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Bringing Rigour and Evidence to Economic Policy Making in Africa

Impact of Agricultural Input Subsidy on Nutritional Outcomes in Malawi

By

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Contents

List of tables

List of figures

Abstract

The study examined the effect of agricultural input subsidy on nutrition in Malawi. The aim was to find out how Malawi's Farm Input Subsidy Programme (FISP) affects nutrition. Household panel data from the Malawi Integrated Household Panel Surveys for the years 2010 and 2013 was used. To answer the research question, we estimated Poisson and Two-Stage Least Square (2SLS) regressions using instrumental variables. The results suggest a generally positive impact of the FISP on household nutritional status. A gender-disaggregated analysis indicates that while there was no difference in the direction of impact, the magnitude was higher for female-headed households relative to male-headed households. There was also evidence of a positive impact of food price fluctuations on nutritional outcomes. The findings emphasize the relevance of farm input subsidy programmes in reshaping agricultural and nutritional outcomes in developing countries.

Key words: Farm input subsidy, Food price shock, Nutrition, Malawi

1. Introduction

Malnutrition continues to pose significant public health challenges and undermines the livelihood of individuals in developing countries. Malnutrition is considered the number one driver of morbidity and mortality in the world[1]. Out of the approximately 7 billion global population, about 2 billion are estimated to be malnourished, and 800 million people are calorie deficient (International Food Policy Research Institute - IFPRI, 2016). This problem is particularly profound in sub-Saharan Africa (SSA) where malnutrition is much more prevalent. In 2014, about 58 million children under age five in SSA were estimated to be stunted, while about 10 million were overweight (IFPRI, 2016). Also, about 23.2% of people living in SSA are estimated to be undernourished compared to the developing country average of 12.9% (FAO, 2015).

Like many countries in the region, Malawi suffers a significant malnutrition burden, with the country ranked 120th out of 132 countries in stunting prevalence among children under age five (prevalence rate of about 42.2%). Moreover, even though individuals mostly suffer from malnutrition, which may result in morbidity and mortality of household members, the impact of malnutrition on a country's economy cannot be overemphasized. Globally, close to 11% of the Gross Domestic Product in Africa is lost to malnutrition-related health problems (IFPRI, 2016). However, in Malawi, about 147 billion Malawi Kwacha (US$ 597) or 10.3% of GDP was lost to malnutrition-related health challenges in the year 2012.[2]

In recent years, several policy efforts have been directed towards improving food security and nutritional conditions in developing countries. The importance of it is evident from the inclusion of some targets and goals, in the defunct Millennium Development Goals (MDGs)[3] and the now active Sustainable Development Goals (SDGs)[4]. Indeed, 12 out of the 17 SDGs are either closely or remotely related to malnutrition. Particularly, the role of agriculture in reducing food security and improving malnutrition can be enormous.

In Malawi, a vital policy effort towards improving agriculture is the Farm Input Subsidy Programme (FISP). The programme was designed to provide fertilizer and seed subsidies to farmers with the primary objective of improving productivity, hence ensuring food security and improved nutrition at the household level. Available evidence suggests that since its inception, grain production has improved in Malawi, with the country experiencing significant gains (Dorward and Chirwa, 2011; Ricker-Gilbert, 2014) . There is evidence[5] showing that the programme has impacted on household economic outcomes, including household poverty reduction (Ricker-Gilbert, 2014), agricultural wages and prices (Dorward and Chirwa, 2011), fertilizer

use (Ricker-Gilbert et al, 2011) and commercial distribution systems (Dorward and Chirwa, 2011). The impact of the subsidy programme on secondary outcomes such as nutrition is, however, scant in the literature.

The pathways through which the Malawi input subsidy may affect nutrition are not difficult to identify. There are several conceptual links from agricultural and food system policies to nutritional improvements (Kanter et al, 2015). Among others, Kanter et al (2015) noted that input subsidy policies are likely to lead to increased agricultural production, which then provides additional income to farmers, allowing them to purchase food items that could improve the nutritional status of the household. Similarly, increased food production through input subsidies is likely to create market excesses, which brings down prices and makes food more affordable to households. Other researchers have argued that increased income from improved agricultural production may allow households to seek better health care and improve nutrition status (Jones et al, 2012; Kanter et al, 2015).

However, it is worth noting that the conceptual framework linking agricultural input subsidies and nutrition is not always positive. Potential reverse impacts are also possible. For example, where input subsidies are directed to specific crops (say grains in the case of Malawi), farmers may shift production towards grains, and this may create shortages in other equally nutritious food items such as fruits and vegetables (Kanter et al, 2015). In this case, even though prices of grains may have declined, increased prices of fruits and vegetables may limit household dietary diversity.

While the agricultural input subsidy in Malawi is expected to improve agricultural productivity and thus food security, households in the country are also highly susceptible to various shocks that may affect nutritional status. One of these shocks is food price shocks that are likely to impact household food intake and, eventually, malnutrition. Food price shocks may wipe out gains from input subsidies as individuals may be unable to purchase food items. Moreover, Malawian households are generally net consumers of agricultural output and are therefore more likely to suffer from such price shocks. Indeed, Chibwana et al, (2012) and Harttgen et al, (2016) showed that nutrition and food security are greatly influenced by food price shocks. For example, Harttgen et al (2016) showed that price shocks rendered poor net food buyers more food insecure.

