Journal of Economics and Sustainable Development www.iiste.org
ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online)
Vol.4, No.5, 2013

Supply Response of Maize to Price and Non-Price Incentives in Malawi

Betchani H. Tchereni[8] and Timothy H. Tchereni[9]

Abstract
This paper analyzed the impact of price and non-price incentives on supply of Malawi's main food crop, maize. The study fills a farmer's response gap identified in several studies on farmer's responses to price at hectarage allocation decision level. To achieve this, the study applies the unrestricted Nerlovean supply response model to maize. Results of the study show that farmers are responsive to crop's own price and non-price incentives. Despite being responsive to price and non-price incentives, hectarage results indicate that farmers allocate land to export crops mainly basing on their previous allocation pattern rather than relative crop prices and foreign income.
Key Words: Maize, price, incentive, lags, supply, Malawi.

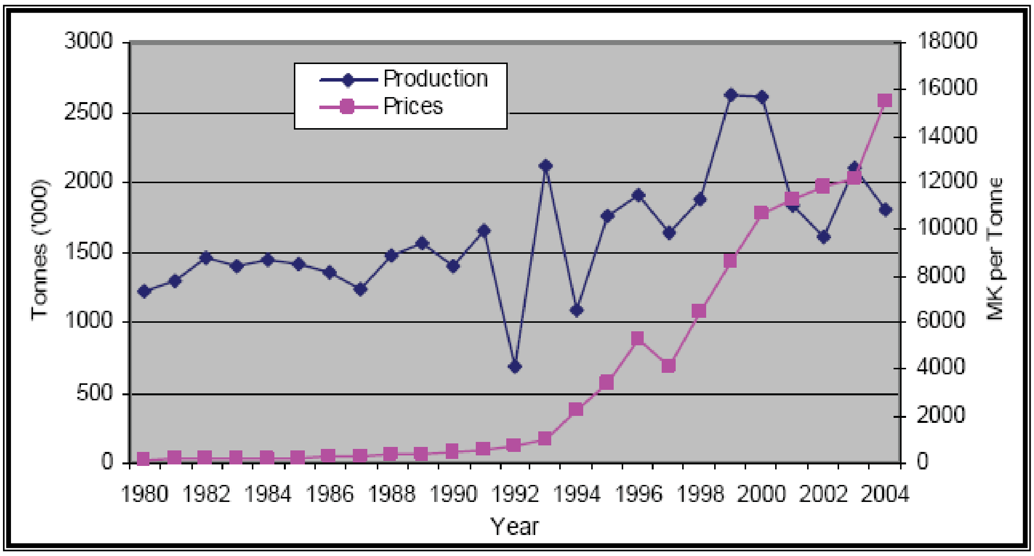
1.0 Introduction

The maize market in Malawi has suffered from the problem of price volatility, and this has had major repercussions on food security (Mulaga, 2007). For example, during most of 1995–1999 period, the Malawi government operated ceiling prices for maize suppliers, but the prices were unpredictably changing (Wold Bank, 2004; Chirwa, 2006). In the face of the volatile prices for maize, and with the importance of the crop as the main staple, the government focused its policy on maize production, pricing, research, and marketing since independence. Some of the interventions have included the development of high yielding maize varieties, subsidization of farm inputs, provision of credit facilities, liberalisation of farm produce prices and farm produce marketing. Chirwa and Zakeyo (2003) points out that those specific policies have good intentions in creating right incentives for producers. As figure 1 show, since 1990s maize production at national level has been variable despite the substantially increasing prices. On the other hand, food requirement levels could not be achieved as depicted in figure 2. In 2008 government directed that the Agriculture Development and Marketing Corporation (ADMARC) should be the sole buyer and seller of maize in Malawi, buying maize at K45 (US$0.32 at MK139/US$1) per Kilogram. The directive was also meant to motivate farmers to produce more, since they would anticipate higher income.

Several supply response studies have been conducted in Malawi. Most of these studies, though, have focused on estimating price elasticities of major cash crops like tobacco, tea, coffee and cotton. There has been less consideration of non-price incentives and maize as a crop of study. Most studies on food production in Malawi have focused mainly on technology development and adoption (Chirwa, 2003; Kutha, 2007).

