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HEDONIC PRICE ESTIMATION FOR SEED COTTON: A CASE STUDY OF DISTRICT KHANEWAL, PAKISTAN

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This paper attempts to evaluate impact of major factors affecting prices of seed cotton in district Khanewal using primary source of data. A representative sample of 40 cotton farmers was selected using stratified random sampling technique. The impact of major factors on prices of seed cotton was estimated employing double log form of regression analysis. The findings of analysis revealed that color, length, and strength of seed cotton were the significant variables affecting its prices whereas the variables (low evidence of contamination and less use of pesticides) showed insignificant impact. Awareness campaigns, with joint involvement of public and private sectors, should be initiated to realize farming community about importance of these traits, so that cotton growers may be motivated to produce quality seed cotton.

I. Introduction

Cotton, known as 'white gold', is an important cash crop in Pakistan. In fact, Pakistan is one of the ancient home of cultivated cotton. It is the fourth largest producer and the third largest consumer of cotton in the world after China, India and the USA. During 2009-2010, the cotton crop was grown on area of 3.07 million hectares to meet the domestic demand of 12.1 million bales annually [GOP, (2009)]. Cotton accounts for 1.6 per cent of Gross Domestic Product and more importantly, 55% of foreign exchange earnings. Cotton production supports Pakistan's largest industrial sector, comprised of over 400 textile mills, 1000 ginneries and 300 oil expellers, thus providing livelihood for millions of farmers and those employed along the entire cotton value chain [GOP, (2010)]. Thus, the success or failure of cotton crop has a direct bearing on Pakistan's annual GDP growth. The major cotton growing areas in Pakistan are located on the southern belt of the Punjab province and the interior of Sindh province. The sixteen districts, growing cotton in Punjab accounts for about 80% of the national area under cotton cultivation, whereas, Sindh dominates the remaining area, under its cultivation. Cotton in Pakistan is planted during April to May and harvested from October to November [AMIS, (2006)].

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The major problems facing the country's cotton industry include absence of a recognized and scientifically devised standardized quality control system, and consequently fluctuating supply and poor marketing practices. The quality of cotton, as determined on the basis of its color, length, strength, fitness and most of all the degree of contamination, greatly affects its price. The marketing system for cotton is also confronted with many problems which mainly include improper handling, storage, packaging and transportation in Pakistan. One of the most important and sensitive issues in cotton marketing is its pricing system. It is not well developed and both, seed cotton and lint cotton are priced mostly on the basis of subjective assessment, such as the variety or source of origin. Some quality conscious millers and ginners do evaluate cotton on the basis of quality parameters, but this has not been the usual practice and, therefore, no significant impact has been realized in the cotton marketing system over years. Due to international requirements, the situation is now changing and the cotton sector in Pakistan is becoming more systematic and is being modernised. As such, quality parameters (staple length, strength, color, purity of fiber etc.) have now a direct bearing on the prices of cotton. Given this background, this study aims at estimating the impact of major quality attributes on the prices of seed cotton using a hedonic price model.

II. Review of the Litrature

Hedonic price estimation is a relatively new area of investigation in Pakistan. As such, the available literature on hedonic price estimation of agricultural commodities in general and for cotton in particular is limited. There is however some relevant literature from the other countries. In the U.S., Ethridge and Davis (1982) estimated a hedonic price model for cotton using ordinary least squares and found that micronarie and the color of the cotton were important variables affecting its prices while fiber length and trash content were less important variables. Ethridge and Neeper (1987) estimated hedonic producer prices for fiber strength uniformity for the southwest U.S. cotton market using seemingly unrelated regression and found fiber strength and length uniformity as significant determinants of cotton prices. Producer prices were more responsive to fiber length and micronaire than its color and strength. Hudson et al. (1995) developed a hedonic model to explain the daily price of cotton as a function of the specific quality attributes of cotton. The model was used to estimate parameters, which were used to compute prices, premiums, and discounts for various qualities of cotton.