Against this backdrop, understanding the impact of the Farm Input Subsidy Programme (FISP) on household nutrition outcomes in Malawi will be crucial, especially for policy purposes. In this study, we seek to find out how Malawi's input subsidy programme affects nutrition. We also perform a gender analysis to understand the gender related dynamics in the impact of FISP on nutrition in Malawi. The gender analysis is motivated by the fact that the criteria for selection into the FISP considers gender of the household head. For example, farm households with female heads were given preference in selection and coupon distribution. The selection criteria were designed to favour female household heads against their male counterparts. It is, therefore, appropriate to expect some differences in the impact of FISP across gender. Moreover, there are significant gender disparities in poverty levels in Malawi.

Female household heads are relatively poorer than their male counterparts (Masanjala and Musa, 2015).

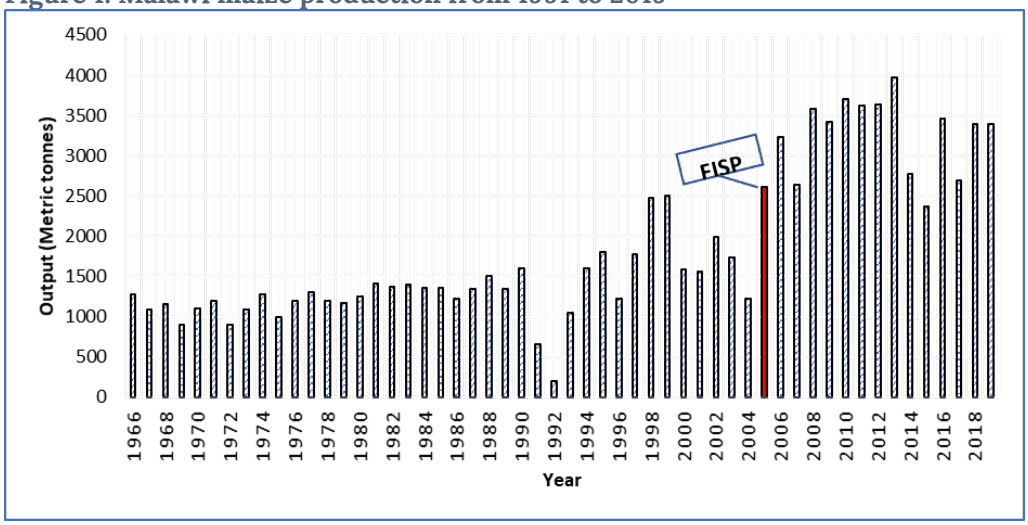
Brief country profile

Malawi is in south-eastern Africa with an estimated population of about 17.5 million as of 2019. The country is highly agrarian and depends largely on the agricultural sector, which contributes about 29.5% of GDP (The World Bank, 2017). While tobacco is the main export commodity, maize is considered a staple across the country (FAO, 2015). Malawi continues to face significant poverty challenges, with poverty estimated to be about 51.0% in 2019, a marginal increase from 50.7% in 2010 (NSO, 2016). Moreover, Malawi's Human Development Index (HDI) value was estimated to be 0.445 in 2014 and categorized to have low human development. The country is positioned at 173 out of 188 countries in the HDI ranking (Jahan et al, 2015).

The earliest forms of input subsidies in Malawi, known as universal input subsidies, were implemented as agricultural development policies in poor rural areas. This was in the period from 1952 to the early 1980s and was aimed at improving the availability of vital agricultural inputs to increase maize productivity and maintain soil fertility. However, Chirwa and Dorward (2013) assert that the subsidies were very expensive and placed a huge demand on public coffers. The high prices, coupled with deteriorating terms of trade, contributed to the ditching of this programme in the early 1980s when the very first Structural Adjustment Programmes (SAPs) were introduced.

Between 1998 and 2000, the Starter Pack (SP) programme was introduced with the intention of increasing maize yields and food security, and countering soil nutrient depletion. In the programme, starter packs of seed and fertilizer were provided to an estimated total of 2.86 million farming households to suffice for the cultivation of one-tenth of a hectare. The programme was necessary for raising maize output in Malawi but not enough as the country experienced poor harvests in the years 2001, 2002, 2004 and 2005 as shown in Figure 1.

Figure 1: Malawi maize production from 1991 to 2019



Source: Lunduka et al (2013) and constructed by authors using data from FAO

In 2004/5, Malawi was ranked as one of the poorest countries in the world, with 52.4% of its rural population classified as poor and 22.0% as ultra-poor (NSO, 2012). Such perilous conditions, coupled with the hunger crises at the time, led to initiation of the Farm Input Subsidy Programme (FISP) in the 2005/6 fiscal year. This targeted at least 50% of all farmers in Malawi and 1.5 million smallholder farmers to improve food security for the whole nation (Arndt et al, 2016). FISP involved the distribution of coupons for Open Pollinated Variety (OPV) maize and four types of fertilizers, both of which were redeemed at the parastatal outlets Agricultural Development and Marketing Corporation (ADMARC) and Smallholder Farmers Fertilizer Revolving Fund of Malawi (SFFRFM) (Chibwana et al, 2012). All fertilizers in this programme were sold at about one-third of the normal price (with maize fertilizers, For example, sold at MK950). Under FISP, the design is such that each farmer is provided with free improved seeds and two coupons, which are redeemable for two 50kg bags of fertilizer (Chibwana et al, 2014; Dorward and Chirwa, 2013). Beneficiaries pay a small redemption fee equating to a subsidy of two-thirds or more of the commercial fertilizer price. The outcome of this was vindicated by studies showing that FISP boosted food production in the periods after the year 2005 as shown in Figure 1.

