The Influence of Price and Non-Price Factors an Acreage Response Of Maize in Iraq

Najlaa Salah Madlul¹,², Rosni Bakar² & Zulkarnain Lubis³
¹ School of Business Innovation & Technopreneurship University Malaysia Perlis, Malaysia.
² Agricultural Economy, College of Agriculture, Tikrit University, Salah Alden, Iraq.
³ Universitas Medan Area, JalanKolam No.1, Medan Indonesia.

Abstract: This study was conducted to analyse the acreage response of maize with respect to price and non-price factors in Iraq. The time-series data for the period of 30 years (1986-2015) pertaining to maize area, maize price, maize production, rainfall were collected from various published sources. Nerlovian adjustment lag model and Ordinary Least square Regression (OLS) technique of estimation was employed for analyzing acreage response of maize. The model explained more than 98 percent of the variation in the dependent variable. The expected maize price was found to be positive and statistically significant. The regression coefficients for the lag price, production under maize in lagged year, rainfall and lag maize land also appeared significant. Therefore, these factors were found to be an important variable influencing farmer’s decision on acreage allocation. Small area adjustment coefficient (0.44) revealed the low rate of farmers’ area adjustment to the desired level because of more institutional and technological constraints. Based upon the findings of this study, it can be concluded that farmers allocate land to maize crop mainly based on crop price and their previous allocation.

1. Introduction

Maize is widely cultivated crop throughout the world and a greater mass of maize is produced each year than any other grain. The United States produce 40% of the world’s harvest of maize, other top producing countries in 2015 include China, Brazil, Argentina, Mexico, India, Ukraine, Indonesia, France and South Africa. It was recorded that USA produced 273.832 million tones, China 208.258 million tones and Brazil 71.296 million tones (FAOSTAT, 2015).

Maize is very important to Iraq, where in facing an increasing number of its population. The demand for fodder and food already have already outstripped the available food, feed and fodder provisions. Maize in Iraq is cultivated as multipurpose food and forage crop, generally by resource-poor farmers using marginal land. Maize is currently the leading world cereal both in terms of production and productivity. Maize is an important crop in Iraq as it is sauce of food for human, feed for poultry and fodder for livestock utilization and as a raw material for the industry (Mahdi, 2009).

As for Iraq, maize is regarded as one of few major economical crops of the country, rating fourth next to wheat, barley and rice. The acreage exploited for growing this crop fluctuates up and down from one year to the next. In 2013, a total of 798,099 acres were exploited, producing around 831,299 tons of maize crop, but this figure soon dropped down in 2014 to 378,061 acres while the production size jumped to 289,288 tons (FAO,2014). Out of all the Iraqi provinces, Babylon comes first as per the acreage used for growing corn crop (Central Statistical Organization,2015).

2. Background of the Study

A considerable number of studies have focused on agricultural supply response to price and non-price factors with wide range of crops over the years. More importantly, expanding cultivated area is a viable option for increasing production (Molua, 2010). Understanding how producers make decisions to allot acreage among crops and how decisions about land use are affected by changes in prices and their volatility is fundamental for predicting the supply of staple crops and, hence, assessing the global food supply situation (Haile et al. 2013).

The production decisions of farmers are dependent on various policies of the government. Price policy, among the others, is the most important one. That is, farmers would allocate their limited land resources to that crop enterprise towards which the relative price movements tend to be favourable. This is however, quite logical and rational as the allocation of land to a better-priced crop would fetch more revenue to farmers. Responsiveness of farmers to economic incentives such as price could influence contribution of agriculture to economy (Mushtaq & Dawson, 2002).

One of the most important issues in agricultural economics is acreage response. Since the
responsiveness of farmers to economic incentives largely determines agriculture’s contribution to the economy. The gap between planting and harvest guarantees that agricultural producers do not know in advance what price they will receive for their product and the random nature of production ensures that producers do not know in advance what their output (yield) will be. The knowledge on the extent to which agricultural sector responds is not only important in understanding the dynamics of production, but also for planning public programmes, mindful of the producer behavior and response to prices (Mckay et al. 1999).

