DETERMINANTS OF FARMERS' WILLINGNESS TO PAY FOR SUBSIDISED FARM INPUTS IN MALAWI

Laston Petro Manja
University of Malawi, Chancellor College
Student
P.O. Box 280, Zomba, Malawi
E-mail: bsoc-60-10@cc.ac.mw

Gowokani Chijere Chirwa
University of Malawi, Chancellor College
Lecturer
E-mail: gchirwa@cc.ac.mw

Patrick Kambewa
University of Malawi, Chancellor College
Associate Professor
E-mail: pkambewa@cc.ac.mw

Abstract
Most recently, citing low price elasticity of demand for inputs in the agro-based Malawian economy, economists and non-economists have advocated for increasing prices for subsidized inputs. However, elasticities alone are not enough to make inferences since knowledge of whether higher prices are indeed affordable by farmers is of special significance. This study uses the standard The results reveal that smallholder farmers are willing to pay for more inputs in the Farm Input Subsidy Programme (FISP) with the mean WTP for each household at MK 1000 being about ten 50kg fertilizer bags and the total WTP at the same price being 46 891 bags per year for 4742

observed households. Using data from the Malawi 2011/12 Farm Input Subsidy Study (FISS4), the model identifies age, sex and education of household head, farm size, food security as well as radio ownership as positive determinants of WTP; with coupon receipt and farm incomes as negative determinants.

Key Words: Malawi, FISP, Willingness to Pay, FISS4, Tobit
JEL Classification: Q10

1 Introduction

Notwithstanding the surging challenges that have been met since time immemorial, input subsidies have served the significant function of improving agricultural productivity in general and food security in particular. For Malawi the Farm Input Subsidy Programme (FISP) was introduced in the 2005/6 growing season targeting at least 1.5 million farm households to improve household and national food production and incomes (Chirwa & Dorward, 2013; Mason & Ricker-Gilbert, 2012). Although subsidy inputs are redeemed at a much lower cost relative to market prices, the necessary requirement for any purchase still remains that smallholder farmers must be willing to pay for the inputs [1]. It is well known that at any point in time different farmers purchase different quantities of inputs and as such it can be inferred that the farmers exhibit different levels of willingness to pay (WTP) for the inputs[2].

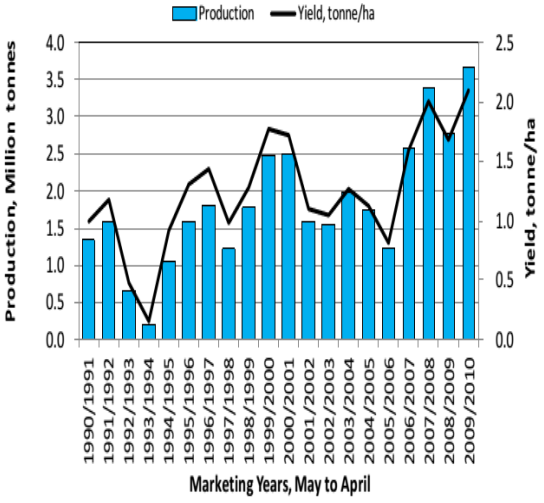
[1] "Smallholder" and "peasant" farmers are assumed to be equal and are thus used interchangeably in this study

[2] A farmer's willingness to pay for farm inputs is basically the farmer's amenableness to contribute a certain fee so as to obtain farm inputs for use on the farm.

