The Effects of the Malawi Farm Input Subsidy Program on Household Per-Capita Consumption Convergence

by Martin Limbikani Mwale, Tony Mwenda Kamninga, and Lucius Cassim

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Abstract

The Malawi Farm Input Subsidy Program (FISP) was praised for turning the country's food deficit into a surplus immediately after its inception in 2005. It is, however, not clear whether these food security gains spillover to equity in distribution of welfare. In this study we examine the effects of the FISP on per-capita consumption convergence, using a sample of 2251 households interviewed in the 2010 to 2013 Malawi Integrated Household Panel Survey. The analysis employs a Lewbel method of instrumental variables (IV) to account for the potential non-random selection into the FISP. The results reveal that FISP helps relatively poor farmers increase household per-capita consumption towards converging to that of the relatively rich. This convergence is robust only amongst small but not large farmers. Past studies that evaluated the FISP while not paying attention to the welfare equity gains in household per-capita consumption, may have underestimated its benefits. Policy, should, therefore, support the FISP with an additional objective of reducing inequality, beyond the primary aim of enhanced food security. Considering that the effects of FISP are limited to small farmers, alternative interventions such as inputs for credit should be made available to large farmers. This will allow the FISP induce widespread welfare gains.

Introduction

Farm Input Subsidy Program (FISP) remains a popular agriculture production strategy in sub-Saharan Africa that attracts academic interest. The literature (Bardhan & Mookherjee, 2011; Chibwana, Shively, Fischer, et al., 2014; Karamba & Winters, 2015) evaluates effects of FISP on household welfare. The findings from this literature reveal that subsidies achieve their primary objective of increasing cereal productivity by improving access to inputs amongst resource-constrained beneficiary farmers. Arguably, the increased productivity raises welfare through improved household liquidity position. Households produce more cereals per unit of land and consume their produce, thereby saving on food purchases (Benfica & Kilic, 2016). This could particularly be the case since sub-Saharan staple diet largely comprises cereals (Barrett, 2010) and the subsidies target cereal production (Dorward & Chirwa, 2011).

In addition to increased savings through own per-capita consumption, subsidies generate income through sales of the cereals in the market (Jayne et al., 2018). The overall increase in resources improves several other household outcomes. For instance, Karamba, (2013) and Harou (2018) find that farm input subsidies result in improved child nutrition. Considering that, the subsidies target cereals that have less nutrition value, the authors argue that the observed increased nutrition stems from improved liquidity from maize sales. Arguably, households use earnings from the sale of the subsidized cereals to finance nutritious food supplements and good medical care for the children. Karamba, (2013) supports these income effects with the finding that farm input subsidies increase household non-food per-capita consumption, pointing at the potential effects of the program on poverty reduction. Denning et al. (2009) and Dorward, Kydd, Morrison & Urey (2004) confirm that subsidies reduce poverty at both household and national level through food self-sufficiency and increased household income (Sibande et al., 2017).

Despite the extensive evidence that subsidies increase household welfare through improving both intended and untended outcomes, we are not aware of any paper investigating whether the subsidies enable relatively poor farmers' catch-up with the relatively rich farmers' well-being. If the results can reveal this potential convergence, farm input subsidies stand as an additional tool to attain equity in welfare. To the best of our research, studies are yet to exploit this dimension of effects. Our study, therefore, attempts to uncover the equity effects of FISP initiatives using evidence from Malawi. In this study, we proxy welfare with household per-capita consumption. We measure convergence over two-time periods; whether, with time, per-capita consumption increases, with a larger magnitude, amongst farmers with low baseline per-capita consumption (the relatively poor) in comparison to those with a higher baseline per-capita consumption (the relatively rich). To examine whether the FISP mediates this convergence, we include an interaction between program membership and baseline per-capita consumption as the treatment variable of interest. The study employs the convergence models on data obtained from Malawi.

Malawi remains a compelling case to understand the effects of farm input subsidies on welfare converge because it pioneered the re-introduction the program in the sub-Saharan African region and registered welfare improving successes overtime (Chibwana, Shively, Fisher, et al., 2014; Aurélie P Harou, 2018; Karamba & Winters, 2015; Kawaye & Hutchison, 2018). As such, the country's FISP program formed an initial framework against which other countries formulated similar programs (Ricker-Gilbert & Jayne, 2017). Therefore, results from Malawi can be used in making contextual comparison on the effects of subsidies in the sub-Saharan African region. Further, the country consistently implemented the FISP since its inception to date. This consistency allows our paper to uncover the cumulative effects of subsidies on the welfare convergence overtime. In the next section, we describe the Malawi FISP program in detail.