The crucial factors responsible for farmers’ area allocation behavior are expected price (based on previous years price), price of competing crop, yield, weather climatic conditions, area, technology etc. The pioneering work of Nerlove (1958) on supply response enables one to determine short run and long run elasticities; also it gives the flexibility to introduce non-price shift variables along with price.

Very little analytic research as per the knowledge of this researcher has been carried out on acreage response of maize growers in Iraq (Mushtaq & Dawson, 2002; Nosheen & Iqbal, 2008). Thus there is an intense need to study acreage response of maize growers to price and non-price factors in Iraq to give an insight to policy makers for allocation of land and production of maize in Iraq.

Acreage response to price and non-price incentives is of considerable importance for devising suitable policy and planning development programmes for the agricultural sector of an economy. Moreover, reliable estimates of acreage response of maize growers are of greater importance for predicting accurately the farmers’ responsiveness towards the price and non-price factors and for formulating programmes consistent with national requirement of food and fodder. This study is important because it will assist policy analysts in managing area allocation to maize in this province.

The following objectives were set for this study.

- To quantify acreage response of maize growers in Iraq from 1986 to 2015.
- To compare short and long run elasticities of price and non-price factors acreage response of maize in Iraq from 1986 to 2015.

The remainder of this paper is organized into three sections. Section 2 is devoted to data and methodology. Section 3 presents, results and discussion. Section 4 concludes this study with some recommendations.

3. Maize price trend

Figure 1 shows a rising maize price trend over time. However, the price of maize was almost stagnant at a very low price from 1986-1995. From there onward the price of maize showed an increasing trend. Farmers respond in different ways to increasing and unstable maize prices as well as other non-price factors such as weather. This is because higher maize price variability and inconsistencies in of non-price factors all pose a risk to producer’s investment. The use of high priced agricultural inputs such as inorganic fertilizer and hybrid seed is intensified with better crop prices as the farmers perceive profits. This therefore, entails that low market prices may contribute to low use of these agricultural inputs. The degree of responsiveness to both market and non-market factors requires empirical research in order to substantiate existing theoretical frameworks that have been developed and adopted to explain the dynamics of supply response in agriculture (Albayak, 1998). In Iraq, this is the case in that there is the assumption that price and non-price factors influence maize donum response but there is lack of robust empirical evidence to support the assumption. This paper therefore aimed to understand how maize farmers respond to prices and non-price factors using empirical evidence.

4. Maize land trend

Figure 2 shows that the acreage exploited for growing this crop fluctuates from one year to the next. In 2013, a total of 798,099 acres were exploited. There was a slight increase during 1986-2015 i.e., about 2.7% due to expanding measures because of technological advances such as the adoption of new varieties, greater application of fertilizers and irrigation. However, this figure soon dropped in 2014 to 378,061 acres. This has been linked to various factors such as reduced productivity, government policies, unstable

5. Maize production trend

Figure 3 shows that maize production has been showing a fluctuation trend, an increase in some years and decrease in other. There was a slight increase during 1986-2015 about 4.6%. Maximum production was in 2013 reaching 831,299 tons due to expanding of land usage. Soon, however, the level of production declined during 2014 to reach 289,288 tons, this has been linked to various factors such as reduced productivity, government policies such as ESAP, unstable macroeconomic environment, the wars in Iraq in 1995, 2003, 2014, 2015 and the pricing policy that all led to Iraqi farmers feeling reluctant to grow maize, eventually leading to decreasing the acreage of this product and therefore, decrease maize production.

6. Rainfall trend

Rainfall is a key determinant of maize supply in developing countries. In Iraq rainfall varies from season to season fluctuating above and below average. Below is a graphical presentation of the standardized rainfall series from 1986 to 2015. The study period averaged to 2884.33 mm maximum rainfall was in 2006 reaching 5029.5 mm in contrast with the lowest Rainfall level in 1986 being 1467.4 mm. This can be noticed from this Figure 4.