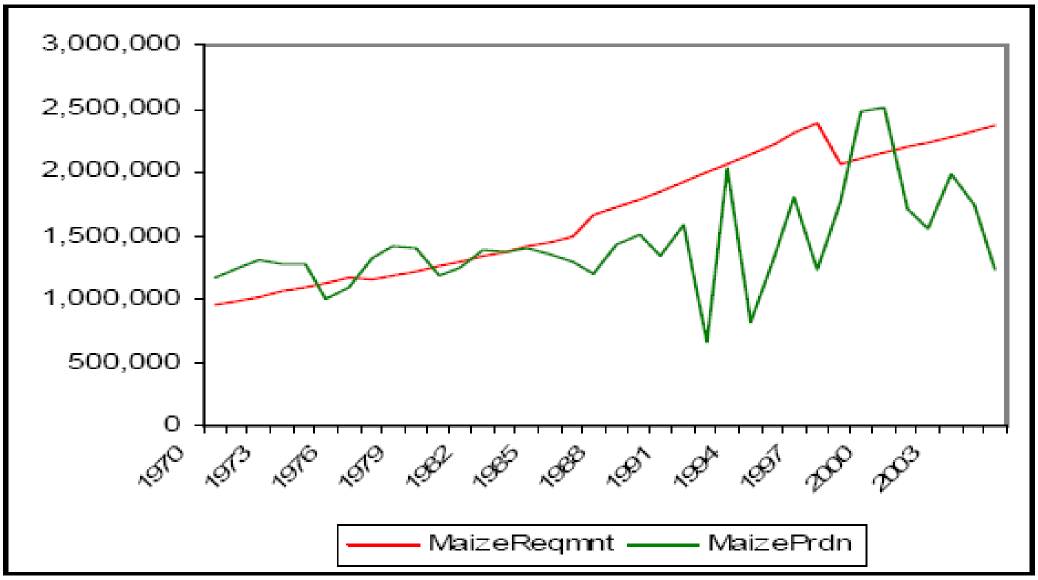
[8] Corresponding author, University of Malawi. Email: betchereni@gmail.com
[9] Umodzi Consulting Group, Malawi.

Figure 1: Maize Production and Prices (Nominal) in Malawi



Source: Chirwa, (2006).

Figure 2: Maize requirement and production



Source: Mulaga, (2007).

Price and non-price elasticities are relevant as they are a medium through which market or trade policies are expected to induce domestic production. Mnenula (1997) points out that price is a key variable in economic analysis, and in the agricultural sector it is crucial to the analysis of farmers supply response. It is against this background that this study investigated how maize production responds to price and non-price incentives as a main objective.

In this paper section 2 presents both theoretical and empirical literature. Section 3 develops and presents the methodology of the study. Section 4 presents the econometric estimation of the elasticities of supply for maize and an interpretation of the results. Finally the last section presents summary, policy implications, and conclusion.

2.0 Theoretical Literature

One of the most widely used supply models has been the Nerlovean response model based on adaptive expectations hypothesis. The model endeavours to analyse the speed and adjustment level of actual acreage towards the desired level. This model estimates both short and long-run elasticities of supply response with respect to changes in expected prices. The model argues that producers respond to expected prices as opposed to actual prices (Nerlove, 1958). Acreage response follows a partial adjustment hypothesis which means that full adjustment to desired cultivated area may not be possible in the short-run such that actual adjustment to area is a fraction of the desired adjustment. As such acreage and price adjustments are modelled as

$$P_t^e - P_{t-1}^e = \gamma(P_t - P_{t-1}^e), \text{ where } 0<\gamma<1, \text{ or} \quad (1)$$

$$P_t^e = \gamma P_{t-1} + (1-\gamma)P_t^e + \mu_{2t} \quad (2)$$

$$q_t - q_{t-1} = \delta(q_t^e - q_{t-1}) + \mu_{1t} \qquad \text{where } 0<\delta<1 \quad (3)$$

Where γ and δ are coefficients of expectation and adjustment respectively. Equation (1) says farmers adjust their expectations as a fraction of the magnitude of the mistake made in the previous period. According to Nerlove formulation, this equation taking into account *n* previous periods incorporated in the farmers decision making, implies

$$P_t^e = \gamma P_{t-1} + (1-\gamma)\gamma P_{t-2} + (1-\gamma)^2\gamma P_{t-3} + \cdots + (1-\gamma)^n \gamma P_{t-(n+1) for\ all\ n\geq 0} \quad (4)$$