Chakraborty et al. (1998) measured the average contribution of color, staple, strength, micronaire, and cleanliness to the price of cotton using the Daily Price Estimation System (DPES) data and found that color had the highest contribution in the price of cotton followed by micronaire and cleanliness. The average contribution of strength was the lowest among all quality attributes. Cho (2006) investigated hedonic pricing for the US cotton by developing quality measures and market factors by employing multi-stage hedonic price models. Higher values in the two-digit color codes were found to be most detrimental to values of the cotton while higher fiber length and strength values were other important determinants of their marginal hedonic

prices. Estur (2008) elaborated an analysis of the objective outcome of cotton sector liberalization in Sub-Saharan Africa and concluded that the price of cotton lint was only primarily linked to fiber characteristics but also to the non-quality factors such as the way it was marketed internationally. In Pakistan, Nosheen and Iqbal (2008) estimated price elasticities for cotton and found the short run price elasticity of cotton area as 0.263 while the long run price elasticity was 1.09. They further added that powerful monopolies or oligopolistic structures in cotton markets distorted incentives for the producers resulting in wasteful and inefficient use of national resources. Sial (2009) showed his concerns about fluctuating and skyrocketing price trends in cotton.

III. Data and Methodology

This study is based on primary data collected from 40 cotton growers of the Khanewal district for the year 2010. This district has major share in total cotton production and area in the Punjab province. A stratified random sampling technique (equal allocation) was used to select the sample. At the first stage, two tehsils of district Khanewal (Khanewal and Kabirwala) were selected randomly. At the second stage, four villages from tehsil Kabirwala (Chah Jamalwala, Chah Meharanwala, Mouza Baraywala and Mouza Pulbagar) and four villages from tehsil Khanewal (Nanakpur, 168/10R, 120/10R and 170/10R) were selected randomly from the list of total villages obtained for this purpose from the Agricultural Extension Department of the Government. of Punjab. Then at the third stage, forty cotton growers (five from each village) were selected randomly from the list of total cotton growers.

A pre-tested questionnaire containing both close and open ended questions was used to collect the data from selected respondents through personal interviews. The questionnaire includes questions on the socio-economic characteristics of the selected cotton growers, business practices and views on the impact of major characteristics (fiber color, fiber length, fiber strength, free from contamination like trash contents etc. and less use of pesticides) affecting prices of seed cotton. SPSS software (Statistical the package for Social Sciences) was used to analyze the data. Categorical data of given independent variables was collected by using the five point likert scale (Very high=5, high=4, medium=3, low=2, and very low=1). The descriptive statistics of data is presented in Table-1.

TABLE 1

Descriptive Statistics of Variables

Variables	Minimum	Maximum	Mean	Std. Deviation
Fiber color	1	5	4.18	0.903
Fiber length	2	5	4.08	0.944
Fiber strength	2	5	4.13	0.939
Less use of pesticide	2	5	3.80	0.723
Low evidence of contamination	2	5	3.93	0.572
Prices of seed cotton	1200	2000	1675.00	161.325
Valid N (listwise)	40			

1. *Theoretical Model*

We have adopted the model suggested by Hudson et al. (1995) and Bowman (1989), and used the notations given by Rosen (1974). Hedonic models can be in different ways; such as, simple linear hedonic regression model, non-linear hedonic regression model (exponential and quadratic) and double log form of hedonic regression model. We adopted double log form of hedonic models due to the nature of the collected data. The scatter plot between prices of cotton and its independent variables suggested such a relationship. In order to avoid biasment in data analysis, we also estimated linear form of regression but based on the model fitness criteria, double log form of regression was found suitable. Unlike general price level models of an agricultural commodity, determined by supply and demand variables, hedonic models determine implicit prices of specific attributes embodied in a product on the basis of the value (utility or productivity) end-users ascribe to these attributes. A hedonic price function relates the price of a product (good or service) to the various attributes or characteristics embodied in it. Hedonic price analysis therefore, extracts information from markets and provides that information back to market participants. The observed price of the product is therefore a composite of the implicit values of the product's attributes.