1.1 History of Input Subsidies in Malawi

The earliest forms of input subsidies in Malawi, known as Universal input subsidies, were implemented as agricultural development policies in poor rural areas from the year 1952 to the early 1990s to meliorate the availability of vital agricultural inputs at a low cost to even the most remote-located smallholder farmers so as to increase maize productivity and maintain soil fertility (Chirwa and Dorward, 2013). After gaining independence in 1994, the Malawi Government introduced the Smallholder Agricultural Credit Administration (SACA) which was implemented up to 1994 when it collapsed due to non-repayment. At the same time the donor community was also against the credit scheme. Since these former subsidies proved to be very expensive (Chirwa and Dorward, 2013), the Starter Pack (SP) program was implemented between 1998 and 2000 with the intention of increasing maize yields and attaining food security as well as countering soil nutrient depletion. In the SP program, small 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. Due to increasing pressure on the government by the donor community to scale down the starter packs, the Targeted Input Programme (TIP) was introduced in 2001 (Dorward, 2009). The program was clearly necessary in raising maize output in Malawi but not sufficient as the country experienced poor harvests in the years 2001, 2002, 2004 and 2005 as illustrated by figure 1 below.

Figure-1: Malawi Maize Production from 1990 to 2009



***Source**: Wiggins & Brooks, 2010*

Figure 1 shows a generally increasing pattern of maize production over the years with harvests exceeding the period's estimated national requirement of 2.4 million metric tonnes. However, output from 2001 onwards was below the estimated minimum, leading to a review of the SP in favor of The Targeted Input Programme (TIP)[3]. In the 2004/5 Fiscal Year, having been ranked as one of the poorest countries in the world (NSO, 2005a) and due to the hunger crises at the time, the Agricultural Input Subsidy Programme (AISP), known as FISP, was initiated in Malawi and this program is still operational at the moment.

[3] The Targeted Input Programme (TIP) was a scaled down version of the SP with a smaller quantity of fertilizer (10kg) per beneficiary and targeted selection of beneficiaries (Dorward, 2009)

Noting that targeting is one crucial issue for input subsidies in Malawi, Chirwa et al. (2013) argue that subsidised fertilizers should be targeted at households that could not have managed to purchase the same at the prevailing market prices so as to avoid the displacement of commercial sales of fertilizers. This implies that individual households' characteristics are necessary to the effectiveness of subsidy programs since they have an impact towards both willingness to pay (WTP) and access to farm inputs at the subsidy prices hence they should be taken into consideration in policy making. With subsidy prices fixed above the farmers' affordability level, the program cannot reach the rural poor households and, contrariwise, if prices are set below the average household's affordability level, the program is all but a waste of public funds and a displacement of commercial sales of fertilizer will occur. In this regard, it is worth examining the factors that have an impact on WTP and the magnitudes of their effects. Not many studies have been conducted in this field. For example, Maganga et al. (2014) looked at factors determining demand for purchased inputs in Lilongwe and Minot et al. (2000) studied fertilizer market reform and the determinants of fertilizer use in Benin and Malawi. However, the study by Maganga did not consider the determinants for Malawi as a whole, whereas Minot's study focused on farmers' fertilizer use rather than their WTP. With due recognition of the contribution made by such previous studies, this study takes as its main objective the empirical determination of factors that influence farmer's WTP for subsidised farm inputs in Malawi, thereby broadening literature in this field.

2 Justification and Policy Relevance of the Study

Many studies (including Dorward, 2009; Dorward & Chirwa, 2014; and Mason et al., 2013) observe that subsidy programs are very costly and they present heavy burdens on government budgets. This presents the need to trim down the government allocation to subsidies to reduce government deficits in a move to achieve fiscal discipline. The best way to do this is to gauge the average maximum that farmers are willing to pay for the farm inputs and charge that, in order to achieve an equilibrium for both the government and farmers. In Malawi, prices of subsidised inputs are typically pre-fixed by administrators based on the total budget allocation without employing quantitative methodologies. This may lead to economic inefficiency by causing a discrepancy between farmers' WTP and the prevailing prices of subsidised inputs.

To this end, a quantitative willingness-to-pay study is needed for pricing of farm inputs in order to ensure that the government can only contribute the minimum amount that people would wish the authorities to contribute. Such information will help the government, planners and policy makers to know the maximum amount to spend to subsidise the farm inputs while justifying the achievement of the intended objectives, that is, food self-sufficiency and poverty alleviation.