Based on these three equations, acreage cultivated was initially hypothesized to be a linear function of anticipated price only such that

$$q_1 = \alpha_1 + \alpha_2 P_t^e + \mu_{1t} \quad (5)$$

In the three equations, P^e_t = expected price in period t; P^e_{t-1} = the price that was expected in period t-1; P_t = the actual price in period t; P_{t-1} = the actual price that prevailed in period t-1; q = cultivated area; q_{t-1} = cultivated area in period t-1; q^e_t = expected cultivated area; and μ = random term assumed to have zero mean. Other researchers have used the Profit Maximisation Framework which involves joint estimation of output supply and input demand functions. The model's basic assumption is that farmers' production decisions are based on the motive of profit maximisation and their responses to changes in agricultural variables reflect this behaviour. The model defines the profit function as

$$\Pi = \Pi(p, x) \quad (6)$$

Where Π is the profit vector, p is a vector of output and input prices and *x* captures the quantities of fixed factors employed in the production process. Kutha (2007) states that if the above profit function satisfies the duality conditions, a farmer's supply function can be derived by utilising the Shephard Duality Lemma to have:

$$\frac{d\Pi}{dP_i(p,x)} = q_i \tag{7}$$

Supply function of a product is a derivative of the profit function with respect to its price. Equations (6) and (7) can be estimated if duality conditions are satisfied, and the parameters obtained can be utilised in the derivation of farmer's output response to changes in price and other relevant variables. The approach is somehow restrictive in it assumptions as is pointed out by Mythili (2006), as quoted by Kutha (2007) that the approach requires detailed information on all the input prices. He further argued that agricultural input markets in developing countries are not competitive, thus adoption of the approach in developing countries renders it unrealistic.

Another model, Rational Expectations Hypothesis, was developed in 1961 by John Muth. The model optimally predicts future value of a variable based on all available relevant information at the time the prediction is being made. It is a forward looking hypothesis where a farmer formulates expectations about the future basing on available information on the past, the current, as well as the future anticipated state (Kuombola, 2007). Supply response analysis rarely uses this hypothesis because future information anticipated state of events is highly subjective. Lastly, the Cobweb model based on the assumption that in underdeveloped countries marketing boards intervene in marketing agricultural produce and fix produce prices at some constant level unrevised was model was propounded in the late 1950s (Sadoulet and de Janvry, 1995). In this static expectations case, supply response is modelled as:

$$q_t = b_0 P_t + z_t, \quad \text{where } z \text{ are other fixed factors.} \tag{8}$$

The measurement and analysis of the responsiveness of agricultural supply to price and other incentives, particularly in developing countries, is a matter of considerable importance in a food-hungry world. Where agricultural supply readily responds to certain incentives, changes in production can be accomplished through relatively changes in market conditions and incentives (Askari and Cummings: 1976). On the other hand, if the agricultural supply is not responsive to price and other incentives, agriculture will not readily respond incentives. Governments wishing to affect supply will have to do so by changing the underlying technological or social conditions under which the crops are produced. It is therefore important to know which crops are responsive and to measure that responsiveness in order to assess the effects of governmental policies on local agriculture. Despite the importance of this topic and despite the fact that it is pre-eminently empirical, capable of an econometric answer, discussions of these issues remained largely theoretical until the early 1960s, when empirical studies, like those reviewed in the next section started to take root.

3.0 Empirical Literature Review

Bond (1983) used the general Nerlove Supply Response formulation to estimate individual and aggregate crop supply response elasticities for Sub-Saharan Africa (SSA). The study found observed price, fixed factors (weather), and a trend variable capturing technology, to be significant variables in estimating supply response in SSA. Bond's findings for SSA were that own-price elasticities were positive and significant for most crops; elasticities tend to be larger in the long run than in the short-run and confirmed that farmers are responsive to changes in producer prices. An overall conclusion was drawn that relative producer price is an important determinant of agricultural output.

In assessing whether economic reforms under the adjustment programs induced agricultural supply in Mozambique, Danielson (2002) analysed the relationship between individual and aggregate crops production and farm-gate prices. Individual crop and aggregate crop elasticities are calculated at farm-gate price to estimate the impact of market-oriented economic reforms. Estimation of aggregate elasticities involved construction of aggregate indices of price and quantity in a Tornqvist formulation. One major observation from this study is that it hypothesizes that farmer decision-making in crop production incorporates mostly and significantly two previous time periods, and as such uses two as the lag length of the dependent variable. This study finds out that farmers in Mozambique were responsive to price incentives but structural constraints in the agricultural sector barred improved incentives being translated into agricultural growth. These structural constraints identified include lack of development finance, lack of markets, and lack of communications infrastructure.