The Malawi FISP

In Malawi, large-scale universal farm input subsidies existed until 1980s, before introduction of the Structural Adjustment Programs (SAPs) reforms. SAPs advocated for the abolishment of universal subsidies on account of inefficiency in converting resources into food security (Dorward & Chirwa, 2011; S. Holden & Lunduka, 2010). The period after the SAPs adoption, sub-Saharan Africa dived into acute hunger and poverty (Chibwana, Shively, Fischer, et al., 2014; Jayne et al., 2018). In an effort to raise household incomes through sustained food security (Chibwana, Shively, Fischer, et al., 2014), the government of Malawi pioneered re-introduction of large scale Agricultural Input Subsidy Program (AISP) in the 2005/06 farming season.

Later, the AISP changed the name to the popular Farm Input Subsidy Program (FISP). Unlike the AISP, FISP increased the number of target beneficiaries and the quantity of distributed inputs. At national level, the quantity of fertiliser rose from 54,000 metric tons in 2005/06 growing season to 202,000 metric tons in 2008/09. In 2009/10 and 2010/11 the quantity declined to 161,000 (Mason & Ricker-Gilbert, 2013), due to increase in price of fertilizer on the international market. (Lunduka et al., 2013). The total program cost for FISP evolved from 32 million USD$ in 2005/06, through 74 million USD$ in 2006/07, to 107 million USD$ 2007/08 and to 242 million USD$ in 2008/09. The cost dropped to 108 million USD$ 2009/10, then rose again to 144 million USD$ in 2010/11 (Ricker Gilbert & Jayne, 2017).

A typical FISP package comprises four vouchers. Two for fertilizer (one for basal dressing and the other for top dressing, each valued at MWK15000[1]), one for maize seed valued at MWK6,000 ($8.11) and the last is a legume seed voucher that is valued at MWK2, 050 ($2.77). The full FISP package is, thus, worth MWK38, 050 which is equivalent to $51.42 (Government of Malawi, 2019). Over the FISP implementation[2] years, the combination of the vouchers has changed with only fertilizer subsidies provided in the 2005/06 growing season. However, in subsequent years, there was a combination of subsided fertilizer, maize, and legume seeds. In the 2006/07 to 2008/09 growing seasons, beneficiaries were given a fertilizer voucher for a 50kg bag irrespective of the type of fertilizer.

In addition to the fertilizer voucher, beneficiary farmers were also given a 2 kg voucher for hybrid seed and 3kg Open Pollinated Variety (OPV) seed. The FISP added a flexible voucher in the 2007/08 growing season. This voucher allowed farmers to purchase cotton, beans, soya, groundnuts, or more maize seed. In the 2009/10 growing season, the government changed from a generic fertilizer voucher to two specific vouchers of maize fertilizer for basal and top dressing, respectively. Unlike in the previous years, all these vouchers were now strictly for maize production. Additionally, the 2009/10 growing season discontinued the flexible seed voucher and replaced it with a voucher that can only purchase legume seed including beans, cow peas, pigeon peas, groundnuts, or soya.

The contribution that farmers pay upon redemption of coupons changed over time. In 2006/07 the beneficiaries redeemed fertilizer vouchers from designated agro-dealers at MK 950. In 2006/07, they redeemed at MK900[3]; in 2007/08, MK800; in 2008/09, MK500; in 2009/10, 2010/11, 2011/12, 2012/13, 2013/14, 2014/15 and 2015/16, MK3500. These are fertilizer prices for a 50 Kilogram bag of maize. Similarly, each seed voucher was redeemed at the value of MK 0 in 2006/07; MK90 in 2007/08; MK 0 in 2008/09; MK100 in 2009/10; 2010/11, 2011/12; MK150 in

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[1] USD$ 20.27 at the exchange rate of MWK740 per dollar.

[2] All information about FISP implementation, provided here, are obtained from the publicly available program implementation documents within the Ministry of Agriculture in the government of Malawi.

[3] Taking a current exchange rate of 1USD to MWK780, readers can calculate the approximate cost of fertilizer in respective growing seasons in current terms. Inflation and rising costs of commodities should be considered during these calculations.