3 Methodology

Based on expected utility theorem and an approach proposed by Stiglitz (1976), a farmer's preferences for income in any two states of nature, good or bad, can be functionally described. The expected income value can be defined as,

$$V(p, W_1, W_2) = (1 - p)U(W_1) + pU(W_2)$$

where W_1 denotes the farmer's income in a good state of nature (say good rains); W_2 his income in a bad state of nature (say poor rains), with probability p; and $U(.)$ the utility of money income.

Assuming that $\alpha = (x, y)$ represents the subsidy program; where x is a farmer's payment for a 50kg fertilizer bag and y is the output for each 50kg bag minus the payment per 50kg bag. Therefore, letting W be the initial income and d the income loss due to a bad state of nature, then the expected value of the subsidy is,

$$V(p, \alpha) = V(p, W - x, W - d + y) = (1 - p)U(W - x) + pU(W - d + y)$$

But a farmer always has the option of not buying the subsidised input. Hence he will utilize the subsidy α only if $V(p, \alpha) \geq V(p, 0) = V(p, W, W - d) = (1 - p)U(W) + pU(W - d)$.

Therefore farmers' WTP and the amount charged on each 50kg bag are related as follows;

when $\alpha_1 \leq WTP$, $V(p, \alpha) \geq V(p, 0)$; and when $\alpha_1 > WTP$, $V(p, \alpha) < V(p, 0)$

meaning that a farmer buys the input to get higher utility if subsidy price is less or equals WTP.

In this study WTP is defined as the number of 50kg fertilizer bags that a farmer would purchase given the various fixed subsidy prices. Data from the Malawi 2012/13 Farm Input Subsidy Study (FISS4) is used to determine the factors that affect farmers' WTP for subsidised farm inputs in Malawi. About 12, 000 households across the country were randomly selected and the survey collected detailed information on education, health, agriculture and many other aspects.

The survey had explored WTP at five different price levels, but this study analyzes WTP at $MK\,1000$. Choice of this price is made because out of the five prices, $MK\,1000$ is the closest to

MK 950, the actual price implemented in FISP by 2015 (Dorward & Chirwa, 2009).

3.1 Variable Definitions and Measurements

A summary of the variables investigated in this paper is presented in Table 1 below some of which are adopted from a paper by Abebe and Bogale (2014) who explore WTP for rainfall based insurance by smallholder farmers in Central Rift Valley of Ethiopia.

Table-1: Description of independent variables

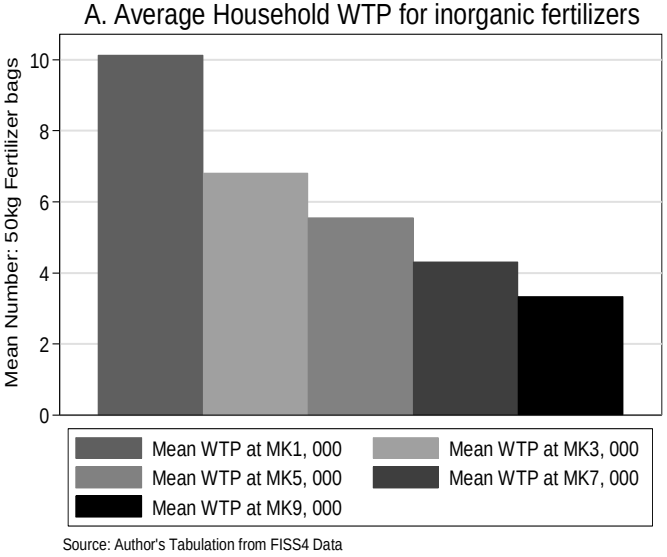
VARIABLE	VARIABLE TYPE	DESCRIPTION	EXPECTED SIGN[4]
Age of Household Head	Continuous	Age (in years) of household head	+
Square of Age of Head	Continuous	Square of age of household head	-
Sex of Household Head	Dummy	1 = Male-headed, 0 = Otherwise	+
Illness Costs of Household Head	Continuous	Money spent on treatment of illness of hh member	-
On-Farm Income	Continuous	Sales of farm crops and animals	+
Off-Farm Income	Continuous	Incomes other than crop or animal sales (e.g gifts, enterprises, etc)	( )
Education of Household Head	Dummy	1 = None; 2 = PSLC; 3 = JCE; 4 = MSCE; 5 = Non-Univ Dip…	+
Farm Size	Continuous	Land being owned or cultivated by household (e.g fallow, virgin)	-