For Malawi, various studies have been conducted assessing export supply responses. In the interest of finding out whether African farmers respond to price and wage changes in the same manner as farmers from more developed countries do, Dean (1966) carried out a path breaking supply response study in Malawi (Chaweza, 1996). In his study, he hypothesised that three variables (weather excluded) (a) last year's price of tobacco, (b) wage rates abroad in the previous year, and (c) price levels of cash goods in the previous year, determine the level of tobacco production. Dean concluded that there was nothing in hid results that contradicted with standard economic theory after his analysis. He found a price of tobacco elasticity of 0.48 and a coefficient for the price index of the cash goods variable was 0.43. Whereas the wage rate variable was insignificant at 0.01 level, these two were found to be significant.

In 1971, Gordon was concerned with forecasting production and acreage for maize, cotton, tea, rice, tobacco, and groundnuts, Malawi's major crops. The results showed that over time acreage increased, and that both acreage and weather had a significant contribution to changes in production. Chaweza (1996) carried a study to investigate the effects of changes in coffee producer price on coffee production in Malawi. Using the Ordinary Least squares technique coffee hectarage and productivity was regressed on coffee producer price, price of a substitute crop (tea), world price of coffee, input cost (fertilizer), output, establishment of Smallholder Coffee Authority (SCA), introduction of Price Liberalisation Programme (PLP), time trend and other variables. Fisher Lag Scheme was applied in the estimation of long-run and short-run elasticities. Regression results showed that coffee production is responsive to producer price changes, through hectarage and productivity analysis. Hectarage was found to respond to changes in most of the variables as well. Finally, the study also revealed that the establishment of SCA and PLP, and time trend, had a positive impact on coffee production.

In an effort to investigate the dynamic interrelationships among tobacco acreage, tobacco producer price, tobacco yield and fertilizer price both in the short and long-run, Kutha (2007) used Cointegration Analysis and Vector Error Correction models. The study findings were that tobacco producer price significantly impacts on tobacco acreage in the short-run while the long-run impact is minimal. The study revealed that tobacco acreage explains much of its dynamics, so is tobacco yield and fertilizer price. Kuombola (2007) carried a study to analyse the impact of price and non-price incentives on supply of Malawi's main export crops. The study analysed agricultural response at three decision levels; crop output, aggregate export, and farmer's hectarage allocation. To achieve this, the study applied the unrestricted Nerlovean supply response model to three export crops; tobacco, tea, and cotton. Results of the study show that farmers are responsive to crop's own price and non-price incentives. Despite being responsive to price and non-price incentives, hectarage results indicate that farmers allocate land to export crops mainly basing on their previous allocation pattern rather than relative crop prices and foreign income.

Askari and Cummings (1976) points out that there are a number of reasons that can explain why the elasticity of supply can vary for the same crop from country to country. These can include differences in social systems, tenancy structures, levels of education, income level, average farm size quality of land, and weather conditions. Into the bargain, even within the same country supply elasticities can differ from crop to crop due to such reasons as type of crop (food or cash crop, and annual or perennial), competition of other crops for inputs, different weather patterns, availability of substitutes in consumption, and the effect of fluctuations in price and yield.

4.0 Methodology and Data

The study applies the unrestricted Nerlovian supply response model, like that used by Kuombola (2007) which combined formulations by Bond (1983), Kwanashie et al. (1998) and Gbetnkom and Khan (2002. The hacterage supply function is specified as follows

$$\ln HA_{M,t} = \beta_0 + \beta_1 \ln HA_{M,t-1} + \beta_2 \ln P_{M,t-1} + \beta_3 \ln P_{T,t-1} + \beta_4 \ln P_{R,t-1} + \beta_5 \ln WE_{t-1} + \beta_6 TPT + \beta_7 \ln FERT + \mu_t \quad (9)$$

HA is the hectarage cultivated by maize. This is the endogenous variable whose response to changes in the other included variables is being measured. Hectarage is being used as the dependent variable due to the fact that planned output is best reflected by the area planted (Behrman, 1968). $\mathbf{P_{M,t-1}}$ is the previous price of maize. It is envisaged that the better the prices in a particular year the more will be the drive offered to farmers for land resources being allocated to maize from other food crops. Due to this positive relationship, it is expected that the coefficient for this variable will be positive. $\mathbf{P_{T,t-1}}$ is the price of tobacco in the previous year. Tobacco is the main cash crop in Malawi; therefore it competes with maize for land. If the previous period price of maize was bad, farmers would rather reallocate the land to tobacco cultivation expecting to realise better income. With this relationship, it is expected that this variable will have a negative coefficient. $\mathbf{P_{R,t-1}}$ is the previous period price of rice. On average, rice is a substitute food for maize in most Malawian households. If the price of rice is good, farmers will reduce production of maize and increase of rice.