2012/13, 2013/14; MK100 in 2014/15 and MK1000 in 2015/16. There was no accompanying seed voucher at the start of FISP program in the 2005/06 growing season.

The fertilizer distribution mechanism has not remained the same over the FISP implementation years. In 2005/06 and 2009/08, the government of Malawi distributed the subsidized fertilizer and seeds through privately procured retailers. Starting from 2008/09 privately procured retailers were excluded but only used in procurement and distribution of subsidized maize seeds (Ricker-Gilbert & Jayne, 2017). Kelly et al., (2010) show that the government banned the participation of the private sector due to absence of a system to monitor their operations. Additionally, private traders were involved in exchange of counterfeit vouchers (Kaiyatsa et al., 2019). The subsidized improved variety of maize seed remained free for all participating farmers while there has always been a farmer contributory amount towards the purchase of fertilizer.

Until year 2019, the program targeted 1 million small-holder farmers, while starting from 2020, the FISP targets 3.4 million farmers (Government of Malawi, 2020). *De-jure*, a beneficiary household should be vulnerable with some of the following attributes. (i) fulltime resource poor smallholder (ii) permanent residence in the village which they currently reside and (iii) owners of land to be cultivated in the given agricultural growing season (Karamba, 2013). Additionally, the FISP program targets household whose heads are elderly, HIV positive, female, children, orphans, physically challenged; or household heads that take care of elderly or physically challenged household members. Furthermore, FISP targets one farmer per household. (for more details see Lunduka, Ricker-Gilbert, & Fisher, 2013).

De-facto, the definition of the minimum vulnerability that guarantees selection into the program, remains idiosyncratic and purely determined by the community in which a household resides. This is commonly known as community targeting, where village members gather on open forums to select beneficiary households that they agree to be vulnerable by the village's standards (S. Holden & Lunduka, 2013). The government introduced this form of targeting on the grounds that the communities are better able to identify the poor than is the government itself or any other outside agents (Chinsinga, 2005).

The Malawi FISP has faced a number of implementation challenges. Lunduka et al., (2013) identify (a) politicization of FISP, (b) diversion and leakages inputs, (c) targeting inefficiencies due to poorly defined selection criteria and (d) untimely delivery of farm inputs to the local beneficiaries. Additionally, Holden and Lunduka (2010) note that due to egalitarian culture in rural Malawian communities, some farmers share inputs with their neighbors after redeeming the vouchers (Lunduka et al., 2013). These implementation bottlenecks could negatively affect the efficiency and effectiveness of the FISP. Nevertheless, empirical findings reveal that the Malawi FISP results in positive welfare outcomes despite these bottlenecks (Chibwana, Shively, Fisher, et al., 2014; Aurélie P Harou, 2018; Karamba & Winters, 2015; Kawaye & Hutchison, 2018).

The most salient feature of this literature is that it does not uncover whether the FISP enables relatively poor farmers converge in welfare to that of the relatively rich farmers. We hypothesize that the Malawi FISP leads to welfare convergence between these continua of farmers as it targets vulnerable households. In this study we define relative poverty along a continuous per-capita consumption scale. Therefore, we do not need to split the sample into two groups of the absolute poor and the absolute rich. The relative terms are what allow us to model convergence in per-capita consumption by examining continuous changes in household per-capita consumption over time, and how the FISP mediates these welfare adjustments. We explain this in detail in the sections to follow.

Estimation strategy

Econometric specification

The empirical application of our research question demands modelling change in per-capita consumption between two time periods as a function of the baseline per-capita consumption between the two, FISP and the interaction between FISP and baseline per-capita consumption presented as follows.

$$\Delta Cons_{it} = \alpha_1 Cons_{it-1} + \alpha_2 FISP_{it-1} + \alpha_3 (Cons_{it-1} \times FISP_{it-1}) + \alpha_4 X_{it} + \varepsilon_{it} \quad (1)$$

In equation (1), the dependent variable, $\Delta Cons_{it}$, represents change in per-capita consumption for a household *i* over period *t*. we capture generic convergence with α_1, the effects of FISP on per-capita consumption by α_2 and the influence of FISP on per-capita consumption convergence by

α_3. Our interest lies on, α_3, the coefficient of the interaction term. If this coefficient is negative, it entails that FISP leads to per-capita consumption convergence; overtime the per-capita consumption of the households that started at a relatively low baseline rises at a rate higher than that of households that had relatively higher per-capita consumption at baseline, when they both receive FISP. The control groups are those that did not receive the FISP. A positive sign for the α_3 means FISP results in per-capita consumption divergence; Household with relatively higher per-capita consumption at baseline experience the highest rate of increase in per-capita consumption, over time, relatively to those that had lower baseline per-capita consumption once both receive FISP.