7. Research Method

This study was conducted in Iraq. Data for the identified variables were collected from various published sources. Data regarding maize yield, maize land, and maize price were obtained from Agriculture Statistics of Iraq for the years 1986 to 2015. Data on rainfall were collected from Iraq meteorological department. The following techniques from simple means to the use of econometric modeling applied for data analysis. The Durbin statistic, augmented dickey fuller test and ordinary least square regression (OLS) were performed (Stata).

Nerlove (1958) introduced the idea of partial adjustment suggesting that since it takes a while for equilibrium to occur, therefore only a partial adjustment takes place within a unit time period. The delay occurring in the equilibrium could be due to many reasons including consumer preferences, which takes a while to change; production already took place and needs to be disposed off.

7.1. The Nerlovian model

As Of all the econometric models used to estimate agricultural supply response, the Nerlovian model is considered one of the most prominent and effective, judged by the large number of studies which utilise this approach (Leaver, 2003). The pioneering work of Nerlove (1958) on supply response enables one to determine short run and long run elasticities; also it gives the flexibility to introduce non-price shift variables in the model. The partial adjustment lagged model is considered appropriate for crop producers and is widely used by researches like Rao (1989), Belete (1995), Leaver (2003), Wasim (2005), Mythili (2008), to measure the producers behavior.
The basic form of the Nerlovian model for an annual crop consists of the following three equations.

\[ A^*_t = b_0 + b_1P^*_{t-1} + b_2X_{t} + V_t \] \hspace{1cm} (1)

\[ P^*_t = P^*_{t-1} + \beta(P^*_{t-1} - P^*_{t-1}) \] \hspace{1cm} (2)

\[ A_t - A_{t-1} = \lambda(A^*_t - A^*_{t-1}) \] \hspace{1cm} (3)

Where:

- \( A_t \) = actual area under cultivation at time t.
- \( A^*_t \) = desired area under cultivation at time t.
- \( P^*_t \) = expected price of maize at time t.
- \( P^*_{t-1} \) = one-year lag price of maize (Dinar/kg).
- \( X_{t} \) = other observed, non-economic factors.
- \( V_t \) = disturbance term

\( \lambda \) Measures the speed of adjustment and assumes values from 0 to 1. It is interpreted as the coefficient of adjustment which characterises the fact that there are limitations to the rate of adjustment of \( A_t \) due to economic and non-economic factors like technological constrains, weather variability, prices and various inflexibilities. Relations with Equation 1 and Equation 3 give the reduced form which eliminates the unobserved variable \( A^*_t \) by an observed \( A^*_t \) variable. By eliminating these variables, the estimating or the reduced form Nerlovian equation is achieved.

The reduced form equation is given by:

\[ A_t = b_0 + b_1P_{t-1} + b_2A_{t-1} + b_3X_{t} + V_t \] \hspace{1cm} (4)

Where:

- \( b_0 = \lambda \beta_0 \), \( b_1 = \lambda \beta_1 \), \( b_2 = 1 - \lambda \), \( b_3 = \lambda \beta_3 \), \( V_t = \lambda U_t \)

7.2. Estimating the Maize Supply Response

The model used for this study is based on economic theory and previous work done in the field of supply response for field crops. However, it is not always possible to estimate a model suggested by theory, because it is not always possible to include all the variables initiated by theory due to the non-availability of data and quantification problems. The supply model used in this particular study is based on supply models for field crops used by Belete (1995), Leaver (2003) and Mythili (2008). The models used by these research studies were used as a framework for constructing a maize supply model for this study.

Ordinary Least Squares (OLS) technique was used to estimate the parameters of the models. The estimation of the Nerlovian model may result in residuals that violate the assumption of normality of the error terms (Leaver, 2003). To ensure normality of the residuals, the estimating equations used in this study were expressed in logarithmic form. The transformation is acceptable because it ensures that the errors are both homoscedastic and normally distributed (Maddala, 2001). An additional benefit of using the logarithmic form is that the coefficient of the price variable can be directly deduced as the short-run supply elasticity.