TPT is an estimate of transport network used to capture crop transportation problems farmers face in accessing markets. The better the road network, the easier it is to access markets, thus the drive for farmers to produce more. With this positive relationship, it is expected that the coefficient for this variable will be positive. Clark C. and Haswell M. (1967) stresses that though fertilizers, improved strains of seed, education and other objects are important, the first requisite for the improvement of agricultural production is transport. It is estimated by the road length. **WE** is a weather variable estimated by the annual rainfall amount; **FERT** is a proxy of fertilizer amount available for agricultural purposes. It is estimated by total fertilizer imports for a particular year. The study employed annual data spanning the period 1970-2005 obtained from the Ministry of Agriculture and Food Security. Conventional practice in time series regression analysis requires that the first step to be undertaken before regression analysis is an empirical investigation of times series properties of the variables.

4.3 Empirical Estimation and Interpretation: Diagnostic Tests

First was to conduct a Unit Root test. When variables are non-stationary in levels, as is the case with most time series, a regression estimated can be spurious.

Table 1 ADF- Unit Root Test Results

Variable	ADF in Levels	ADF in first difference	Integration order
LOGPM(-1)	-0.512150	-3.837029	I(1)
LOGHA(-1)	0.702121	-5.520501	I(1)
LOGPR(-1)	0.831100	-2.937573	I(1)
LOGPT(-1)	0.866342	-4.283688	I(1)
LOGWE(-1)	-0.151487	-11.66717	I(1)
LOGTPT	1.344504	-5.578875	I(1)
LOGFERT	0.394457	-7.525098	I(1)

The Augmented Dickey Fuller test (ADF) was used for the Unit Root test. Table 1 shows the results of the unit root test. The critical values for rejection of hypothesis of a unit root in levels[+], and first difference are given in table 1. The Unit Root Test on the series indicates that all the variables were non-stationary at levels and stationary at first difference. LOGWE and LOGFERT were substantially stationary at first difference against the above critical values. This takes us to cointegration as our next test to assess the existence of a long-run equilibrium between the variables. Next was a cointegration analysis. This concept of cointegration is based on the findings that even though individually variables may not be stationary, their linear combination may be. Estimating cointegration variables in levels might still be meaningful despite individual variables being non-stationary. Cointegration is preferred to differencing because cointegration equation retains important long run information which would otherwise be lost if alternative method of differencing were used. Table 2 gives the results of the cointegration test:

Table 2 Results of Cointegration Test

Variable	AEG Statistic	Critical AEG Statistic	Level of Significance	Order of Integration
Residual	-7.136702	-4.47*	5%	I(0)

The results show an AEG Test Statistic of -7.136702 implying that the residuals are stationary at 5% (given critical value of -4.47). This implies existence of a long run structural relationship between the non- stationary variables. In other words, the variables are co- integrated. It is therefore possible to run an Error Correction Model (ECM) to tie the long run and short run behaviour of the variables. It is necessary to check if the model is well specified so as not to violate the regression assumption of correct specification. From table 3, the hypothesis that the model has a specification error is rejected and the conclusion that the model is well specified is made. Substantiating this is the high the R^2 and Durbin Watson of the long run regression equation coupled with a low value of Schawrz criterion, as such the model is said to be well specified.

Table 3 Ramsey RESET Test Results

F-statistic	2.504998	Probability	0.125575
Log likelihood ratio	3.219401	Probability	0.072770

Further, a test for serial autocorrelation was also conducted. The Breusch-Godfrey (BG) test is a general test for higher order autocorrelation. A significant *R-squared implies autocorrelation problem. The results in table 4 show that the observed *R-squared is insignificant at 5% level, indicating that there is no problem of autocorrelation.

