation of interventions which provide increased benefits to rural households. As the number of educated and skilled labour in rural areas is increasing over time due to improved access to education, rural to urban migration of household members is inevitable. Therefore, policies that facilitate access to agricultural land could effectively

contribute to reduced rate of rural to urban migration in the long-term through increased access to food and income from crop production and sales, respectively.

Appendix 4A. Identification test results of MP community residence and visit as IV

Table 4.A1: Regression results on factors influencing household members' migration.

Independent Variables	**Dependent Variables:**		
	Rural-Urban	**Rural-Rural**	**Seasonal Migration**
	Probit Model (I)	**Probit Model (II)**	**Probit Model (III)**
	ME/SE	**ME/SE**	**ME/SE**
MP residence or visit	0.004	0.01	-0.02*
	(0.01)	(0.01)	(0.01)
HH Head (male)	0.02***	0.02*	0.01
	(0.01)	(0.01)	(0.01)
HH Head age (years)	-0.001**	0.001**	-0.002***
	(0.0002)	(0.0003)	(0.0004)
Household size	0.002*	-0.004*	0.001
	(0.001)	(0.002)	(0.003)
Land total (hectares)	-0.05***	-0.01	-0.04***
	(0.01)	(0.01)	(0.01)
Distance to district	-0.0001	0.0002**	0.0001
	(0.0001)	(0.0001)	(0.0002)
Central region	0.001	-0.001	-0.06***
	(0.01)	(0.01)	(0.01)
Northern region	-0.01	0.002	-0.11***
	(0.01)	(0.01)	(0.02)
Primary Sc Cert.	0.01	0.001	0.02
	(0.01)	(0.01)	(0.02)
Junior Sec. Cert.	0.01	0.04***	0.05***
	(0.01)	(0.01)	(0.02)
Malawi Sec. Cert	0.02**	0.04***	0.03*
	(0.01)	(0.01)	(0.02)
Diploma/Degree	0.04***	0.06***	0.07***
	(0.01)	(0.01)	(0.02)
Control	0.02***	0.05***	0.10***
	(0.003)	(0.004)	(0.01)
No. of observations	3155	3155	3155
Wald chi2	122.90	74.77	141.83
Prob > chi2 [p-value]	[0.0000]	[0.0000]	[0.0000]
Log pseudolikelihood	-285.86	-542.37	-933.08
Correctly classified	97.69%	95.50%	90.30%

Notes: *, **, and *** represents statistically significant at 10%, 5% and 1% significance level, respectively; ME=Average Marginal Effects; SE =robust standard errors.

Chapter 5

CONCLUSION

5.1 Summary of the Results

The research reported in this thesis, has examined the effects of a farm input subsidy policy on farm households' market participation, welfare and migration using cross section, linear and non-linear panel data models. To our best knowledge, the research in this thesis is the first to have estimated the effects of farm input subsidies on farm household's output market participation, and to have used different indicators of welfare and migration to those used in existing literature to analyse the effect of this policy in sub-Saharan African (SSA), and in particular, Malawi. Every effort has been taken to account for potential endogeneity of explanatory variables and the conversion of non-standard measurement units into standard units. A range of alternative models have also been estimated to check the robustness of the selected empirical models' estimates and the results presented in this thesis do suggest that they are robust to the estimation strategies.

In Chapter 2, the research examined the impact of subsidised fertilizer on farm households' maize market participation. Here the dependant variables of interest were participation in market as sellers, the quantity sold and proportion of harvested maize sold, employing non-linear panel data models. The rationally for the analysis of this relationship is that theoretically, farm input subsidies are expected to increase production and productivity and therefore, increase surplus produce available for sell. Furthermore, a farmer's participation in agricultural produce markets as a seller can become an important source of household income. In addition to the provision of household consumption, this income may be used to finance future purchase of farm inputs and investment in non-farm enterprises and hence may contribute considerably toward poverty alleviation.