To estimate the impact of price and non-price factors on changes in maize output this study uses acreage response functions. The simplified acreage response function is computed as follows:

\[ \ln(Area_{mt}) = b_0 + b_1 \ln P_m + b_2 \ln P_{m(t-1)} + b_3 \ln y_{m(t-1)} + b_4 \ln R_{t-1} + b_5 \ln A_{m(t-1)} + e \]

Where:

- \( Area_{mt} \) = Area of maize under cultivation in time (dunum).
- \( P_m \) = Maize price (Dinar/kg).
- \( P_{m(t-1)} \) = One year lag price of maize (Dinar/kg).
- \( y_{m(t-1)} \) = Yield of maize with one year lag (Ton/Dunum).
- \( R_{t-1} \) = Average rainfall in mm with one year.
- \( A_{m(t-1)} \) = Area under maize with one year lag (Dunum).
- \( e \) = Stochastic error term.
- \( \ln \) = Natural log.

7.3. Estimation of short run and long run elasticities

The coefficients of log model give short run elasticities of the corresponding variables. The long run elasticity can be derived as follows:

\[ LR = \frac{Sr}{\lambda} \]

Where:
Long run elasticity 

Short run elasticity

\[ \lambda = 1 - \text{coefficient of lagged dependent variable} \]

\[ \lambda = \text{Adjustment coefficient and } 0 \leq \lambda \leq 1, \text{ is the speed of adjustment.} \]

7.4. Detection of Autocorrelation

Usual Durbin-Watson test for serial correlation is inappropriate for models including a lagged dependent variable as an explanatory variable. There is always a greater likelihood of autocorrelation in autoregressive models than the d-statistic test would suggest. The combination of autocorrelation and lagged dependent variable results in biased parameter estimates because the error term is correlated with a regression. For such models, called autoregressive models, Durbin has developed the so-called statistic which is defined as follows (Gujarati & Porter, 2009).

\[
 h = p \sqrt{\frac{N}{1-n} \text{var}(\alpha)} \\
p = 1 - \frac{1}{2}d \\
d = \text{Durbin Watson value (DW)} \\
\text{var}(\alpha) = (s.e)^2 \\
-1.96 \leq h \leq 1.96
\]

Where \( h \) is total number of sample, \( \text{var}(\alpha) \) is the variance of the coefficient of the lagged dependent variable, \( s.e \) is the standard error and \( p \) estimate the first order autocorrelation. If the value of \( h \) Durbin statistic is in between -1.96 and 1.96 then there will be no autocorrelation.

7.5. Detection of Stationarity/nonstationarity

By stationarity we mean that the variance of data is constant i.e. there is homosedasticity in the data. If a non-stationary time series is regressed on another non-stationary time series it may create a spurious regression. To avoid this problem, the data has to be transformed from non-stationary to stationary. There are two methods to make the data stationary: 1) if a time series has a unit root problem, take the first difference of such time series to make it stationary. This is called difference stationary process and 2) to regress such a non-stationary time series on time and it will become stationary. This process is called trend stationary process. The terms unit root, non-stationarity, random walk and stochastic trend can be treated as synonymously. For the detection of stationarity, ADF test was applied (Gujarati & Porter, 2009).

8. Results and Discussion

This section presents the results of empirical analysis of the maize supply response analysis. The analysis integrates the hypothesised model, estimation procedure and data described in order to obtain the required model elasticities. Firstly descriptive statistics are used to describe variables and data used for the model. The data is then tested for stationarity. The pre-test is required to determine the statistical properties of the variables before they are entered into the partial adjustment model. Long-run and short-run supply elasticities are obtained from the model and are interpreted according to theory and previous work done in the field. The section concludes with a final discussion of the results obtained.