[4] + is for positive; - is for negative; and ( ) is for indeterminate

Livestock Holding	Continuous	Cows held by a household	( )
Radio Ownership	Dummy	1 = Ownership; 0 = Otherwise	+
Food Security	Dummy	1 = Adequate or more (security); 0 = not adequate (no security)	+
Coupon Receipt	Dummy	1 = Any Receipt; 0 = Otherwise	+

3.2.Descriptive Analysis

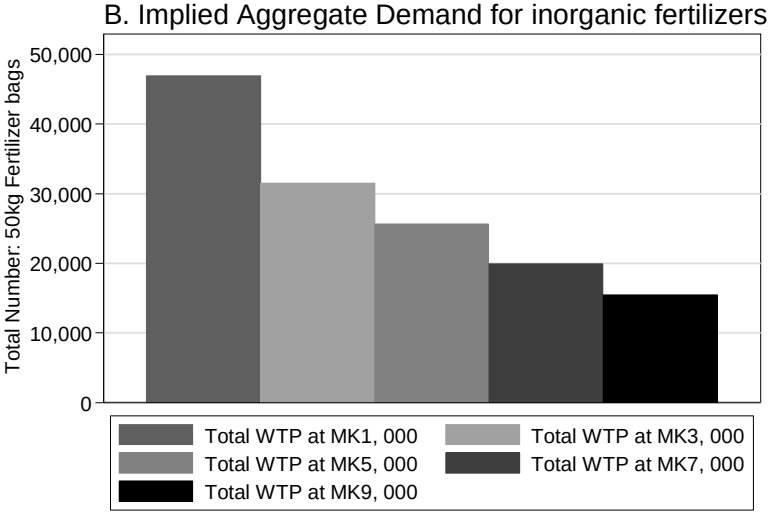
One issue of particular interest in FISP is to trace farmers' ability to make purchases of fertilizers at prices different from the subsidy levels. The aim is to have an efficient system of targeting so as to maintain the demand for commercial fertilizers by the rest of the population that can afford to buy. Farm households in the FISS4 were asked to state the number of 50kg fertilizer bags they would be willing to buy at the five different prices:



Source: Author's Tabulation from FISS4 Data

MK 1000; MK 3000; MK 5000; MK 7000 and MK 9000. In this case interest is on the average household demand curve which is derived by calculating the mean WTP at each of the five prices in FISS4.

Further interest is cast on the aggregate demand curve which is a vertical summation of the individual household demands at the five levels of prices. Bar graphs for these two are plotted respectively in parts A and B of Figure 2 below.



Source: Author's Tabulation from FISS4 Data

The graphs above demonstrate a negatively sloped implied demand curve at both household and aggregate cases. For the household demand, the highest WTP is 10.13 bags at MK 1000 whereas for the aggregate demand there is 46 891 at MK 1000 as the highest and 15 442 as the lowest WTP at the highest price of MK 9000. The area under the aggregate demand (curve) represents the gross value of consumer surplus if the inputs are provided to producers for free[5]. These two graphs validate the traditional price-demand nexus.

Table 2 below presents the descriptive statistics of the variables included in the model, in terms the number of observations, mean, standard deviation, minimum and maximum values for each.