Table 4 Breusch-Godfrey Serial Autocorrelation Test results

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.782353	Probability	0.384529
Obs*R-squared	1.022403	Probability	0.311950

The White Heteroscedasticity test (no cross terms) was employed to test for presence of heteroscedasticity. A significant observed R-squared implies presence of the problem of heteroscedasticity. Results of this test are reported in table 5 and the observed R-squared is insignificant at 5% level. This means that the error terms are homoscedastic.

Table 5 White Heteroskedasticity Test Results

White Heteroskedasticity Test:			
F-statistic	1.348914	Probability	0.263769
Obs*R-squared	16.99811	Probability	0.256279

Multicolinearity implies the existence of a perfect or near perfect linear relationship among all or some of the explanatory variables of a regression model. The rule of thumb is that, correlation of above 0.8 indicates serious multicolinearity. The correlation matrix given as table A1 in appendix B shows that serious multicolinearity exists among some of the explanatory variables. Though such is the case, since the OLS estimators are still BLUE even in the presence of multicolinearity, the study continues.

4.4 Empirical Estimation and Interpretation of the Long-run Supply Response Model

Table 6 presents estimation results. The results show that the explanatory variables used; hectarage, producer price of maize, producer price of tobacco, producer price of rice, rainfall (these are 1 year lagged), fertilizer as an input, and transport explained 81.27% of the systematic variation in hectarage of maize during the period 1970 to 2005.

Table 6 Long run Estimation Results

Dependent Variable: LOGHA				
Method: Least Squares				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.810205	2.614832	1.457151	0.1566
LOGHA(-1)	0.375344	0.153928	2.438443	0.0216**
LOGPM(-1)	0.31561	0.024499	1.288262	0.0208**
LOGPT(-1)	-0.047193	0.046147	1.022672	0.3155
LOGPR(-1)	-0.059599	0.030306	-1.966598	0.0596***
LOGWE(-1)	0.119843	0.055798	2.147818	0.0409**
LOGFERT	0.040077	0.026965	0.151206	0.0881***
LOGTPT	0.398865	0.280077	1.424127	0.1659

R-squared	0.812675	Mean dependent var	14.01016
Adjusted R-squared	0.764110	S.D. dependent var	0.160145
S.E. of regression	0.077780	Akaike info criterion	-2.072230
Sum squared resid	0.163343	Schwarz criterion	-1.716722
Log likelihood	44.26403	F-statistic	16.73353
Durbin-Watson stat	1.803070	Prob(F-statistic)	0.000000
* ** *** indicate significance at 1%, 5%, and 10% respectively			

The F-statistic of 16.73 is significant explaining that the explanatory variables in this model are relevant in explaining hectarage. Furthermore, there is no first order serial correlation as can be appreciated by the value of Durbin-Watson Statistic of 1.803070 which is close to 2. The high value of the Adjusted Coefficient of the determination, R^2, 76.41% manifests the overall model as a good fit. Only about 23.59% is left unexplained, attributed to other factors and this is captured by the disturbance term μ_t

4.3.2 Interpreting the long run results

The coefficient of this variable (0.375344) has a positive sign. This says that previous year's hectarage is positively related with current period's hectarage. The results also show that previous period's hectarage of maize is significant at 5% which tells that there is a significant relationship between previous period's hectarage of maize and hectarage of maize. A 1 percentage change in the current hectarage allocation will induce a 0.38 percentage change in the next crop season's hectarage allocation to maize. Thus farmers mostly allocate land to maize basing on their previous allocation. This is a reasonable finding, as Kuombola (2007) puts it, in recognition of the fact that due to land scarcity and other factors, crop rotation is not common amongst farmers in Malawi. A positive relationship has been found between previous year's price of maize and hectarage of maize. Changing producer price influences hectarage (output) in that farmers increase hectarage as price increases. A 1 percent increase in the price of maize is leading to a 0.32 percent increase in planned output in the next period. The coefficient has been found to be significant at 5%. This is consistent with the cobweb phenomenon which basically states that a rise in current period price of an agricultural crop leads to its increased production in the following period.

There is a negative relationship between the lagged producer price of tobacco and hectarage of maize consistent with the premise that farmers will reallocate land to tobacco cultivation in case of price of tobacco being higher in relation to that of maize. The results show an elasticity coefficient of -0.05, implying that a 1 percent increase in the price of tobacco, hectarage (output) of maize decreases by about 0.05 percent. One of the determinants of supply response in agriculture is how readily can land and labour be shifted from one crop to another (Lipsey: 1989). Since not all land in Malawi is favourable for tobacco production, it explains the weak coefficient. The price of tobacco has been found to be insignificant at 10% with a probability of 31.55%. However the price of tobacco can rise, farmers cannot shift all their land to its cultivation, neglecting maize altogether. Maize is the main food crop so much that they will still cultivate it to have food.

