IMPACT OF SUPPORT PRICE ON COTTON PRODUCTION IN PUNJAB, PAKISTAN

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"This study makes an effort to determine the relationship between the support price policy and the major variables of the seed cotton production in Pakistan. Time-series data have been utilized for this purpose over a period of 26 years, from 1975-76 to 2001-02. The analysis is carried out by employing Nerlovian Adjustment Model (NAM) for the statistical measures of the impact of support price on cotton production in Punjab, Pakistan. Three single equation specific form models are formulated each with one of the major variables of the cotton production as the dependent variable. The three dependent variables of the analysis include output, yield and area of seed cotton. Along with the support price, the set of independent variables also include a few other theoretically relevant exogenous variables. The results are obtained by applying Ordinary Least Squares (OLS) techniques of estimation. No significant relationship of the support price is observed with the output and area of seed cotton. However, significant and positive relationship is observed between the yield and the support price. Finally, the authors recommend that the support price policy of seed cotton in Pakistan needs to be sustained since not only it is directly helping the rural uplift by increasing the households' income in the farm sector, but also warrants for maintaining the comparative advantage of the country, given the contemporary agricultural subsidies regime in the international arena."

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Introduction

Cotton remains the most miraculous fibre under the sun. Its use goes back beyond the records of history. As early as 3000 BC cotton was grown and used in the Indus Valley. Pakistan is one of the major world cotton producer, after China, United States (US), Common Wealth of Independent States (CIS) and India. Cotton not only provides thousands of useful products domestically, but also a major source of foreign exchange earnings of Pakistan. More importantly, it supports millions of jobs in the country while moving from field to fabric. This study attempts to estimate short run and long run price elasticity response of production, area and yield of seed cotton in Punjab, Pakistan, over a period of 26 years, 1975-76 to 2001-02. The analysis is carried out in three parts. Part-I highlights terms of reference of the study. Part-II explains the model applied for analytical formulations of the comparative price impacts. Finally, Part-III presents the results and discussion of major findings.

PART - I

Punjab and Sindh are the cotton producing provinces in Pakistan. Their respective average shares in production are about 81 and 19 per cent. Punjab has the geographical area of 20.63 million hectares of which 12.4 million hectares are cultivated and about 1.6 million hectares is cultivable waste. The total cropped area is 15.8 million hectares, of which irrigated area is 14.09 million hectares including 11.11 million hectares irrigated by government and private tubewells and wells (Agricultural Statistics of Pakistan, 2005-06). The Province offers a variety of soil types and climatic conditions. However, there are two principal crop seasons, Kharif and Rabi1. Cotton is the major crop of the Kharif season along with rice, sugarcane, maize and millet. It is the largest cash crop which, apart from being the principal raw material of the textile industry, is the major source of foreign exchange earnings of Pakistan. Hence, the production level of seed cotton in Pakistan not only affects the cotton growers, its implications for macro balances of the country also happen to be very serious.

In the post World War II period, support price has been almost universally employed as one of the most important fiscal policy instruments. The highly controversial Common Agricultural Policy (CAP) of the European Union (EU) is an elaborate system to support the farmers’ income through the support of the market price (Bukwell 1982; Baule and Koster 1990; Christopher 2002). The second largest cotton grower of the world, the USA, considers its farm policy important to national security (Schneif and Edwin 2001). Similarly, there has always been an extensive use of price supports in Japan (Kaur 1998; Homma 1999). Finally, the largest cotton grower of the world, China has also raised price incentives since the agricultural reforms in 1979 (Baifu and Zhenyu 1987; Hafiz 1993; Alexandratos 1997).