A convergence outcome implies that, over time, FISP reduces per-capita consumption inequalities by helping the relatively poor move closer to the relatively rich household's per-capita consumption. A divergence outcome entails that FISP increases welfare inequalities by expanding the per-capita consumption of the rich at a rate that is higher than the rise in the relatively worse-off household's per-capita consumption. If the interaction, term is not different from zero; the FISP does not affect welfare inequality. The size of the coefficient defines the nature of convergence. A coefficient that is between 0 and -1 entails partial convergence while that which is equal to negative -1 entails complete convergence. It is worth noting that we need not define a threshold for poverty in this study since we are only comparing per-capita consumption in relative terms, where the per-capita consumption in a continuous variable. This functional form is what enables modelling convergence. Further, the study uses only per-capita consumption as a proxy for welfare.

We anticipate that farmers, whether relatively rich or relatively poor, may face different production challenges based on the size of their landholding. Farmers with relatively large farms may need more inputs while those with small plots require less inputs. Therefore, the same FISP package could significantly shift the productivity of small farmers while failing to produce a noticeable effect on large farmers' yields. Therefore, this paper splits the sample by landholding in additional estimations, to examine if the FISP could have these different effects on per-capita consumption convergence based on the amount of land that a farmer holds. Thus, we now compare converged of per-capita consumption due to FISP amongst relatively large farmers and relatively small farmers separately. We define the relatively small farmers as those below the median land holding for the sample of interest and those above the median as relatively large farmers[4].

The model also controls in, X_{it}, for gender of the household head, age of the head, number of children who are less than 18 years in the household, household size, number of years that the household has lived in the village, whether at least one household received a FISP voucher in the village. We further control for geographical attributes that include distance to the road, ADMARC (government agriculture market), auction floors and BOMA (British Oversees Military Administration). We also include in the conditioning variables, annual average rainfall, and regional fixed effects.

Identification

Identification of the effects of FISP on per-capita consumption convergence hinges on how well we settle the potential endogeneity caused by the non-random selection of beneficiaries in the initiative. The traditional solution to the FISP endogeneity has been the usage of instrumental variables (Aurelie P Harou, 2018; Karamba, 2013; Mason & Ricker-Gilbert, 2013). Instrumental variables effectively find exogenous variation in FISP that shifts the outcome of interest, on satisfaction of two crucial assumptions. The first is that the chosen instrument should be orthogonal to the errors of the outcome equation (exclusion restriction) and the second is that it should produce a significant change in the FISP allocation (instrument relevance). We can empirically test relevance, but we only contextually argue for exclusion restriction; exclusion restriction remains a problem in this literature. For instance, other authors (Aurelie P Harou, 2018) use the number of votes won by a ruling party in the most recent elections as an instrument. Nevertheless, it is also possible that political parties get the votes due to FISP vouchers allocated previously; hence, votes become endogenous for not only being the cause for FISP but also the result. Another branch of FISP literature uses number of years that a household has lived in the village as an instrument (Chibwana, Shively, Fischer, et al., 2014; Ricker-Gilbert et al., 2011). However, this would also not be exogenous in our function at hand since long timers may occupy better and more productive

[4] Note that this categorization is done purely on empirical basis and has nothing to do with selection into FISP criteria. The median landholding in our dataset was 0.517 hectares. Hence small farmers are those with land below the threshold while large farmers are those above this threshold.

plots that would directly affect their per-capita consumption outside FISP. Hence, time in this per-capita consumption function becomes endogenous.