More simply, hedonic price function assumes that commodity price is a function of the good and its quality characteristics. Quality characteristics are at the heart of hedonic price analysis. Most hedonic regression models use a set of quantitative (continuous) variables, a set of qualitative (discrete) variables, and in some cases, a set of interaction variables. For quantitative variables in the regression, the respective partial derivative of the function represents the implicit marginal attribute price. The estimated coefficient in qualitative variables measure the impact of presence of the given attribute, but the implicit (predicted) price cannot be derived directly and required further manipulation [Jabbar (1997)]. Perhaps the first analysis to consider the influence of quality on prices was Waugh (1928) on vegetables. In 1951, both Houthakker (1951) and Theil (1951) independently formalized many of the theoretical issues of consumer demand for quality. Gorman (1956) on the study on quality differentials in the egg market linked consumer demand with measurable product characteristics. Lancaster (1966) further developed the notion that consumer utility was derived from the characteristics which was represented by a hedonic price function, where commodity price was a function of the good and its quality characteristics.

Hedonic price models can be estimated using qualitative data as well. This is particularly adopted in the situations where quantitative data is difficult to obtain. Major studies which estimated hedonic price regression models using qualitative data include Deodhar and Intodia (2001) for ghee, Knights et al. (2005) for sheep and goat, and Corsi and Strom (2008) for organic wine. Hudson et al. (1995) estimate parameters which are then used to compute the effect of various quality traits on the prices of seed cotton, influenced by Bowman's (1989) conceptual framework to a large extent. This conceptualization requires viewing a commodity as a bundle of characteristics rather than as a homogenous product. Fundamental to hedonic theory in price analysis is the assertion that the demand for a commodity is derived from the demand for the characteristics contained in the commodity. In the

[2] F-value and R2 was higher in the double log model than the linear model; and the significance level of coefficients was also better in the first model.

same context, hedonic theory suggests that seed cotton has value to the extent that the characteristics inherent to it have value.

2. *Hedonic Price Regression Model*

A particular combination of seed cotton quality characteristics Z's, can be expressed, as a function of individual seed cotton quality characteristics as shown below.

$$P = f\,(Z_i) \qquad (1)$$

where;

P = Prices of seed cotton (Rs. / Maund)
Z_i = Vector of qualitative variables i = 5

In more specific form, equation (1) can be written as;

$$P_i = \lambda_0\, Z_i^{\lambda i}\, e^{\mu} \qquad (2)$$

And equation (2) can be further explained as;

$$P = \lambda_0\, Z_1^{\lambda 1}\, Z_2^{\lambda 2}\, Z_3^{\lambda 3}\, Z_4^{\lambda 4}\, Z_5^{\lambda 5}\, e^{\mu} \qquad (3)$$

By taking natural log on both sides, equation (3) can be written as;

$$ln\,P = \lambda_0 + \lambda_1\, ln\,Z_1 + \lambda_2\, ln\,Z_2 + \lambda_3\, ln\,Z_3 + \lambda_4\, ln\,Z_4 + \lambda_5\, ln\,Z_5 + \mu \qquad (4)$$

where; P is the price of seed cotton. Categorical data of given independent variables were collected by using a five point Likert scale (very high=5, high=4, medium=3, low=2, and very low=1), and:

Z_s are the independent variables in which,

Z_1 = fiber color of seed cotton,
Z_2 = fiber length of seed cotton,
Z_3 = fiber strength of seed cotton,
Z_4 = low evidence of contamination,
Z_5 = less use of pesticides on seed cotton,
λo is the intercept, λs are slope coefficients, μ is the random error,
ln = natural log

The application of hedonic model for cotton pricing in study area rests on the following assumptions. First, the cotton market in sample area is assumed to be operated under perfect market conditions as no single buyer should be in a position to affect the prices of cotton. Secondly, quality variations are assumed in cotton and differences in implicit prices of cotton should reflect these quality variations. Finally, market is supposed to be in equilibrium and so price differences should only be because of quality differences.