Government of Pakistan has also made efforts to help determine the cotton market outcomes in Pakistan. Government intervention in cotton markets has been typically characterized in one of the three ways, namely, direct control, managed domestic prices and free market prices. During 1980s and 1990s, however, Pakistan mostly practiced the policy of managed domestic prices (Townsend and Gitchons 1994). The Government of Pakistan had already started fixing the support prices of seed cotton (phutti) and cotton lint in mid 1970s. The Cotton Export Corporation (CEC), established in 1974, enjoyed monopoly in cotton exports till late 1980s when the private sector was again allowed to export cotton. The CEC worked efficiently till 1991-92. Afterwards, due to failure of cotton crop for a

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1 Support price is the guaranteed minimum price meant to provide a floor to the market in the immediate post-harvest period. It is intended to provide a guarantee to the growers that in the event of the market prices falling below the fixed level, the government would purchase all the produce offered by the growers for sale at the fixed price. However, if prices are high, the growers have the option to sell their output in the open market (see, Aftal et al. 1999).
number of years, it purchased just nominal quantities of cotton. As the private sector had already been allowed to export cotton in late 1980s, the CEC was wound up in 1997. The Government did not fix the support price of cotton lint for 1997-98. Also, no public sector organization was nominated to intervene in the market. But good crop of 1999-2000 obliged the Government to revise its policy and it hurriedly fixed the support price of seed cotton and asked the Trading Corporation of Pakistan (TCP) to implement it (Salam 2001).

The findings of many studies show that farmers in Pakistan are responsive to price changes and they accordingly adjust their resources for growing seed cotton (Falcon 1964; Luther 1987; Hudson and Ethridge 1997). It has also been determined that, compared to Sindh, the farmers in Punjab face quite different constraints as they respond to changes in support price. The magnitude of the response co-efficient and the cross effects of other prices were also found to differ significantly, depending on the prevalent cropping pattern of the zone (Pickney 1989).

PART - II

Nerlovian Adjustment Model (NAM) is employed for the statistical measures of the impact of support price on cotton production in Punjab, Pakistan. In its simplest form, NAM can be presented as a single variant linear relationship model of the following form:

\[
A^*_t = a + bP_{t-1} + U_t
\]

(1)

\(U_t\) is the stochastic error term. The left hand side variable, \(A^*_t\), is the acreage, farmers would plan in period \(t\) if there were no difficulties of adjustment. However, equation (1) cannot be estimated as \(A^*_t\) is not observable. One way out of this impasse is to assume that acreage actually planted in period \(t\) equals acreage actually planted in period \(t-1\), plus a term that is proportional to the difference between the acreage farmers would like

to plant now and the acreage actually planted in the preceding period. This hypothesis is formulated in the following:

\[
a_t - A_{t-1} = \beta(A^*_t - A_{t-1})
\]

(2)

Technological and institutional factors prevent the intended acreage from being realized during a period and the proportionality parameter, \(\beta\), is called the acreage adjustment coefficient.

From equation (2), \(A^*_t\) is rewriting in terms of directly observable variables:

\[
a_t - A_{t-1} = \beta A^*_t - \beta A_{t-1}
\]

\[
a_t - A_{t-1} = \beta A_{t-1} = \beta A^*_t
\]

(3)

\[
A^*_t = 1/\beta \{ A_t \} - [1-\beta/\beta]A_{t-1}
\]

By substituting the value of \(A^*_t\) into equation (1):

\[
1/\beta \{ A_t \} - [1-\beta/\beta]A_{t-1} = a + bP_{t-1} + U_t
\]

\[
a_t = a\beta + bP_{t-1} + (1-\beta)A_{t-1} + \beta U_t
\]

or

\[
a_t = a_o + b_o P_{t-1} + c_o A_{t-1} + V_t
\]

Where,

\[
a_o = a\beta
\]

\[
b_o = b\beta
\]

\[
c_o = (1-\beta), \text{ and}
\]

\[
V_t = \beta U_t
\]

Additional explanatory variables can be incorporated into the NAM model. For example, if the yield in the previous year \(Y_{t-1}\) is included as
another explanatory variable, the model simply takes on $c_0 Y_{t-1}$ as another independent variable:

$$A_t = a_0 + b_0 P_{t-1} + c_0 Y_{t-1} + d_0 A_{t-1} + V_t$$  \hspace{1cm} (5)