Table 1 presents the results of the trend equations on maize total land, production, rainfall, and maize prices in Iraq. In the 1986 to 2015 period, maize land, production, rainfall, and prices all experienced a positive growth in Iraq. The growth rate of maize production reached 4.6%, area contributed 2.7%, while rainfall contributed only 1.4%, prices contributed 26.8%. And it shows that the increase of maize price is the main contributor to the increase of the total land of maize.
Table 1. The results of the trend equations on maize total land, production, rainfall, and maize prices in Iraq.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Equation</th>
<th>T</th>
<th>$R^2$</th>
<th>F</th>
<th>growth rate%</th>
<th>Test of Normality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Land</td>
<td>$Y = 321446.5 + 9332.2x$</td>
<td>2.46*</td>
<td>0.63</td>
<td>6.06*</td>
<td>2.7*</td>
<td>0.365</td>
</tr>
<tr>
<td>Production</td>
<td>$Y = 136243.8 + 9894.5x$</td>
<td>3.3**</td>
<td>0.72</td>
<td>10.7**</td>
<td>4.6**</td>
<td>0.425</td>
</tr>
<tr>
<td>Prices</td>
<td>$Y = -124.5 + 24.6x$</td>
<td>12.**</td>
<td>0.83</td>
<td>144**</td>
<td>26.8**</td>
<td>0.725</td>
</tr>
<tr>
<td>Rainfall</td>
<td>$Y = 2310.6 + 23.9x$</td>
<td>3.01*</td>
<td>0.69</td>
<td>9.02*</td>
<td>1.4*</td>
<td>0.236</td>
</tr>
</tbody>
</table>

** Significant at the 1% level *significant at the 5 % level.

8.1. Model Adequacy Tests

The value of Durbin statistic is 0.946 found within the given range that is $-1.96 \leq 0.946 \leq 1.96$ which ensured that the data is not plagued with the problem of serial-autocorrelation. Table 2 shows that all variables were not integrated of order zero (non stationary) and were found to be integrated of order 1 or I(1) (stationary).

Table 2. The results of the Augmented Dickey Fuller test.

<table>
<thead>
<tr>
<th>Series</th>
<th>ADF test statistic</th>
<th>Critical value</th>
<th>Lag-length</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Ln_{ym}$</td>
<td>6.2410</td>
<td>4.323979</td>
<td>0</td>
<td>0.0001</td>
</tr>
<tr>
<td>$LnA$</td>
<td>5.0136</td>
<td>4.323979</td>
<td>0</td>
<td>0.0026</td>
</tr>
<tr>
<td>$Ln_{rp}$</td>
<td>5.2413</td>
<td>4.323979</td>
<td>0</td>
<td>0.0012</td>
</tr>
<tr>
<td>$LnR$</td>
<td>7.5425</td>
<td>4.323979</td>
<td>0</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Critical value at 1%

8.2. Estimates of Acreage Response of Maize

Table 3 shows the Ordinary Least square (OLS) regression analysis at one lag. The model estimated contains natural log of land as explained variable with natural log of maize price, natural log of maize price, natural log of lag maize yield, natural log of lag rainfall and natural log of lag area as explanatory variables with one year. The positive coefficient of maize price (0.76) in the acreage equation bears a significant relationship with maize acreage, and indicates that price has influence area under cultivation. Result is similar to that of Mahmood et al. (2007), Molua (2010) and Bailey and Womack (1985). Gulati and Kelley (1999) who observed that the price factor is a significant variable explaining area changes. However, it opposes the finding of Gulati and Kelley (1999).

The estimate for lag maize price i.e. 0.79 has proper sign and statistically significant. It indicates that there is a significant effect of maize price on maize area response, this result shows similarity to the observation of Bailey and Womack (1985) that acreage of rice in Cameroon is influenced by rice price lagged one year, but the result contradicts the observation of Molua (2010). The lag yield estimate 0.39 significant with proper sign. Result suggests significant effect of lag yield on maize growers’ behaviour as like Tey et al. (2009) and Molua (2010), which shows significant effect of lag yield on rice area allotment in Malaysia and Cameroon, respectively. These results are in contrast to the findings of Mahmood et al. (2007).

The estimated coefficient for lag rainfall (0.54) is relatively significant, with expected sign. The significant positive coefficient of lagged rainfall indicates that last year rainfall affected the current year acreage allotment with the positive relationship. If previous year rainfall goes up by 1 cent, mean current year acreage will go up by 0.54 cents. This result is in conformity with the results of Molua (2010) who observed a significant positive relation between last year rainfall and present year rice area allocation decision. For tobacco crop. The result is in contradiction with the findings of leaver (2004) who observed insignificant negative relation between last year rainfall and present year rice area allocation decision.