Table-2: Descriptive Statistics[6]

Variable	Obs	Mean	Std. Dev.	Min	Max
WTP_1000	4742	9.888	8.987	0	70
Age of H/H Head	1279	38.151	14.225	20	85
Square of Age	1279	1657.696	1316.364	400	7225
Male H/H Head	1279	0.782	0.413	0	1
Farm Size	4742	1.823	3.552	0	30.5
Education of H/H Head					
PSLC	4742	0.024	0.154	0	1
JCE	4742	0.012	0.110	0	1
MSCE	4742	0.000	0.021	0	1

[5] The farmers are the demanders in this case

[6] All figures are rounded off to 3 decimal places except for the monetary variables

Coupon Receipt	4742	0.988	0.107	0	1
Farm Income	4742	1418.67	8982.00	0	400 000
Off-Farm Income	4742	21 341.77	181 210.00	0	2 200 000
Illness Costs	4742	558.08	2168.84	0	15 500
Food Security	4742	0.682	0.466	0	1
Radio Ownership	4742	0.038	0.190	0	1
Livestock Ownership	4742	0.663	2.426	0	30

Source: Author's Tabulation from FISS4 data

The table shows that the average age of the household head in the survey was 38.15 years with a minimum of 20 and a maximum of 85. For sex, with 1 indicating a male household head, the mean is 0.782 implying that about 78.2% of the 1279 responses that were non-missing in the data set were males and the rest were females. The average farm size is approximately 1.823 acres (about 0.74ha) and, for education, with about 2.4% of the surveyed household heads having acquired a primary school as their highest qualification; 1.2% acquired a junior certificate; and 0.04% a Malawi School Certificate of Education; with the remaining 96.36% of observations being with no education qualifications or giving missing values. These statistics show that education levels are very low among the sampled farming households. For the two income variables which show very high deviations, there are means of 1418.67 Kwacha and 21 341.77 Kwacha for the previous year (about US$2 and US$30) for on- and off-farm incomes respectively. Another monetary variable is illness costs with an average of 558.08 kwacha for the past 12 months

(approximately US$0.77). The statistics also show that about 3.8% of the sample owns wireless radios and the remaining 96.2% does not own radios or has missing variables. This means that radio ownership is very low among the farming households in Malawi. The statistics also show that 66.3% of the households owns livestock with a relatively small deviation ranging from 0 to 30. A quick look at the dependent variable shows 9.888 as the mean and 8.987 as the standard deviation with a minimum value of 0 and 70 as the maximum. The mean of 9.888 is the average number of 50kg fertilizer bags that households would purchase in the 2012/13 agricultural season at MK 1000 if there were no subsidies or if unsubsidised urea prices were different. The statistics in this regard show that some households are willing to pay for as many as 70 bags while others are not willing to buy any bag at the MK 1000 price level.

3.2 Econometric Results

Using STATA version 13.1, various diagnostic tests were conducted to ensure that the made statistical inferences are down-to-earth. First the model is estimated using robust standard errors to resolve any heteroscedasticity that may have been prevalent. Multicollinearity is also checked using pair-wise correlation coefficients between the regressors revealing that only the correlation between age and its square was more than 0.8, suggesting the absence of serious multicollinearity (Greene, 2007; Maddala. 1992). Having successfully passed a bivariate analysis for the regressors, model specification was tested using the Link test and the result revealed that the model is fit. Since the Tobit regression coefficients show a linear effect on the uncensored latent variable, and not the observed outcome, the study focuses on the marginal effects of the regressors.

These are presented in the last two columns in Table 3 below for means and probabilities respectively.

The results show that despite being statistically significant, all incomes have a very small impact on WTP and are thus economically insignificant, while illness costs have no significance at all. A one-year increase in age of household head is found to result in about a 0.785 bags increase in desired WTP, a result depicting economic significance. There are however declining returns to age for WTP as can be seen in the negative coefficient of the square of age such that WTP increases with age at a declining rate. Conditional on WTP being positive and all variables being at their mean values, an additional year in the age of household head is estimated to increase WTP by about 0.767. Therefore older household heads are more likely to be willing to pay for the farm inputs compared to younger heads. The result also shows that for each additional year in age of the household head, the probability of WTP for subsidised farm inputs increases by 1.1%. This result is at par with our *a priori* expectations and a similar result was obtained by Maganga et al (2014) who estimated the determinants of jatropha adoption by peasants. Conditional on WTP being positive, ownership of a radio at mean values of all variables is estimated to increase expected WTP by about 2.21 bags. This variable also shows that farmers that own radios have 1.88% more probability of paying for fertilizer than those farmers who do not possess. Furthermore, the result shows that with WTP being positive and all variables at their average, being male is estimated to increase WTP by about 4.83 50kg fertilizer bags. In this case, being male increases WTP by about 16.09%. This variable has the greatest impact in this study. At the means and with positive WTP, the attainment of a primary education is estimated to increase