In fact, farmers respond to expected price ($P^e_t$). The model described so far implies that $P^e_t = P_{t-1}$ which corresponds to only one way of farming expectations. The adaptive expectations model $P^e_t = P^e_{t-1} + \gamma [P_t - P^e_{t-1}]$ is more flexible and it would coincide with the above rule only if the elasticity of expectations coefficient varies. In the present study, the adaptive expectations are not required since support prices are used which are pre-announced in which case $P^e_t = P_t$. Thus, equation (4) takes on the following form:

$$A_t = a_0 + b_0 P_t + c_0 A_{t-1} + V_t$$  \hspace{1cm} (6)

Nerlovian adjustment model is usually given in the linear form. An alternative way of presenting the NAM is to postulate that the percentage change in the acreage planted is a proportion $\beta$, of the percentage difference between intended acreage in period $t$ and actual acreage in the previous period. The model, with price in the previous period as the determinant can be rewritten as:

$$A^*_{t-1} = aP^e_{t-1} U_{t-1}$$  \hspace{1cm} (7)

$$A_t / A_{t-1} = [A^*_{t-1} / A_{t-1}]^\beta \hspace{1cm} 0 \leq \beta \leq 1$$  \hspace{1cm} (8)

From equation (8),

$$[A_t / A_{t-1}]^{1/\beta} = A^*_t / A_{t-1}$$

$$[A_t / A_{t-1}]^{1/\beta} = [A_{t-1}]^{-1} A^*_{t-1}$$

$$A^*_t = [A_{t-1}]^{1/\beta} [A_{t-1}]^{-1/\beta}$$

Substituting equation (7):

$$aP^e_{t-1} U_{t-1} = \{A_{t-1}\}^{1/\beta} \{A_{t-1}\}^{-1/\beta}$$

$$A_{t-1}^{1/\beta} = aP^e_{t-1} U_{t-1} \{A_{t-1}\}^{1/\beta}$$

or

$$A_t = aP^e_{t-1} \{A_{t-1}\}^{1-\beta} U_{t-1}^{\beta}$$

Taking log on both sides:

$$\log A_t = \beta \log a + b_\beta \log P_{t-1} + (1-\beta) \log A_{t-1} + \beta \log U_{t-1}$$

or

$$\log A_t = \log a_0 + b_\beta \log P_{t-1} + c_\beta \log A_{t-1} + V_t$$

This is the logarithmic form of the estimated equation and:

$$\log a_0 - \beta \log a$$

$$b_\beta, \ b_\beta$$

$$c_\beta = 1-\beta$$

and,

$$V_t = \beta \log U_t$$

The percentage adjustment differs from the linear adjustment model in assuming that the proportion of disequilibrium, which is eliminated, is smaller. The greater the disequilibrium, the more inclined farmers are to eliminate it (hence, the assumption incorporated in the model is perhaps more realistic as it is likely that the closer producers are to equilibrium, the less there is to learn about it). The economic adjustment measured by $\beta$, the adjustment coefficient, is the same whether the linear or log-linear formulation is adopted. When $\beta$ is equal to one it means that there are no technological or institutional constraints to prevent the producers from realizing the intended acreage level. Smaller is the $\beta$, greater is the constraint.
PART – III

For determining the farmers’ supply response to change in the support price of seed cotton, a single equation model is estimated. Since the increase or decrease in production depends upon the changes in area and yield, another two models are estimated to separately determine the responsiveness of each to a change in support price. The logarithmic form of the models is given below:

\[ \begin{align*}
\log QC &= a_0 + a_1 \log SP + a_2 \log FP + a_3 \log PP + a_4 \log WA + a_5 \log Cr + \epsilon_0 + \epsilon_1 + \epsilon_2 + \epsilon_3 + \epsilon_4 + V_i \\
\log YC &= c_0 + c_1 \log SP + c_2 \log FP + c_3 \log PP + c_4 \log WA + c_5 \log Cr + \epsilon_0 + \epsilon_1 + \epsilon_2 + \epsilon_3 + \epsilon_4 + V_i \\
\log AC &= b_0 + b_1 \log SP + b_2 \log FP + b_3 \log PP + b_4 \log WA + b_5 \log Cr + \epsilon_0 + \epsilon_1 + \epsilon_2 + \epsilon_3 + \epsilon_4 + V_i
\end{align*} \]