Targeting of the FISP

According to Chirwa and Dorward (2013), targeting of the programme focused on land-operating but land-poor households who have unemployed labour. This is in line with the aim of resourcing the country's productive poor to increase their production. Among these households, those classified as vulnerable were prioritized. The vulnerability criteria includes the age and gender of the households (households headed by an aged or a female are more vulnerable), chronic diseases, poverty status

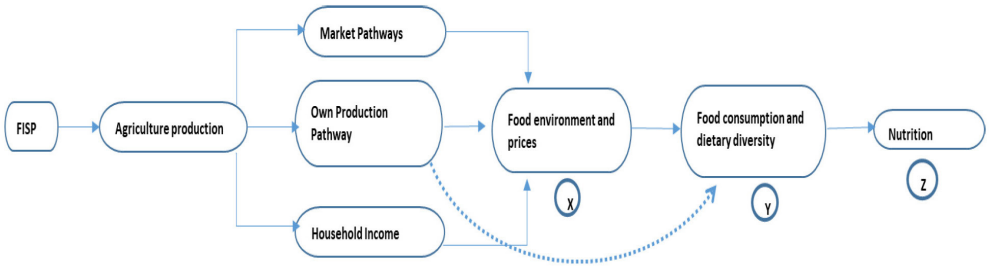
and orphans. These were supposed to form the guiding principles to inform the selection of beneficiary households. However, in some instances, the selection has been affected by political considerations and elite capture at the committee level (Chirwa and Dorward, 2013). But this does not affect the number of coupons to be supplied to an area because this is predetermined by the government and is fixed.

2. Literature review

Conceptual Framework: The subsidy's effect on health outcomes

In this study, the conceptual framework inspired by Kanter et al (2015) shows the existing linkages between agriculture, the food system, and health. This is presented in Figure 2.

Figure 2: The nexus of agriculture, the food system, and health



Source: Authors' modification from Kanter et al (2015)

In Malawi, the framework shows that a subsidy programme such as FISP, by improving agricultural production, affects the food system and ultimately health of individuals in three distinct ways. Firstly, FISP households can earn incomes through the market by providing transport, retailing and storage services for the increased agricultural output. Such incomes can be used to purchase household food items, thereby reducing household food insecurity or can be used directly for the purchase of various health services, both of which improve nutrition status. Given that a healthy population is a necessary requirement for high farm production, it can be noted that there is a bidirectional impact between these outputs from the subsidy programme. Secondly, FISP directly enhances household food security and hence members' nutrition status by increasing own-production when the household produces for subsistence. This is the greatest path of influence for the case of Malawi. Lastly, FISP increases agricultural-based household income mainly through wages that are

accrued when more people are employed in farms of FISP beneficiaries. It is worth mentioning that the focus of the current study is not on the immediate outputs (such as agricultural production, income and food security) but the potential mid-term outcome (in this case nutritional status).

Effect of subsidy on welfare from other countries

Previous studies on the impact of agricultural interventions on nutritional status and health have found mixed results. Berti et al,(2004) synthesized evidence indicating that most agricultural interventions increased food production as per intuitive consequence but failed to significantly improve the nutritional welfare and health of the participants in such programmes, citing various studies worldwide. A critical finding was that improved diet did not necessarily imply an improvement in anthropometric, biochemical/clinical or morbidity indicators. However, the findings showed that broader interventions in different forms of capital, namely natural, physical, human, social and financial capital were more likely to influence nutritional outcomes. More importantly, projects that deal much in human capital investment, especially nutrition education, and have a consideration of gender issues are more effective in improving nutrition.

Other studies considered the efficacy of nutrition upscaling, especially for micronutrients through Animal Source Foods (ASF) by promoting Animal Production (AP). Leroy and Frongillo (2007) found this causal relationship to be somewhat inconclusive. Analyses indicated improvements in intermediate outcomes of increased production, dietary intake, and household income while the direct impact of increased animal production on nutritional improvement was rather elusive. The success of the programmes also had gender specifications, in that better outcomes were noted in groups of women who played active roles in the intervention, and those in interventions that involved nutrition education.

Studies focusing on investigating the effect of agricultural interventions in child nutrition also have little evidence to support the notion that the interventions help reduce child undernutrition. Masset et al, (2012) found that interventions targeting specific diets for the absorption of necessary nutrition for children, including iron and vitamin A, bear no statistical importance in as much as indicators such as wasting, stunting and underweight of children aged less than five years are concerned. However, emphasis was made on the potential of methodological and statistical inadequacies of the samples used in the analysed studies not to write off the possibility of the existence of an effect.

Ruel (2001) noted that for interventions in agriculture to be effective, it is important to include strong nutrition education and behaviour change strategies. These ensure increased food and income for households leading to improved dietary quality.

Effect of input subsidy on food security in Malawi

With interest in the subsidy programme placed on targeting poverty reduction, not many studies have explored its impact on the food system and health. Nevertheless, with many studies analysing the household welfare effects of farm input subsidies in Malawi, a few studies proceed to link the resulting food security with the nutrition of farm households. Some studies such as Manja, Chirwa and Kambewa (2015) actually go a step further to examine how factors such as food security influence the willingness to pay for subsidized farm inputs. In finding the impact of FISP on food security, one interesting study by Cornia et al, (2016) integrated studies of food insecurity in Malawi with regional and monthly perspectives and verified that child malnutrition is fuelled by transitory food insecurity, including seasonal and temporary features such as households' dependence on markets for food purchases in the lean season. Similarly, Dorward and Chirwa (2011) and Jones et al, (2014) found that farm production diversity, which mainly accrues to FISP in Malawi, is consistently positively associated with dietary diversity and hence improved health of household members. Other studies include Steyn et al (2006), who discovered that Malawi's FISP has a positive impact on child nutritional status, mainly through non-food pathways (via increases in household income); and Lunduka et al, (2013) who found the existence of a positive influence of FISP on child nutrition and food security. These studies basically attest to the significance of FISP in improving food security and health.