The main findings of the study presented in Chapter 2 are that subsidised fertilizer does appear to increase farm households' participation in maize market as sellers and increases quantities sold of maize. In addition subsidised fertilizer is estimated to increase the commercialisation of maize, but the magnitude of this effect is small. This small effect on the commercialisation of maize suggests that the level of maize production at household level remains at or below the level needed to meet household food requirements and thus, some part of any additional produce resulting from subsidised fertiliser and other input use may itself be required for household consumption, leaving little as a marketable surplus. Consistent with the theory of change of input subsidies, overall, subsidised fertilizer is estimated to increase farm household maize market participation. However, the results highlight the challenge of significantly increasing household income from staple food crop sales when the households' priority for producing such crops remains predominantly for household subsistence consumption. Furthermore, the frequency of accessing subsidised fertilizer is found to have no effects on maize marketing.

In Chapter 3, the research examined the effects of subsidised fertilizer on farm households' food security and consumption expenditure. The dependent variables of interest here were available daily per capital calories, the household's food security status, food, non-food and total annual per capita consumption expenditure. By increasing crop productivity generated by farm input subsidies, the potential for increased households' purchasing power may result in increased consumption expenditure. As a result the availability of food in farm households is expected to improve and consequently, contribute to reduction in both poverty and food insecurity.

This study finds that the fertilizer subsidy has a positive impact on food security, but that its effect is heterogeneous across the households' distribution. In particular, the results suggest a higher positive impact among the most food secure households. The study finds that

subsidised fertilizer increases farm households' available per capita per day calories, months of food secure and the probability of being food secure. The study also finds no evidence of an effect on food, non-food and total annual per capita consumption expenditure. However, repeated benefit to subsidised fertilizer is found to increase the magnitude of positive effects on available calories per capita per day and annual food per capita consumption expenditure. Furthermore, the estimated magnitude of the effects of subsidized fertilizer on food security is not large enough to eradicate food insecurity among poor households in isolation. This underscores the importance of the adoption of more integrated livelihood policy approaches in development interventions. These results also highlight the challenge of achieving significant poverty alleviation and food security among small farmers who are faced with myriad constraints such as drought, limited income sources, and lack of adequate access to output and input markets. Consequently, farm input subsidies are not a magic bullet solution to poverty, food and income insecurity.

The research in Chapter 4 examined the effects of subsidised fertilizer on farm household members' internal migration. The dependent variables of interest were rural to urban, rural to rural and seasonal migration, and estimations employed cross section data models. The rationale for this research is based on the premise that farm input subsidy programmes are expected to improve the economic returns of agricultural production due to reduced input costs of subsidised farm inputs, especially fertilizers and hybrid seeds and consequently, improve crop production and productivity. This might act as incentive to farm household members to stay on the farm and engage in agricultural activities, consequently, slowing down the out-farm migration.

Overall, the study finds that fertilizer subsidy decreases the probability of farm household members' migration. The results suggest that the members of a household which receives a programme standard package of subsidised fertilizer have a decreased probability of migrating

from rural to urban and from rural to rural areas. However, the study finds no evidence of any effect on the probability of a household member's seasonal migration. The study also finds that repeated benefits to subsidised fertilizer does not increase the magnitude of the negative effects on migration. The negative effects of subsidised fertilizer on rural to urban migration of the rural farm households members suggest that the fertilizer subsidy policy might be one of the effective tools of controlling rural to urban migration in developing countries and thereby contributing to the reduction in urban unemployment, food insecurity and poverty.

5.2 Policy Implications

Overall, the empirical findings of this thesis have important policy implications. The magnitude of effects of subsidised fertilizer on maize marketing has policy implication on the sustainability of the farm input subsidy programme itself. This is because any increased level of household income from crop sales for subsidy beneficiaries affects their ability to self-finance the purchase of future farm inputs for the next production cycle. This thesis suggest the following policy implications: First, the results highlight the challenge of significantly increasing household income from staple food crop sales when the households' priority for producing such crops is subsistence. Consequently, this cast doubt on the sustainability and success of the program's objective to simultaneously achieving household food security and increasing household income from food crop sales. This is due to the fact that for most small farmers food crops are mainly produced for household consumption. Therefore, apart from food crops, the program improvement should include targeting the same households with subsidised coupons for cash crops production (such as cotton and other high value food crops). Cash crop production could be strategic to farmers with relatively adequate land and they can use income from cash crop sales to finance future farm input purchases and sustainably exit from the subsidy program.