Where,

QC = Production of seed cotton (1000 tonnes)
AC = Area of seed cotton (1000 hectares)
YC = Yield of seed cotton (kgs per hectare)
SP = Support price of seed cotton (Rs per 40 kgs)
FP = Fertilizer price (Rs per 50 kg bag)
PP = Pesticide price (Rs per litre)
WA = Irrigation water availability in kharif season (million acre feet)
Cr = Credit by all sources (Rs per hectare)

The variable Cr is included in all the three models, keeping in view the importance of credit as a vital tool for raising farmers’ productive capacity. Indeed, average farmers are universally in need of credit for having access to pesticides and other agriculture inputs like fertilizers, machinery, etc. All monetary values have been taken in constant market prices in view of inflationary trends.

Utilizing the secondary data available in various issues of both Agriculture Statistics of Pakistan and Economic Survey of Pakistan, regression is run on the log linear variation of the models by applying the Ordinary Least Squares (OLS) method. The results are reported in Table 1 and Table 2. The former lists the estimated coefficients along with their ratios and the coefficient of multiple regression (R²), while the adjustment coefficients and the short run and long-run own price and other elasticities of supply are given in the latter.

The figures reported in Table 1 provide useful insight into the interplay of the factors responsible for change in the dependent variables of the three models. The estimated coefficient of the support price variable, SP, carries theoretically right sign in all the three models, but it turns out to be significant only in Equation 2, the yield model with YC, as the dependent variable. The results show that no significant relationship is observed of the support price with both the level and acreage of seed cotton in Punjab. The success of the support price policy, however, is still underscored by the increase in farmers’ incomes, reflected in the positive and significant coefficient of SP, in Equation 2 (Table 2). In the short run, an increase of one rupee in support price increases farmers’ income by 43 paisas. In the long run, the yield impact of one rupee increase in support price is realized in an addition of 5 paisas in the farmers’ income from growing seed cotton in Punjab.

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1 Short-run elasticity is the coefficient \( b_0 \) while the formula for calculating the long-run elasticity is calculated as \( b_0 / \beta \), i.e. \( b_0 \) divided by the coefficient of adjusted variable.
The estimated coefficients of the fertilizer price variable, FP, carry negative signs in all the three models. Although theoretically relevant signs, the estimated coefficients do not have the scientific validity as all three happen to be insignificant. The positive coefficients of the variable for pesticide price, PP, are significant in two of the three equations, indicating that pesticides happen to be important input for the farmers once they have invested in all the other major inputs. However, the increase in pesticide price is not observed to reduce the farmers’ yield, rather it happens to be positively related with the latter, possibly because of relatively smaller share in total input cost and greater benefits in terms of protecting the cotton from the attacks by the pests. Moreover, the estimated coefficients of PP, are relatively small and wide divergence is not observed in Table 2 between the short run and long run elasticity coefficients.

Irrigation water availability, W, is the only variable having significant coefficients, with right signs, in all the three models. This is both a valid and expected result which also shows the widest divergence between the short run and long run elasticity estimates listed in Table 2, particularly in Equation 3 where the dependent variable, AC, is the area under cotton cultivation.

The coefficients of the credit variable, Cr, are positive and highly significant for the production and yield models, Equation 1 and Equation 2 respectively.

The coefficient of the multiple regression reported in Table 1, shows a strong relationship between the dependent variable of all three models with the respective independent variables as the size of the R² is 0.941, 0.885 and 0.975, respectively.

Finally, all three models were estimated exclusive of 1982-84 when the cotton crop was severely damaged by the attack of cotton leaf curl virus in Punjab. It was observed that by excluding 1982-84, the values of all coefficients generated by regression were higher compared to the values reported in this study.