In terms of food choice, diversity and consumption, Snapp and Fisher (2014) examined the impact of supporting maize production on crop diversity and quality of household diets, finding the existence of a positive but weak impact. Earlier on, Ecker and Qaim (2011) showed that diets in Malawi were dominated by maize. They also found that income-related policies are not only less market distorting, but better suited than price policies to reduce dietary deficiencies. They suggest that policies that lead to income growth facilitate access to health and education services, which may improve nutritional outcomes.

Dorward and Chirwa (2011) and Chirwa and Dorward (2013) all find that FISP improves food adequacy at the household level. Chirwa and Dorward (2013) also found an overall increase in primary school enrolment and reduced probability of having sick under-five-year-old children. The study, however, found no statistically significant effect on subjective self-assessed poverty at household level. Nevertheless, a study by Ricker-Gilbert et al, (2011) found that, on average, an additional kilogramme of subsidized fertilizer increases farm net crop income by US$ 1.16. Additionally, Ricker-Gilbert (2014) also found increased crop incomes to richer households at the top percentiles, and no statistically significant impact on poor households at the bottom percentiles. However, none of these studies found evidence of effects of FISP on asset worth.

Our review suggests that previous studies have focused on the impact of FISP in Malawi on consumption, food security or child health (Holden and Lunduka, 2013).

By employing different proxies of dietary quality, namely Household Dietary Diversity Score (HDDS), Food Variety Score (FVS) and Micronutrient sensitive Dietary Diversity Score (MSDDS), we are able to estimate the effect of the progamme on nutrional quality. Thus, this study provides empirical evidence from different dimensions of dietary quality.

3. Data and methods

Data

We used data from two rounds of the Malawi Integrated Household Panel Survey (IHPS) collected in 2010/2011 and 2013. The dataset is a multi-topic survey of nationally representative households in Malawi. It provides comprehensive information on households' consumption, income, employment, health, education and other household characteristics. The households were selected based on two-stage sampling design. The first stage involves the identification of the enumeration areas (EAs), defined from the 2008 Population and Housing Census. At this stage, 204 out of 768 EAs were selected for the IHPS3. In the second stage, a baseline sample of 3,247 households was selected from the 204 EAs for the panel study. In all, there are 3,104 households that can be traced in both panels, leading to an attrition rate of 3.78% (NSO, 2014)[6].

In addition to household consumption and expenditure patterns, the IHPS collected detailed information on household farming (agricultural or livestock) activities. Module E of the agriculture questionnaire contains information on the quantity, type and use of coupons that the household obtained from the FISP. Therefore, we can identify which households benefited from the programme.

Variables and measurements

The study estimates the impact of FISP on household nutrition outcomes. This section describes how we measured the key variables in this study.

Price

We measure consumer price shock with changes in the Laspeyres consumer price index. Our measure follows the approach of Frempong and Stadelmann (2018), who measure changes in food price with the fluctuations in the price index in Uganda.

Agriculture policy intervention

Here, we put households in the IHPS dataset into two groups: those who received the fertilizer subsidy and free maize seed, and those who did not. This is made possible by the set of questions in the data set that allow for the identification of which households received the redeemable input coupons. To this end, we generated a dummy variable that captured if a farmer received the FISP.

Nutritional outcome measure

We used three measures of nutrition, following common practice in the literature (Jones et al, 2014; Koppmair et al, 2017; Snapp and Fisher, 2014; Swindale and Bilinsky, 2006). These are the Household Dietary Diversity Score (HDDS), Food Variety Score (FVS) and Micronutrient-Sensitive Dietary Diversity Score (MSDDS). A careful assessment of the scores showed that the MSDDS and HDDS closely mimic each other with a correlation of almost 1.00 (see Appendix 2). We, therefore, report estimates from the MSDDS and FVS in this paper. Estimates from the HDDS are reported in Appendix 1. The estimates were, moreover, very similar across the various indicators of nutritional status. We describe the three indicators in detail below.

Household Dietary Diversity Score: Household dietary diversity refers to the variety of different food items or groups consumed by the household over a given reference period (Ruel et al, 2012). Dietary diversity was used as our main proxy for household's nutrition status. This is because it satisfies three important dimensions of cross-section validity[7], inter-temporal[8] validity and, nutritional relevance[9] (Headey and Ecker, 2013b). This quality makes dietary diversity relevant for policy purposes. Following a related study by Snapp and Fisher (2014), we measured household dietary diversity with the 12-scale Household Dietary Diversity Score (HDDS) per the guidelines of the Food and Nutrition Technical Assistance (FANTA) Project of the United States Agency for International Development (USAID). Recent validation studies suggest that this indicator correlates with important desirable nutritional outcomes such as anthropometric indicators, caloric intake, and micronutrient adequacy (Hatløy et al, 1998; Kennedy et al, 2007; Ruel et al, 2012; Steyn et al, 2006; Torheim et al, 2004). To measure HDDS, we grouped all food items consumed by the household into one of the 12 food groups proposed by Swindale and Bilinsky (2006). We then count the number of food groups consumed over the seven-day recall period to get the HDDS for the household.

***Food Variety Score (FVS)*:** This refers to the individual food counts consumed by an individual over a reference period. These are not necessarily groups of food but unique food. The variable has a theoretical range of 1-96.

***Micronutrient Sensitive Dietary Diversity Score (MSDDS)*:** This builds on the HDDS and disaggregates and reorganizes the HDDS food groups into 16 micronutrient-based groups. The HDDS is measured on a 1-12 scale, while MDDS has a maximum of 16 food groups. Higher values in each case represent higher dietary diversity.