Our paper therefore, diverges away from the traditional instruments proposed by the FISP literature to use the Lewbel (2018) approach to internal instruments identification. Lewbel proposes a method that identifies the effects of interest by exploiting the heteroscedasticity in the data without external instruments. We can describe the Lewbel approach as follows. Assume a sample of endogenous variables Y_1 (Per-capita consumption) and Y_2(FISP) and a vector of exogenous covariates X. We intend to estimate δ, the effects of FISP, and the vector β in the model.

$$Y_1 = X'\beta + Y_2\delta + \varepsilon_1 \qquad (2)$$

$$Y_2 = X'\alpha + \varepsilon_2 \qquad (3)$$

Where the errors in the two equations, ε_1 and ε_2, may be correlated. We first estimate α by regressing Y_2 on X, and extracting the predicted residuals $\hat{\varepsilon}_2 = Y_2 - X'\hat{\alpha}$. Z Could be part or all elements of X. One then estimates the δ and β by a two stage least squares regression of Y_1 on Y_2 and X using $(Z - \bar{Z})\hat{\varepsilon}_2$ as instruments. $\bar{Z}$ is the sample mean of Z. In addition to the standard instrumental variables that $E(X\varepsilon_1) = 0$, $E(X\varepsilon_2) = 0$ and $E(XX')$ is non-singular, the Lewbel (2012) estimator requires that $Cov(Z, \varepsilon_1\varepsilon_2) = 0$, and $Cov(Z, \varepsilon_2^2) \neq 0$. Considering that FISP is a binary variable, then our equation (3) will produce heteroskedastic errors by construction, that enables it to meet the Lewbel (2012) assumptions. We employ the Lewbel estimator on household level data from Malawi, described in the next section.

Data and descriptive statistics

The Malawi Integrated Household Survey

This study uses data from the Living Standards Measurement Survey-Integrated Surveys on Agriculture (LSMS-ISA), implemented by The World Bank, in conjunction with the Malawi

National Statistics Office[5] (National Statics Office of Malawi, 2013). The World Bank conducts similar surveys in seven other countries of the sub-Saharan African region (Mali, Ethiopia, Burkina-Faso, Niger, Nigeria, Uganda, Tanzania, and Malawi). The primary objective of the surveys is to provide a comprehensive outlook of the connection between agriculture, socioeconomic position, and non-farm income for the purposes of monitoring welfare changes over time. In this paper, we use the Malawi Integrated Household Panel Survey (IHPS)[6], an LSMS-ISA dataset for the country.

The IHSP collected data in 2010, 2013 and 2016 with a three-year gap between every wave. We use only the 2010 and 2013 waves particularly because 2013 has retrospective information on how many years in the past since 2009 to 2012 a household received a FISP voucher. The variable enables us to explore the cumulative effects of the FISP on per-capita consumption. Together with baseline household per-capita consumption, the subsidy variable allows us to understand per-capita consumption convergence between the farmers across the two-year period of 2010 and 2013. Furthermore, we left out the last wave (2016) due to presence of split-off households that the survey poorly traced. Including the wave would lead to systematic missing observations that could threaten the representativeness of our analysis. As such, we limit the analysis to estimating a two-period convergence between 2010 and 2013 years.

In total, the IHPS panel component collected data from 4000 households. These households can be traced back to the baseline of 3104 collected in the first wave of the panel in 2010. Since our interest is on estimating the convergence effects of FISP on farming household's per-capita consumption, we are only interested in farmers. Hence, our estimation sample excluded all non-farming households. We then remained with 2251 farming households that can be perfectly traced between the two years of 2010 and 2013.

Measurements

a) *The outcome variable*

[5] http://www.nsomalawi.mw/

[6] https://catalog.ihsn.org/index.php/catalog/6160

In this paper, we use change in real per-capita consumption between 2010 and 2013 as the outcome variable. Thus, we subtract a household's per-capita consumption between the two years. The IHS measures real per-capita consumption in Malawi Kwacha currency. We take a log of per-capita consumption to reduce the impact of outliers.

b) The treatment variable

We use FISP and baseline (2010) real per-capita consumption as the treatment variables. FISP here captures the number of years a household received subsidy vouchers between the years 2009 and 2012. This makes the FISP a count variable ranging from 0 for those who are never beneficiaries in all the years and 4 for the households that received the FISP vouchers for all the three years. The IHPS survey gathers FISP retrospective information limited to data on whether a household obtained the vouchers. This is unlike its sister cross-sectional components that go as far as clarifying whether the household indeed redeemed the inputs. Therefore, our paper limits to understanding the intention to treat.

c) Conditioning variables

We condition our analysis to a household, village, and geographical attributes to minimize chances of omitted variable bias in our analysis. The household characteristics include gender of the head, age of the head, household size, number of children under the age of 18, land holding and the number of years that a household head lived in the current village. We also include a variable denoting those households that stay in a village that at least received a FISP voucher in the current growing season. The geographical controls include distance to a road, government agricultural marketing agent, tobacco auction floors and trading center. We also account for differences in rainfall using annual average precipitation for the cluster in which a household resides. In addition, we include regional fixed effects. Previous literature (Chibwana et al., 2012; Dorward & Chirwa, 2011; Aurelie P Harou, 2018; S. T. Holden & Lunduka, 2018; Karamba & Winters, 2015) on FISP evaluations use the same conditioning variables, hence, our selection of the presented set.