The coefficient of the lagged dependent (0.56) is statistically significant at 1% level with positive sign. This implies that if lag area is increased by 1 cent it will lead, on average, to an increase of about 0.56 cent in current acreage. This tends to confirm the hypothesis of Nerlove's partial adjustment model; farmers do not adjust their acreage planted instantaneously to changes in prices and technology. Rather, they adjust to the optimum acreage level over time.
Table 4 shows short and long run price and non-price elasticities. For maize acreage, short run and long run market maize price elasticity is worked out as 0.76 and 1.73, respectively; while short run and long run lag price elasticity is 0.79 and 1.80, respectively; with a significant influence. Short and long run elasticity of a significant variable, lag maize yield is 0.39 and 0.88 respectively. In the case of rainfall, response variable (area) is inelastic to the independent variable (rainfall). In the short run, a one per cent increase in rainfall increases total area by 0.54 per cent and increases 1.23 per cent in the long run. Average rainfall shows a high effect on the decision of farmers regarding allocation of land to maize. The area in long run is perfectly elastic to the lag area i.e. one per cent increase in the lag area bring about 1.27 per cent increase in area allocation to maize crop.

These findings confirm the economic theory of elasticity where a short run period, the price elasticity is inelastic and in the long run, it is elastic.

The value of is 0.98 which is quite high and shows that the variables included in the function account for more than 90 % of the variation in maize area during the period under reference. The value of is 51.36 shows that the model is over all good fit.

Table 3. Estimates of the Acreage Response of Maize in Iraq
(Dependent Variable = Log Area)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Short run elasticities</th>
<th>Long run elasticities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>26.69</td>
<td>5.44**</td>
</tr>
<tr>
<td>LnR</td>
<td>0.76</td>
<td>4.99**</td>
</tr>
<tr>
<td>LnR&lt;sub&gt;mr-1&lt;/sub&gt;</td>
<td>0.79</td>
<td>6.52**</td>
</tr>
<tr>
<td>LnR&lt;sub&gt;mr-1&lt;/sub&gt;</td>
<td>0.39</td>
<td>4.55**</td>
</tr>
<tr>
<td>LnR&lt;sub&gt;mr-1&lt;/sub&gt;</td>
<td>0.54</td>
<td>4.32**</td>
</tr>
<tr>
<td>LnA&lt;sub&gt;mr-1&lt;/sub&gt;</td>
<td>0.56</td>
<td>4.68**</td>
</tr>
</tbody>
</table>

** = significant at 1% level.

\[ R^2 = 0.98, \quad F = 51.36**, \quad N = 30. \]


### 3.8. Conclusion and Recommendations

On assessing acreage response, positive and significant relationship of rainfall and positively significant influence of lagged area is observed on the maize acreage response, also rest of the variables included in the partial adjustment model; own price, lagged price of maize and lagged yield are found to be statistically a significant in Iraq over a period of time series data from 1986 to 2015. The numeric of quantitative analysis estimated, lag maize area, lagged rainfall is observed to be elastic in long run. Maize area response is found to be positively related with lagged rainfall, own price, lagged price of maize and lagged yield and in a direct relation with lagged area. The adjustment coefficient for maize acreage, that is 0.44 indicated slow pace of farmers’ adjustment toward desired acreage level of maize which suggests that acreage is influenced more by technological and institutional constraints. This result supported the view of many researchers that farmers seem to be reluctant to make larger adjustments in main cereal crops which are used for self consumption. Due to the existence of technological and institutional rigidities which had hindered the farmers from realizing the desired equilibrium level in Iraq, there is a need of research to find out the problems faced by the farmers in order to tackle them and increase maize acreage. The metrological department is needed to provide timely information about rainfall to the farmers as it plays a vital role in the area allocation decision to maize crop. Future research could be conducted on multiple crops. Lastly, it is also recommended that future studies include the direct and indirect effects of the siege on maize production.
9. References