Table 1 presents brief descriptive statistics of variables in the analysis. The table shows that the receipt of subsidy inputs declined from about 59% in 2010 to 47% in 2013, so did coupon redemption in the sampled households. In contrast, our measures of nutrition intake (FVS and MSDDS) both improved in 2013 relative to their 2010 levels. There is also evidence of an increase in household non-food consumption expenditure. More than 60% of the households in our sample are headed by males, with an average household size of about 5 persons.

Table 1: Descriptive statistics of some of the key variables for agricultural households

Variable	2010	2013	Panel
Proportion of household received FISP coupon	0.591	0.473	0.536
Proportion of household redeemed FISP coupon	0.579	0.448	0.518
Food Variety Score (1-96 food items)	15.01	17.14	15.99
Household Micronutrient-Sensitive Dietary Diversity Score (1-16 food groups)	9.629	9.969	9.786
Housed Dietary Diversity Score (1-12 food groups)	8.559	8.766	8.320
Age of household head (year)	43.00	38.71	41.02
Sex of household head (Male=1)	0.745	0.605	0.680
Head ever schooled (Yes=1)	0.766	0.803	0.783
Household size	4.849	4.841	4.845
Non-food expenditure	2590.1	9675.4	5865.1
Farm land size	2.045	1.923	1.988
Credit access	0.116	0.215	0.162
South	0.496	0.502	0.499
Central	0.417	0.426	0.421
Laspeyres monthly Spatial and Temporal Price Index (Base National March 2013)	91.54	83.04	87.61
Observations	1,082	930	2,012

Standard errors in parenthesis.

Source: Authors' computation from IHPS data

Model specification

To achieve the objectives of this study, we run the following model to examine the effect of the input subsidy programme on household nutrition. The empirical specification is inspired by the conceptual framework discussed earlier and presented in Figure 2.

$$y_{it}^{j} = \beta_0 + \beta_1 fisp_{it} + \beta_2 price_{it} + \beta_3 HH_{it} + \beta_4 Reg_i + \varepsilon_{it} \quad (1)$$

where, y_{it}^{j} is the nutritional indicator, j, of household i at time t. fisp is a dummy variable that indicates whether a household benefitted from FISP. The variable price captures the price index. The vectors HH_{it} and Reg_i contain a set of relevant household (age of head, sex of head, household size, education of head, farm land ownership, household non-food expenditure and access to credit) and regional (region of residence) characteristics, respectively.

Endogeneity and identification

The FISP was designed to benefit the most vulnerable smallholder farmers, hence a set of criteria was designed to help select eligible beneficiaries based on plot size and other characteristics. However, over time, these criteria have been ignored in the distribution process (Chibwana et al, 2014). The programme design itself and the non-commitment to the selection criteria pose challenges to the identification of the FISP impact. First, the selection process means that assignment to the farm input subsidy treatment is not random. Secondly, the non-commitment to these criteria makes participation endogenous, since households may exploit their political affiliations (Fisher and Kandiwa, 2014; Ricker-Gilbert et al, 2011) and leadership positions to enrol in the programme.

To resolve the endogeneity problem, we used the instrumental variable approach. Our instrument was constructed by exploring the design of the FISP in Malawi. By design, the government determines the number of coupons to be shared to eligible households in a particular village. Since the number of coupons is predetermined by the government, it is entirely exogenous to the household that finally receives the coupon. However, the number of coupons assigned to a village is likely to be correlated to whether a household receives the coupon or not. For example, consider two villages A and B with both receiving a different number of coupons as determined by the government. If village A receives more coupons than B, then a household in A is more likely to receive a coupon compared to a household in B. Moreover, the number of coupons assigned to a village is not likely to influence the nutritional outcome of the household. Indeed, the fact that this variable is exogenous to the household strengthens the intuitive validity of the instrument. We, however, provide a statistical justification for the validity of the instrument. To do this, we used two separate instrumental variable techniques. The first was the Two-Stage Least Squares (2SLS) for panel data and the Poisson instrumental variable technique.

4. Results

Mean difference test

We begin the section with a mean difference test for the main outcome variables by FISP status. The analysis was to determine whether there exist significant differences in outcomes for households that received the subsidy programme and those that did not receive. The results are presented in Table 2. The results suggest that we reject the null hypothesis that the mean difference in the outcomes across treatment groups is not different from zero for the years 2010 and 2013. In 2010 and 2013, the average score in all three measures of malnutrition was relatively higher for households that received subsidies, and these differences were statistically significant. For example, in 2010, average Food Variety Score (FVS) was 15.34 and 14.55 for those who redeemed and those who did not redeem FISP coupons, respectively, and the difference (0.79) between the two treatment groups is also statistically significant at 5%. Likewise, in 2013, the difference in FVS between the treatment arms was 1.22 in favour of those who participated in the programme. While these statistics indicate protective programme impact in the years 2010 and 2013, the extent to which this conclusion is valid is also limited. This is because the raw data used for the mean difference test is not randomized. This implies that the difference may not entirely be attributable to the programme. To better understand the direction and magnitude of impact, we use a regression approach, and the results are presented in the following subsection.