Descriptive statistics

Table 1 shows summary statistics for the variables used in the estimations. We split the sample by FISP (column 1) and non-FISP (column 2) households. These FISP and non-FISP households contain both small and large farmers. As highlighted in the method, convergence demands use of a continuous variable, per-capita consumption. Therefore, the welfare inequality, is here, measured in relative terms (relatively poor and relative rich) not absolute thresholds of poor and rich. In the Table 1, first row shows that between the two waves per-capita consumption increased for both groups of households. This increase is significantly higher for the FISP beneficiaries relative to the non-beneficiaries. Second row shows that the baseline per-capita consumption was high amongst non-recipient households relative to the recipients. Therefore, those with lower baseline per-capita consumption (the FISP group) experience the larger increase in per-capita consumption relative to those with a larger baseline per-capita consumption (the non-FISP group).

Table 1
Summary statistics for variables used in the estimations.

	FISP	No-FISP	Difference
Delta per-capita consumption (Malawi Kwacha-continuous)	71788.204	5507.836	-66280.367**
Per-capita consumption2010 (Malawi Kwacha-continuous)	566274.550	704412.570	138138.015***
Land holding (Hectares-continuous)	0.685	0.379	-0.306
Male head (dummy 1=Male, 0= Female)	0.751	0.787	0.036
Age of head (continuous)	45.308	41.020	-4.287***
Number of under 18s (continuous)	2.855	2.686	-0.170*
Household size (continuous)	5.475	5.278	-0.197
Time since settlement (years-continuous)	43.306	37.426	-5.880***
FISP Village (dummy 1=Yes, 0=No)	0.973	0.886	-0.087***
Distance to a road (Kilometres-continuous)	9.288	9.044	-0.244
Distance to ADMARC (Kilometres-continuous)	7.937	8.069	0.132
Distance to auction floors (Kilometres-continuous)	82.179	74.013	-8.166***
Distance to BOMA (Kilometres-continuous)	53.271	54.821	1.551
Annual average rainfall[7] (Millilitres-continuous)	863.264	838.657	-24.606***
Northern region (dummy 1= North, 0=Otherwise)	0.266	0.171	-0.095***
Central region (dummy 1= Central, 0=Otherwise)	0.354	0.391	0.037
Southern region (dummy 1= South, 0=Otherwise)	0.379	0.438	0.059**
Observations	1456	795	2251

[7] Rainfall was measured per cluster: A cluster comprises 25 households in a geographic unit.

Source: Authors own calculations from IHPS

The rest of the table provides statistics for conditioning variables used in the analysis. We observe that FISP household have older heads, a larger number of children under the age of 18, have settled for a long time in their current village, they live in FISP recipient villages (villages where at least a member is a beneficiary of the program), they live far away from auction floors and received more rainfall in comparison to the non-FISP households. The southern region has higher number of FISP beneficiaries (37.9%) followed by the central region (35.4%) and finally by the northern region (26.6). Land holding (hectares), gender of the head of household, household size, distance to a road, and distance to a government agriculture agent (ADMARC), distance to a trading center (BOMA) and living in central region do not significantly differ between the FISP and non-FISP households.

Empirical findings

Table 2 presents results of the effects of FISP on per-capita consumption convergence. In column 1, we present OLS findings while the second column of the table provides the instrumental variables outcomes. Both methods provide similar output, only differing in coefficient size and standard errors. The IV output further shows that, overall, our instruments are relevant with an F-statistic of 12. The sargan statistic is also significant revealing that FISP is indeed endogenous such that estimating only the OLS models would result in inconsistent estimates. The dependent variable in all our models is change in log of household per-capita consumption between the year 2010 and 2013.