Previous period price of rice affects hectarage negatively and significantly at 10% levels. Rice is a substitute food for maize in most Malawian households. If the price of rice is good, farmers will reduce production of maize and increase of rice. The results show that with a coefficient of -0.059599, a 1 percent increase in price of rice leads to a 0.06 decrease in hectarage of maize. Just like with tobacco, land allocated to maize cultivation cannot easily be shifted to rice cultivation, or vice versa. These crops grow in different land conditions. This could be the reason for the inelastic supply which is far less than unity.

A positive and significant relationship between rainfall and hectarage has been found in this study. Increasing rainfall increases hectarage on maize in succeeding years. On the whole, the variable (rainfall) is significant at 5% with a probability of 4.09%. The coefficient of this variable has been found to be 0.119843. This implies that a 1 percent increase in rainfall translates into a 0.12 percent increase in hectarage allocated to maize in the next period. This elasticity, though also inelastic, is relatively higher as compared to the other. This is because weather is one of the key factors that affect agricultural production, and maize is not exempted from this. A positive relationship also exists between fertilizer and hectarage. Availability of more fertilizer translates into increased hectarage since inputs are available. In this analysis fertilizer is significant at 10% authenticating its relevance to the model. A 1 percent increase in fertilizer translates into a 0.04 change in hectarage. The transport network coefficient of 0.398865 is insignificant at 10% with a positive relationship with hectarage. An improvement of the transport network increases easiness of access to markets thereby motivating farmers to produce more.

5.1 Summary, Conclusion and Policy Implications

The focal point of this study was to determine the relationship between supply of maize and the factors that determine production of maize in Malawi. It was to assess whether such variables affect supply of the crop in any way and if they do, in what way. The study realised that actual agricultural output often differs considerably from planned output because of important environmental factors which are beyond farmers' control. The area actually planted in a particular crop is to a much greater degree under farmers' control, thus, a much better index of planned production, and therefore, this study estimated output response by hectarage response of maize. In this study, quantitative effects of price and non-price incentive were examined to attain an overall objective of analyzing the impact of price and non-price incentives on supply of Malawi's main food crop over the period 1970-2005. Quantitative effects of own price and prices of tobacco, a resource-competing with maize, and rice, a substitute crop, and quantitative effects of non-price incentives like transport network, and fertilizer import incentives have been examined. Weather has also been examined for its impact on the supply of maize in Malawi. The analysis has applied the unrestricted Nerlovean supply response modelling technique. Diagnostic tests conducted confirmed that each of the regression equations explains the model well and is well specified.

Econometric results from the study indicate that own hectarage of maize exerts independent and significant (at 5 percent) positive effects on maize hectarage cultivation with an elasticity of 0.38. This is suggesting that farmers mostly allocate land to crops on the basis of their previous allocation. The crop's own price (price of maize) has had a positive and significant effect on land allocation to maize. This implies that a rise in the price of maize leads to a rise in hectarage. Price of tobacco has had no effect on land allocation to maize as it has been found to be statistically insignificant. With price of rice, it has had a negative effect on maize hectarage, being statistically significant at 10 percent. As a competing commodity in consumption to maize, a rise in the price of rice will lead to fall in maize hectarage. Rainfall and fertilizer have also been found to be significant at 5 percent and 10 percent significant levels, and elasticities of 0.12 and 0.04 respectively. This again indicates that weather pattern and availability of agricultural inputs alter hectarage allocation of maize. Finally, transport network is insignificant, but has a positive relationship with hectarage.

In light of the above findings the overall conclusion made is that in the long-run farmers are responsive to price and non-price incentive structures and that the key challenge is to identify key non-price incentive structures to effectively maize production. Offering of good prices for agricultural produce is one of the keys to food security status of a country. The current national drive of re-offering producers (farmers) price incentives to induce domestic supply needs to be accompanied by effective non- price incentives like availability of farm inputs like fertilizer if production is to be further stimulated. The estimates of the study lead to the conclusion that Malawi maize farmers are responsive to prices of competing food crops to maize, availability of farm inputs, own hectare and weather conditions. This implies that maize farmers adjust hectarage in accordance with the prevailing conditions of these variables. If therefore the goal of the government is to have more maize in the country, it has to keep prices of other food crops relatively low in order not to drive away farmers from maize production to other crops. In addition, farm inputs availability needs to be improved to curtail the price structures. An example of input policy is the subsidized farm inputs program where farmers are subsidized in accessing fertilizer and other inputs.