Table 2: Mean differences in outcome variables by FISP status

	FISP(Yes)	FISP(No)	Difference (No – Yes)	Std error of the difference
2010				
FVS	15.34***	14.55***	-0.79*	0.37
HDDS	8.38***	8.16***	-0.22	0.13
MSDDS	9.76***	9.45***	-0.31*	0.16
2013				
FVS	17.81***	16.59***	-1.22**	0.47
HDDS	8.73***	8.42***	-0.31*	0.13
MSDDS	10.22***	9.77***	-0.45**	0.16

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: Authors' computation from IHPS data

Impact of FISP and input price shock on nutritional status

Table 3 presents the estimation results from the base model. The model establishes the relationship between Farm Input Subsidy Programme participation and nutritional status, with two separate indicators (Food Variety Score and Micronutrient Sensitive Dietary Diversity Score). Both models from the Pooled 2SLS and Poisson specifications are reported in the table. Unlike the Poisson, the 2SLS estimation allows for testing the relevance of the instrument. The F-statistic from the first stage estimations is reported in the last row of Table 3. It is recommended that for an instrument to be considered relevant, this F-statistic should be greater than 10 (Angrist and Pischke, 2009; Staiger and Stock, 1997). The statistical significance of the statistic also suggests a rejection of the null hypothesis of weak instruments. This implies that the instrument used in the estimations is valid and strong enough. These results are consistent across all estimations, including the gender disaggregation.

The results show a positive and statistically significant relationship between subsidy programme participation and nutritional outcomes. The results were consistent across both measures of nutrition status. The results suggest that households that benefited from the subsidy programme are more likely to have better nutritional outcomes. In addition to the above, we also found that cluster level price changes have a negative and statistically significant impact on nutritional outcomes. This suggests that lack of stability in local price levels (including food prices) negatively impact the nutritional outcomes of the household. We also established a positive and significant relationship of formal education on nutritional outcomes of the households. Household heads who were formally educated were more likely to have better nutritional outcomes compared to their counterparts without any formal education. The relationship was statistically significant at the conventional levels. We also observed a positive relationship between access to credit and our measures of nutritional outcomes. Households with access to credit facilities were more likely to have better nutritional outcomes compared to their counterparts without access to credit facilities. The relationship was statistically significant at 1% across all specifications.

Table 3: Impact of FISP on household nutritional outcomes – Full sample

	MSDSS Pooled 2SLS	MSDSS Pooled Poisson	FVS Pooled 2SLS	FVS Pooled Poisson
Redeemed FISP coupon	0.185***	0.083***	0.297***	0.111***
	(0.044)	(0.020)	(0.065)	(0.024)
Price index	-0.347***	-0.156***	-0.482***	-0.181***
	(0.119)	(0.054)	(0.178)	(0.067)
Age of household head	-0.002***	-0.001***	-0.003***	-0.001***
	(0.000)	(0.000)	(0.001)	(0.000)
Sex of household head	0.052***	0.024***	0.034	0.013

	(0.015)	(0.007)	(0.022)	(0.008)
Head ever schooled	0.087***	0.040***	0.123***	0.048***
	(0.017)	(0.008)	(0.024)	(0.009)
Household size	0.005	0.002	0.007	0.003
	(0.003)	(0.001)	(0.005)	(0.002)
Non-food expenditure	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Farm land size	0.010***	0.005***	0.010*	0.004*
	(0.004)	(0.002)	(0.005)	(0.002)
Credit access	0.083***	0.036***	0.133***	0.048***
	(0.016)	(0.007)	(0.025)	(0.009)
South	-0.075**	-0.034***	-0.025	-0.011
	(0.029)	(0.013)	(0.043)	(0.016)
Central	-0.075**	-0.034**	-0.024	-0.009
	(0.032)	(0.014)	(0.047)	(0.018)
Interview year and month	Yes	Yes	Yes	Yes
N	2012	2012	2012	2012
	0.055		0.056	
R^2				
F-statistic	248.962		248.962	

Notes: * p<0.10, ** p<0.05, *** p<0.01. Robust standard errors in parentheses.
Source: Authors' estimation

Gender difference in the impact of FISP on nutritional outcomes

To further understand the direction and magnitude of the impact of the input subsidy programme on nutritional outcomes, we disaggregated the results by gender of household head. By undertaking a disaggregated sample analysis, this also implied sensitivity analysis of the results. Here, we hypothesize that the impact of the Farm Input Subsidy Programme may differ across households by gender. The results for female-headed households are reported in Table 4 whereas Table 5 reports results for males. Similar to results from the full sample reported earlier, there was a consistent positive relationship between FISP participation and household nutritional status. This suggests that nutritional outcomes were better for households that received and redeemed FISP coupons relative to households that did not redeem this coupon. The relationships were statistically significant across all specifications. The results also show a negative and significant relationship between price index and household nutritional outcomes. The statistical significance for this relationship was 10% for

MSDSS models and 5% for FVS models, suggesting that price fluctuations do not favour nutritional outcomes among female-headed households.

The performance of other control variables included in the models also deserves some comments. For example, we found that for female-headed households, the age of household head and credit access were significant determinants of nutritional outcomes in the household. While older household heads were likely to have poorer nutritional outcomes, households with access to credit were likely to have better nutritional outcomes. This is evident in the negative and positive relationships estimated for the two variables, respectively.

Table 4: Impact of FISP on household nutritional outcomes – Female-headed households

	MSDSS Pooled 2SLS	MSDSS Pooled Poisson	FVS Pooled 2SLS	FVS Pooled Poisson
Redeemed FISP coupon	0.251***	0.115***	0.344***	0.130***
	(0.093)	(0.043)	(0.130)	(0.049)
Price index	-0.476*	-0.217*	-0.854**	-0.323**
	(0.255)	(0.118)	(0.347)	(0.134)
Age of household head	-0.002**	-0.001**	-0.002*	-0.001*
	(0.001)	(0.000)	(0.001)	(0.000)
Head ever schooled	0.052	0.024	0.076*	0.030*
	(0.032)	(0.015)	(0.043)	(0.017)
Household size	-0.000	-0.000	0.003	0.001
	(0.006)	(0.003)	(0.009)	(0.003)
Non-food expenditure	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Farm land size	0.004	0.002	0.002	0.001
	(0.007)	(0.003)	(0.010)	(0.004)
Credit access	0.117***	0.052***	0.206***	0.074***
	(0.034)	(0.015)	(0.050)	(0.018)
South	-0.093	-0.043	-0.054	-0.022
	(0.059)	(0.027)	(0.082)	(0.032)
Central	-0.131**	-0.060**	-0.116	-0.044
	(0.061)	(0.028)	(0.085)	(0.033)
Interview year and month	Yes	Yes	Yes	Yes
N	643	643	643	643
	0.070		0.109	
R^2				
F-statistic	79.246		79.246	