Table 1: Estimates of Supply Response of Seed Cotton (Punjab: 1976-2002)

<table>
<thead>
<tr>
<th>Equation 1</th>
<th>Equation 2</th>
<th>Equation 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable Qc</td>
<td>Dependent variable Yc</td>
<td>Dependent variable Ac</td>
</tr>
<tr>
<td>Variable</td>
<td>Coefficient</td>
<td>Variable</td>
</tr>
<tr>
<td>Constant</td>
<td>-8.537</td>
<td>Constant</td>
</tr>
<tr>
<td></td>
<td>(-3.117)**</td>
<td></td>
</tr>
<tr>
<td>SP</td>
<td>0.404</td>
<td>SP</td>
</tr>
<tr>
<td></td>
<td>(1.552)</td>
<td></td>
</tr>
<tr>
<td>FP</td>
<td>-0.046</td>
<td>FP</td>
</tr>
<tr>
<td></td>
<td>(-0.199)</td>
<td></td>
</tr>
<tr>
<td>PP</td>
<td>0.128</td>
<td>PP</td>
</tr>
<tr>
<td></td>
<td>(1.790)*</td>
<td></td>
</tr>
<tr>
<td>W</td>
<td>7.128</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td>(3.221)**</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>0.301</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.652)**</td>
<td></td>
</tr>
<tr>
<td>Q</td>
<td>0.364</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.180)**</td>
<td></td>
</tr>
</tbody>
</table>

| No. of observations = 26  |

R² = 0.941  R² = 0.885  R² = 0.957

* Significant at 10%
** Significant at 5%
*** Significant at 1%
Table 2: Adjustment Coefficients, Price Elasticity and Other Elasticities

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Adjustment coefficient (β)</th>
<th>Price elasticity</th>
<th>Other elasticities</th>
<th>Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Short-run</td>
<td>Long-run</td>
<td>Short-run</td>
<td>Long-run</td>
</tr>
<tr>
<td>Q</td>
<td>0.636</td>
<td>0.404</td>
<td>0.035</td>
<td>-0.046</td>
</tr>
<tr>
<td></td>
<td>PP</td>
<td>0.128</td>
<td>0.201</td>
<td>2.148</td>
</tr>
<tr>
<td></td>
<td>W</td>
<td>0.341</td>
<td>0.473</td>
<td>0.159</td>
</tr>
<tr>
<td>Y</td>
<td>0.816</td>
<td>0.431</td>
<td>0.528</td>
<td>-0.136</td>
</tr>
<tr>
<td></td>
<td>PP</td>
<td>0.152</td>
<td>0.186</td>
<td>1.581</td>
</tr>
<tr>
<td></td>
<td>W</td>
<td>0.332</td>
<td>0.406</td>
<td>-0.039</td>
</tr>
<tr>
<td></td>
<td>PP</td>
<td>0.016</td>
<td>1.741</td>
<td>-0.016</td>
</tr>
</tbody>
</table>

Summary of Conclusions and Recommendations

No relationship of the support price is observed with the acreage and production of seed cotton.

However, a positive and significant relationship is observed between yield and support price of seed cotton, which happens to be a very important variable for Pakistan to maintain its edge as one of the major cotton producers in the international market.

The farmers are being compensated all over the world, especially in the developed countries where the welfare transfers by the governments already ensure the provision of basic needs to all citizens.

No such safety nets exist in developing countries like Pakistan. Unless the support price cushion is provided the producer are reluctant to take the risk of high farm investments in the face of uncertain market conditions.

The observed positive and significant relationship between support price and cotton yield in Pakistan more than justifies the support price policy of the country.

The success of the support price policy of the seed cotton is underscored by its positive effect on yield which could be taken as a proxy for increase in the farm sector welfare resulting from higher incomes of the rural households.

In order to secure competitive edge in the international market, it is important that Pakistan’s comparative advantage in cotton production is shielded with the support price policy, at least till the time the developed countries agree and practically remove all the subsidies, which they presently provide to their farm sectors.
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