Consistent with previous findings (Karamba, 2013), we observe that FISP leads to increased household per-capita consumption. Furthermore, the coefficient on baseline per-capita consumption reveals that overtime, per-capita consumption converges. Thus, farmers who had low baseline per-capita consumption obtain a larger increase in per-capita consumption over time relative to those who had high per-capita consumption at baseline. Our interest lies in understanding if FISP mediates this convergence. The results in the third row of both models show that, indeed, FISP plays this mediating role. Thus, farmers with low per-capita consumption at baseline who receive the subsidy vouchers in more seasons catch up with those who had high baseline per-capita consumption.

Considering that per-capita consumption amongst farmers may closely relate to farm productivity, we anticipate that the effects of FISP on per-capita consumption convergence could also depend on covariates of farm productivity. Literature (Tchale, 2009) on farm productivity consistently find that landholding has a significant and negative relationship with this productivity. We therefore investigate if the effects of FISP on convergence dissipates with increasing hectares that the farmer holds. Table 3 provides output for these results. We partition the sample into farmers above (larger farmers) and below (small farmers) median landholding. The first two columns provide output for the small farmers. We find that FISP remains the determining factor for increased per-capita consumption and per-capita consumption converges overtime. Furthermore, the interaction between FISP and baseline shows that FISP positively mediates per-capita consumption convergence amongst small farmers.

The third column of the table 3 provides OLS findings for large farmers. We observe that FISP improves per-capita consumption over time and that convergence happen with time. Nevertheless, we see that this convergence is not due to FISP amongst large farmers. The fourth column of the table shows that FISP does not improve per-capita consumption amongst large farmers. The result differs from the OLS findings in column 3 that shows a marginal relationship between FISP and increased per-capita consumption. This result could emerge due OLS failure to control for unobserved endogeneity. The third column also shows that convergence happen amongst these farmers. Nevertheless, this convergence is not due to FISP.

Table 2
Estimates of the effects of FISP on per-capita consumption convergence

	(1) OLS	(2) IV
Cumulative FISP	0.457***	0.528***
	(0.112)	(0.172)
Per-capita consumption2010 (Log)	-0.495***	-0.344***
	(0.020)	(0.038)
Cumulative FISP*Per-capita consumption 2010	-0.033***	-0.037***
	(0.009)	(0.013)
Gender of household head	0.022	-0.007

	(0.025)	(0.026)
Age of household age	0.015***	0.008**
	(0.004)	(0.004)
Squared age of head	-0.000***	-0.000*
	(0.000)	(0.000)
Number of children under 18 years	-0.044***	-0.050***
	(0.008)	(0.008)
Household size	0.118***	0.106***
	(0.016)	(0.016)
Household size squared	-0.003***	-0.003**
	(0.001)	(0.001)
Time number of years in the village	-0.004***	-0.003***
	(0.001)	(0.001)
FISP village	0.223***	0.194***
	(0.039)	(0.043)
Distance to a road	-0.004***	-0.003**
	(0.001)	(0.001)
Distant to ad arc	-0.003	-0.001
	(0.002)	(0.002)
Distant to auction	-0.001***	-0.001***
	(0.000)	(0.000)
Distance to BOMA	-0.001**	-0.001***
	(0.000)	(0.000)
Average rainfall (Log)	-0.555***	-0.654***
	(0.178)	(0.182)
Central region	-0.100**	-0.131***
	(0.039)	(0.040)
Southern region	-0.062	-0.079*
	(0.046)	(0.047)
Constant	9.674***	8.592***
	(1.233)	(1.276)
F-statistic		12
Sargan statistic		82.321***
Observations	2,251	2,251
R-squared	0.360	0.336

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

Table 3

Estimates of the effects on FISP on per-capita consumption convergence by landholding

	(1) Small farmers OLS	(2) Small farmers IV	(3) Large farmers OLS	(4) Large farmers IV
FISP	0.444**	0.601**	0.296*	0.284
	(0.174)	(0.264)	(0.169)	(0.262)

Per-capita consumption2010	-0.508***	-0.378***	-0.542***	-0.400***
	(0.032)	(0.058)	(0.032)	(0.065)
FISP*Per-capita consumption2010	-0.033**	-0.043**	-0.020	-0.018
	(0.013)	(0.020)	(0.013)	(0.020)
Constant	9.320***	8.493***	9.546***	8.297***
	(1.915)	(1.952)	(1.824)	(1.914)
All controls included	Yes	Yes	Yes	Yes
F-statistic		12		12
Sargan statistic		71.611		63.258
Observations	1,105	1,105	1,096	1,096
R-squared	0.381	0.365	0.369	0.349