Notes: * p<0.10, ** p<0.05, *** p<0.01. Robust standard errors in parentheses.
Source: Authors' estimation

Table 5 presents the results of the impact of FISP on nutritional outcomes for male-headed households. The results are similar to those observed for female-headed households. We observed a positive and statistically significant relationship between FISP redemption and nutritional outcomes. This was consistent across the various measures of nutrition status. While the direction of impact is similar across gender,

we observed that the magnitude of impact was higher for female-headed households relative to male-headed households. Also, apart from the age of household head, education of head, household size, land size and credit access were found to be important determinants of nutrition in male-headed households. It should be noted that only age and credit access were significant in the female sample. The results for the male sample indicate that better education, higher household size, access to credit and larger farmland size were all related to better household nutritional outcomes.

Table 5: Impact of FISP on household nutritional outcomes – Male-headed sample

	MSDSS Pooled 2SLS	MSDSS Pooled Poisson	FVS Pooled 2SLS	FVS Pooled Poisson
Redeemed FISP coupon	0.162***	0.072***	0.280***	0.104***
	(0.047)	(0.021)	(0.073)	(0.027)
Price index	-0.169	-0.074	-0.169	-0.062
	(0.135)	(0.060)	(0.209)	(0.078)
Age of household head	-0.002***	-0.001***	-0.004***	-0.001***
	(0.001)	(0.000)	(0.001)	(0.000)
Head ever schooled	0.114***	0.052***	0.159***	0.062***
	(0.020)	(0.009)	(0.029)	(0.011)
Household size	0.006**	0.003**	0.009*	0.003*
	(0.003)	(0.001)	(0.005)	(0.002)
Non-food expenditure	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Farm land size	0.014***	0.006***	0.015***	0.005***
	(0.004)	(0.002)	(0.005)	(0.002)
Credit access	0.063***	0.028***	0.093***	0.034***
	(0.018)	(0.008)	(0.029)	(0.011)
South	-0.042	-0.019	0.020	0.007
	(0.033)	(0.015)	(0.050)	(0.019)
Central	-0.021	-0.009	0.061	0.023
	(0.038)	(0.017)	(0.055)	(0.021)
Interview year and month	Yes	Yes	Yes	Yes
N	1369	1369	1369	1369
	0.045		0.041	
R^2				
F-statistic	166.525		166.525	

Notes: * p<0.10, ** p<0.05, *** p<0.01. Robust standard errors in parentheses.

Source: Authors' estimation

5. Discussion

This paper complements previous literature by understanding the causal effect of Farm Input Subsidy Programme (FISP) on nutritional outcomes using panel data from Malawi. The paper further adds a gender dimension to the analysis to assess the differential impact of the programme. In general, the findings of the study are consistent with *a priori* expectations about the impact of the FISP.

There is a consistent and statistically significant positive relationship established between FISP and household nutritional outcomes. This suggests that households that participated in the FISP are generally better off in terms of nutritional outcomes. The findings of the study are consistent with previous studies that have evaluated the impact of agricultural subsidy programmes on nutrition (Dorward and Chirwa, 2011; Jones et al, 2014). Our findings further show that the intensity of the impact of the programme may depend on the gender of the household head. The results suggest a favourable impact for female-headed households relative to male-headed households. The gender disparities in the impact of FISP and prices on nutrition status is interesting. This may be justified by the gender dimensions in the level of poverty and inequality in Malawi, especially in rural Malawi. Available evidence suggests that females are generally poorer than their male counterparts, and income inequality favours males (Masanjala and Mussa, 2015). This suggests that household consumption and nutrition may be better in male-headed households than in female-headed households. The changes in nutrition due to introduction of FISP is therefore likely to be larger for female-headed households.

The findings underscore the importance of agricultural subsidies in improving nutritional outcomes of households in Malawi. Specifically, it shows that in the fight against malnutrition, it is crucial to focus on farm households and identify various ways of improving farm outputs. This is particularly relevant in developing countries where a large proportion of rural households depend on subsistence agriculture for survival. Supporting these households with such interventions as subsidised inputs will be a step in the right direction. Aside from the direct improvement in household agricultural output, our conceptual framework confirms many other channels through which such interventions could improve nutritional outcomes. These include additional income from market engagements and increased farm labour supply.

The findings also highlight the relevance of broader policy discussions on nutrition and food security. These include global goals such as the Sustainable Development Goals (SDGs). The second SDG focuses on “ending hunger, achieve food security and improve nutrition and promote sustainable agriculture” by the year 2030 (UN, 2015).

Evidently, agricultural subsidies will be instrumental in achieving this goal.

The results further point to potential gains from effective policy implementation. Therefore, policy makers must improve the implementation of the subsidy programme by way of sustaining and scaling up. Incorporating nutritional objectives into the basic design of the programme and ensuring complementary policy measures could consolidate the impact. This includes deliberate efforts to enlarge the scope of the subsidy programme to reach out to more rural farm households. The complementary policies could include education on nutrition and easy access to basic health care. Indeed, the findings indicate that education plays an important role in improving nutritional outcomes.