expected WTP by 1.61 bags and it adds a 1.6% chance of paying for farm inputs than with no education. This result is similar to the results by Maonga et al (2015), Oladele (2008) and Hagos et al (2012).

Table-3: Marginal Effects of the Explanatory Variables on the Dependent Variable

VARIABLES	**Change in Latent Y** $\frac{\partial[E(y^*\|\boldsymbol{x})]}{\partial x_i}$	**Change At Means** $\frac{\partial[E(y\|\boldsymbol{x}, y>0)]}{\partial x_i}$	**Change in Probability**[7] $\frac{\partial[P(y>0\|\boldsymbol{x})]}{\partial x_i}$
Age of H/H Head	0.7852636***	0.7671398***	0.0111327***
	(0.0845363)	(0.0821773)	(0.0018359)
Age Squared	-0.0082399***	-0.0080497***	-0.0001168***
	(0.000926)	(0.0009009)	(0.0000195)
Sex of H/H Head			
Male	5.166269***	4.825429***	0.1609398***
	(0.3482826)	(0.3029703)	(0.0198197)
Farm Size	1.894079***	1.850364***	0.0268524***
	(0.1177463)	(0.1173106)	(0.0029406)
Education of H/H head			
PLSCE	1.632459***	1.607898***	0.0159621***
	(0.2783333)	(0.2758209)	(0.0027581)
JCE	(3.837266)	3.803761	0.0227373***
	(4.510688)	4.50314	(0.0070131)
Coupon Receipt			
Yes	-5.188698***	-5.150964***	-0.0256047***

[7] This is also the same as $\frac{\partial E(y_i|x_i, y_i^*>0)]}{\partial x_i}$

	(0.3799053)	(0.3788245)	(0.0039953)
On-Farm Income	-0.0000286**	-0.000028**	-0.000000406**
	(0.000014)	(0.0000136)	(0.000000201)
Off-Farm Income	-0.00000786***	-0.00000767***	-0.000000111***
	(0.00000259)	(0.00000254)	(0.0000000365)
Illness Costs	0.0000139	0.0000136	0.000000198
	(0.0003204)	(0.000313)	(0.00000454)
Food Security			
Secure	1.921006***	1.863337***	0.0335869***
	(0.3283931)	(0.3131163)	(0.0086053)
Radio Ownership			
Yes	2.238286***	2.209813***	0.0188215***
	(0.5219469)	(0.5185773)	(0.0035688)
Livestock Holdings	0.0328022	0.0320451	0.000465
	(0.0584307)	(0.057078)	(0.0008322)

Note: * denotes significance at 10% (i.e. $p < 0.10$); ** at 5% (i.e. $p < 0.05$); *** at 1% (i.e. $p < 0.01$).
In parentheses are Robust Standard errors
Source: Author's Tabulation from FISS4 data.

In summary, the results in this study reveal that WTP for subsidised farm inputs is a function of many factors in Malawi. Age, sex and primary education for the household head as well as farm size, food security and radio ownership have positive and significant effects on WTP, whereas farm incomes and coupon receipt have a negative impact on WTP. Given all farmer characteristics the descriptive statistics showed that the maximum number of bags that some

farmers would pay was 70 if fertilizer sold at MK 1000. The Tobit model revealed that out of the twelve potential regressors ten were statistically significant, two of which had no economic significance. Such factors must be well considered in policy formulation for effective and efficient service delivery.

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