BIBLIOGRAPHY

Askari H. & Cummings J. T. (1976). *Agricultural Supply Response: A Survey of the Econometric Evidence.* New York. Praeger Publishers,Inc.

Behrman J. (1968). *Supply Response in Underdeveloped Agriculture: A Case Study of Four Annual crops in Thailand*. Amsterdam. North-Holland Publishing Company.

Chaweza R. (1996). Supply Response of Coffee to Producer Price Changes in Malawi. University of Malawi. Chancellor College

Chirwa E. (2006). Commercialization of Food Crops in Rural Malawi: Insights from a Household Survey. *Department of Economics Working Paper No. 2006/04,* University of Malawi, Zomba.

Chirwa E. (2006). Future Scenarios for Agriculture in Malawi: Challenges and Dilemmas. Institute of Development Studies. Sussex.

Chirwa E. & Zakeyo C. (2003) *Impact of Economic and Trade Policy Reforms on Food Security in Malawi.* University of Malawi.

Chirwa E. (2003). Sources of Technical Efficiency among Smallholder Maize Farmers in Southern Malawi. *Wadonda Consult Working Paper WC/01/03,* Zomba.

Clark C. & Haswell M. (1967). *The Economics of Subsistence Agriculture.* (3rd ed.). London. MacMillan and Co. Ltd.

Dean E. (1966). *The Supply Response of African Farmer: Theory and Measurement in Malawi.* Amsterdam. North-Holland Publishing Co.

Global Property Guide. (2008). GDP per Capita - Malawi Compared to Continent <http://www.globalpropertyguide.com/Africa/Malawi/gdp-per-capita> accessed on 9th February 2009.

Gordon J. (1971). *M model for estimating future agricultural acreage and production in Malawi.* Ashford. Wye College.

Gujarati D. (1995). *Basic Econometrics*. (3rd ed). McGraw-Hill, London

Harrigan, J. (2005). Food Security Policies and Starter Pack: a Challenge for Donors? In S. Levy (ed) **Starter Packs: A Strategy to Fight Hunger in Developing Countries?** Oxfordshire: CABI Publishing.

Kuombola H. (2007). Supply Response of Malawi's Main Export Crops to Price and Non-Price Structures. *Unpublished Master's Thesis,* Department of Economics, University of Malawi. Chancellor College, Zomba.

Kutha L. (2007). Dynamics of Acreage and Producer Price: The Case of Tobacco in Malawi*. Unpublished MA Thesis,* Department of Economics, University of Malawi, Chancellor College, Zomba.

Lipsey R. G. (1989). *An Introduction to Positive Economics* (7th ed.). Weidenfeld and Nicolson Ltd, London.

Mnenula M. J. (1999). The Traditional Smallholder Tobacco producer Price Response in Malawi (1968-1997). *Unpublished MA Thesis,* Department of Economics, University of Malawi. Chancellor College, Zomba.

Mulaga B (2007). *Food Pricing Reform and Market Integration in Malawi: The Quest for Food Policy and Food Security.* University of East Anglia.

World Bank (2004). *Malawi Country Economic Memorandum: Policies for Accelerating Growth.* Report No. 25293-MAI

APPENDICES

Appendix A: Multicollinearity Test Results

Table A1: Correlation Matrix

	LOGHA	LOGHA(-1)	LOGPM(-1)	LOGPT(-1)	LOGPR(-1)	LOGWE(-1)	LOGFERT	LOGTPT
LOGHA	1.00000							
LOGHA(-1)	0.814322	1.00000						
LOGPM(-1)	0.814536	0.790365	1.00000					
LOGPT(-1)	0.803273	0.758172	0.955141	1.00000				
LOGPR(-1)	0.76236	0.75819	0.941729	0.97611	1.00000			
LOGWE(-1)	0.198347	0.023178	0.026726	0.045344	0.039528	1.00000		
LOGFERT	0.235181	0.202374	0.187883	0.284606	0.279352	0.093783	1.00000	
LOGTPT	0.816053	0.801669	0.88653	0.93498	0.925712	0.010006	0.318938	1.00000