Second, designing programs to suit climatic conditions of specific regions may be more beneficial than the standard program for all regions. Despite maize being the staple food for the majority of the population, some districts are not suitable for its production, especially in the southern region. Therefore, programs focusing on other interventions and types of crops might have more positive effects on households' incomes in this region.

Third, the small magnitude of effects of landholding size on commercialisation of maize suggests that maize is not considered a viable commercial crop by farm households. This may have implication on household resource allocation, where more resources may be located to cash than food crops in order to make profit and increase household income at the expense of food crops production. The government intervention in the marketing of maize in Malawi, where maize exportation is banned during the months of acute food shortage or when yield estimates show national food deficit might have contributed to the commercial unviability of maize.

Fourth, the results reported in Chapter 3 suggest that the farm input subsidy programme generates minimal effects on household food security and annual consumption expenditure among the poor and food insecure households. This highlight the challenge of achieving significant poverty alleviation and food security among small farmers who are faced with many constraints. This calls for a more integrated livelihood strategy with interventions promoting household food productivity and incomes.

Fifth, although maize is the main food staple and as such is an important determinant of food security in Malawi, focusing and allocating more farm input subsidy programme resources on one crop and neglecting other crops and agricultural interventions may render such programmes less useful. This is because consumption of maize only cannot provide all the required adequate important nutrients. Again, coupled with limited land allocated to maize

and low commercialisation, income from maize sales may not meet household consumption expenditure requirements to achieve food security and poverty alleviation objectives.

Sixth, since continuous access to subsidised fertilizer has positive effects on household food availability and food consumption expenditure, targeting processes should aim at providing repeated access to improved farm inputs to the targeted smallholder farmers in order to stimulate adoption and increase crops productivity. This would contribute to achieving the macroeconomic objectives to reduce food crop prices and hence, improved national food security; stimulate the development and efficiency of the inputs markets and thus, leading to increased accessibility to improved input and reduced prices.

Seventh, results in Chapter 4 suggests that policies aimed at reducing urbanisation should ensure implementation of interventions which provide increased benefits to rural households in terms of increased crop production and productivity as evident in the negative effects of subsidised fertilizer and landholding ownership on migration of farm household members.

Eighth, as the number of educated and skilled labour in rural areas is increasing over time due to increasing access to education, rural to urban migration of household members is inevitable. Therefore, policies that facilitate access to agricultural land could effectively contribute to reduced rate of rural to urban migration in the long-term.

5.3 Future Research

Based on the empirical analyses in this thesis, future research is suggested to focus on five research agenda. Cross-country and regional analyses to compare the effects of farm input subsidies will be important to provide more lessons since more countries especially in sub-Saharan Africa are now implementing farm input subsidies, but using different designs.

Analysing the market demand effects such as on buyers, net buyers and quantities bought of food commodities targeted in the farm input subsidies is also important in examining household and economy wide level effects. Understanding such effects is also important in estimating subsidies' contribution to food security and poverty alleviation. The macro level analysis especially on the effects of subsidies on imports and exports of targeted crops will help in assessing the economy wide effects of the subsidy programmes and the fiscal implication of the subsidies on foreign exchange reserves since importation of both farm inputs and food and non-food leads to reduced foreign exchange reserves.

Analysis of the effects of FISP on the development of the rural input market supply system and the rural economy will help in understanding the economy-wide effects and contribution to improved farm input use in rural Malawi. Lastly, a comparative analyses of the effects of farm input subsidies with other social protection interventions such as public works, food and cash transfer programmes will contribute to generation of important information for comparison on the efficiency, sustainability and cost effectiveness of the FISP to alternative social protection interventions.

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