The results also indicate that, among others, price fluctuations are an important determinant of household nutritional outcomes. The results of the study are corroborated by previous studies, which have also found a negative impact of food price fluctuation on nutrition in Mozambique (Arndt et al, 2016) and in Malawi (Cornia et al, 2016). This is expected as many rural households are susceptible to significant price changes. While many rural households depend on subsistence agriculture, they also engage with the market in several ways, including purchasing some other food items not produced on their farms. Unregulated price fluctuations, therefore, pose a significant risk to such households, and this will limit their food consumption choices.

Moreover, for households that sell some part of their produce to generate extra income, this fluctuation limits their market prospect. This suggests that while the FISP and related agricultural policies may be relevant, efforts to minimize price fluctuations will be a step in the right direction. The gender disparities in favour of females may be justified by the fact that females and males engage differently with the market. In general, men in Malawi are more active and benefit more from bargaining. Women are disadvantaged in this regard and the impact of unstable prices may be greater compared to their male counterparts.

The scope and analysis of the study were limited by some constraints that deserve to be mentioned. First, the lack of experimental data on the FISP intervention prevented us from conducting a true experimental analysis of the impact of the programme. Also, there were practical challenges in implementation of the programme, which were not captured in our dataset and hence could not be explored because of data constraint. However, these limitations do not hinder the generalization of our findings.

6. Conclusion

Malawi's Farm Input Subsidy Programme (FISP) is considered one of the most important reforms in the agricultural sector. While the programme's primary objective is to improve availability of farm inputs, previous studies have assessed its impact on secondary outcomes, including food security and child health outcomes. In this paper, we assessed the impact of FISP on household nutritional outcomes. We found that households that redeemed the FISP coupon were more likely to have better nutrition outcomes. Specifically, we found that female-headed households had relatively higher magnitude of impact compared to their male counterparts. The findings suggest that farm input subsidies transcend their direct impact on farm outputs. They also enhance nutritional outcomes within households.

Notes

1 See *https://data.unicef.org/topic/nutrition/malnutrition/.*

2 See report by Government of Malawi, UN Economic Commission for Africa, World Food Programme (2015). https://www.wfp.org/content/cost-hunger-malawi.

3 Check MGDS Goal 1 http://www.jo.undp.org/content/jordan/en/home/post-2015/mdgoverview/overview/mdg1/.

4 https://sustainabledevelopment.un.org/?page=viewandnr=164andtype=230andmenu=2059.

5 A systematic review of the evidence is available in Jayne and Rashid (2013).

6 Twenty (20) households exited the panel completely between 2010 and 2013 (NSO, 2014).

7 An indicator that has cross-sectional validity can capture the difference between differences in economic, social and regional groups (Headey and Ecker, 2013).

8 Inter-temporal validity in this case means the ability of the indicator to effectively capture long-term trends, and respond to seasonality in food insecurity and shocks (Headey and Ecker, 2013).

9 Nutritional relevance relates to the ability of the indicator to inform policy makers on the demographic dimensions of food insecurity (Headey and Ecker, 2013).

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Appendix

Appendix 1: Impact of FISP on household nutritional outcomes

	Full sample		Female sample		Male sample	
	HDDS Pooled 2SLS	HDDS Pooled Poisson	HDDS Pooled 2SLS	HDDS Pooled Poisson	HDDS Pooled 2SLS	HDDS Pooled Poisson
Redeemed FISP coupon	0.142***	0.068***	0.203**	0.099**	0.119***	0.056***
	(0.041)	(0.020)	(0.088)	(0.043)	(0.043)	(0.021)
Price index	-0.314***	-0.151***	-0.506**	-0.247**	-0.109	-0.051
	(0.112)	(0.054)	(0.242)	(0.120)	(0.125)	(0.059)
Age of household head	-0.002***	-0.001***	-0.001*	-0.001*	-0.002***	-0.001***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Sex of household head	0.045***	0.022***				
	(0.014)	(0.007)				
Head ever schooled	0.090***	0.044***	0.062**	0.031**	0.110***	0.054***
	(0.016)	(0.008)	(0.031)	(0.015)	(0.019)	(0.009)
Household size	0.004	0.002	0.001	0.000	0.005*	0.003*
	(0.003)	(0.001)	(0.006)	(0.003)	(0.003)	(0.001)
Non-food expenditure	0.000***	0.000***	0.000	0.000	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Farm land size	0.011***	0.005***	0.005	0.002	0.015***	0.007***
	(0.004)	(0.002)	(0.007)	(0.003)	(0.004)	(0.002)
Credit access	0.076***	0.036***	0.089***	0.042***	0.065***	0.030***
	(0.015)	(0.007)	(0.033)	(0.016)	(0.017)	(0.008)
South	-0.096***	-0.046***	-0.119**	-0.058**	-0.061*	-0.029*
	(0.027)	(0.013)	(0.054)	(0.027)	(0.031)	(0.015)
Central	-0.105***	-0.050***	-0.159***	-0.078***	-0.052	-0.025
	(0.030)	(0.014)	(0.056)	(0.027)	(0.035)	(0.016)
Interview year and month	Yes	Yes	Yes	Yes	Yes	Yes
N	2012	2012	643	643	1369	1369
	0.075		0.076		0.075	
R^2						
F-statistic	248.962		79.246		166.525	

Notes: * p<0.10, ** p<0.05, *** p<0.01. Robust standard errors in parentheses

Source: Authors' construction

Appendix 2: Pairwise correlation of nutritional outcome indicators

	MSDDS	FVS	HDDS
MSDDS	1		
FVS	0.8427*	1	
HDDS	0.9672*	0.7951*	1

Source: Authors' estimation. Note: * is statistical significance at 5%

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