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

Discussion and policy

Our results show that FISP mediates per-capita consumption convergence amongst voucher recipient farmers in Malawi. Overtime, the FISP leads to a larger positive change in per-capita consumption amongst those who had low intake at baseline relative to those who were consuming more at the beginning. The possible pathway is that FISP increases land productivity leading to increased household income through direct sells of maize harvests. This is consistent with (Sibande et al., 2017) findings that program participants sell the crop output in the market. Alternatively, FISP increases own production (Chibwana, Shively, Fischer, et al., 2014; Jayne et al., 2018) to an extent that farmers save on purchase of maize from the market for household food per-capita consumption during lean season. The saving made from the avoided purchase of food from the market leads to expansion on the range of non-food purchases that households consume (Gautam, 2015; Karamba, 2013). In addition, as FISP increases own production the own food component of total households' per-capita consumption increases. All these paths lead to overall increase in household per-capita consumption.

We also find that both farmers who had low baseline per-capita consumption and those with high initial per-capita consumption experienced a rise in their resources. Nevertheless, the fact that FISP targets vulnerable farmers, (Chibwana, Shively, Fischer, et al., 2014; Karamba & Winters, 2015) entails that it provides a big push that enables them start catching up with high per-capita consumption farmers, as our results have shown. Even in instances that both groups receive the vouchers, the per-capita consumption increase of those who were relatively poor could be higher than the relatively rich. This is because the relatively poor may be lacking more goods and services than their counterparts at baseline. Then, FISP unties the liquidity constraints more in the less affluent group than their counterparts.

Furthermore, we find that the effects of FISP on per-capita consumption convergence dissipate with increased land holding. Small farmers are often highly productive due their reduced managerial demands and adequate farm labor provision (Msuya et al., 2008). Therefore, FISP could be more effective in increasing small farmer output. These farmers would then experience increasing household per-capita consumption. In addition, the fact that FISP provides a fixed amount of two fertilizer bags (Chibwana, Shively, Fischer, et al., 2014), increasing land holding would mean a reduced amount of the inputs applied per hectare. This would also lead to minimal changes in crop output due to FISP, and the resultant low increase in household per-capita consumption amongst farmers with large landholdings.

These results have implications for policy. Since FISP leads to per-capita consumption convergence, it can be used as a strategy to, not only achieve its overall goal of increasing household income through sustained food security, but also to attain per-capita consumption equity goals (Chibwana, Shively, Fischer, et al., 2014; Karamba, 2013). These outcomes are in line with the first and second Sustainable Development Goal of “ending poverty and hunger”. In addition, the outcomes assist in meeting the tenth goal of “reducing inequality”. Nevertheless, government needs to put other initiatives in place to assist the subsections of the population that do not derive maximum benefits from the current structure of FISP such as large farmers. An example would be cushioning the larger farmers with alternative input initiatives such as fertilizer loans that can enable them obtain inputs that meet their production needs.

Conclusion

The study is motivated by the quest to understand the effects of fertilizer subsidies which have gained prominence is the sub-Sahara African region since their re-introduction pioneered by Malawi in 2005. The initiatives aim at raising income through sustained food security. Our empirical strategy goes beyond examining the effects of FISP on household welfare to understanding the influence of the initiative on welfare convergence. Nearly all-existing literature on the effects of the subsidies on household welfare base on the static welfare outcomes. Eventually, the dynamic-equity effects of the subsidies remain an empirical question. Our study fills this literature gap.

We use two waves of panel data from Malawi that tracks farm input subsidy recipients from 2010 to 2013. We test a hypothesis that remains largely unanswered in the subsidy literature to date-the low per-capita consumption of households that receive farm input subsidy vouchers does not converge towards that of high per-capita consumption household receiving the vouchers in comparison to all non-beneficiary households. We test this hypothesis using a dynamic function of per-capita consumption convergence. To account for non-random selection into the FISP and potential measurement errors that could bias our estimates we employ an instrumental variables technique developed by Lewbel (2012; 2018). We find that the Malawi farm input subsidy mediates per-capita consumption convergence amongst households. The mediating role of FISP is limited to small farmers. Therefore, farm input subsides can be used as a tool to achieve equity in per-capita consumption. Nevertheless, a holistic approach that accounts for the heterogeneity in convergence benefits of the subsidies between small and large farmers remains key in achieving effective per-capita consumption equity in Malawi and elsewhere in the sub-Saharan African region.

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