IV. Empirical Findings

The relationship between the dependent variable (Prices) and the independent variables (fiber color, fiber length, fiber strength, low evidence of contamination like trash contents etc., and less use of pesticides) was estimated by employing double log form of regression analysis. A scatter plot between the dependent and independent variables suggested such a relationship. As a first step, a check for multicollinearity was applied. This is the undesirable situation where the correlations among the independent variables are strong. Tolerance is a statistic used to determine how much the independent variables are linearly related to one another. VIF or the Variance Inflation Factor is the reciprocal of the Tolerance. As the VIF increases, so does the variance of the regression coefficient, making it an unstable estimate. Large VIF values are indicators of multicollinearity. If the value of VIF is greater than 10 then there exists problem of multicollinearity [Gujrati (1995)]. As shown in Table 2, the VIF values of all variables are less than 10 which show the absence of multicollinearity in the data set.

TABLE 2

Collinearity Statistics of Variables

Variables	Tolerance	Variance Inflation factor (VIF)
Fiber color	0.407	2.460
Fiber length	0.452	2.214
Fiber strength	0.408	2.449
Cotton free from contamination	0.440	2.275
Less use of pesticide	0.532	1.881

The estimated hedonic model is shown in Table 3. The value of the adjusted R2 was 0.58 implying that the independent variables as a group explained 58% of the variation in the dependent variable, keeping all other factors constant. The F-value was 11.89 which was highly significant and confirmed the overall appropriateness of the model. Fiber color is usually considered to be an important variable for assessing cotton quality. A bright color of the fiber enhances the probability of farmers being able to sell at higher prices. The coefficient of fiber color 0.11 ($p<0.1$) in the model showed a positive sign and was significant. Since the model is of the double log form, the estimated coefficients may be interpreted as elasticities. Thus, the coefficient indicates that for every one per cent increase in the category of color (improvement in color) there should be an increase of 0.11 per cent in the prices of seed cotton, keeping all other factors constant.

Fiber length is another usual determinant of the prices of cotton. The coefficient of fiber length 0.03 ($p<0.1$) showed a positive sign and was significant. This coefficient indicates that for every one per cent increase in the category of fiber length (improvement in the fiber length) there should be an increase of 0.03 per cent in the prices of seed cotton, keeping all other factors constant. Fiber strength also plays an important role in the determination of seed cotton prices. Normally, the higher the fiber strength of seed cotton, the greater will be the price offered to cotton farmers. In the results, the coefficient of fiber strength 0.12 ($p<0.1$) was positive and significant. This coefficient explained that for every one per cent increase in the category of fiber strength (improvement in fiber strength) there would be an increase of 0.12 per cent in the prices of seed cotton, keeping all other factors constant.

Low evidence of contamination in cotton may also increase the probability of fetching higher price by cotton farmers. If there is less evidence of contamination, like trash contents, weeds and leaves, human hair and any other unwanted material, prices received by cotton farmers may be higher. However, the coefficient of this variable 0.028 ($p>0.1$) (while positive) was insignificant. Therefore, while there was a tendency for an increase or improvement in the category of cotton free from contamination to lead to an increase in the price of seed cotton, this was not a statistically significant relationship.

Similar results were found with the variable lesser use of pesticides on seed cotton. Some buyers may pay higher price for cotton which has less pesticide applied, but this was not confirmed in this data set. The coefficient of this variable was 0.033 ($p>0.1$), and there was tendency for lower pesticide use to lead to higher price, but the effect was insignificant. This result is also supported by the findings of Ethridge and Davis (1982), Ethridge and Neeper (1987), Chakraborty et al. (1998). These authors also found an insignificant effect of lower pesticide use on prices of seed cotton.

TABLE 3

Summary of Estimated Hedonic Price Model for Seed Cotton

Variables	Coefficients	Standard Error	T-Value	Significance (P-value)
(Constant)	6.980	0.081	86.160	0.000
Fiber color	0.110	0.055	1.642**	0.100
Fiber length	0.037	0.018	2.009*	0.053
Fiber strength	0.117	0.063	1.857*	0.071
Low evidence of contamination	0.028	0.071	0.392	0.697^{NS}
Less use of pesticide	0.033	0.067	0.494	0.625^{NS}
R^2	0.63			
Adjusted R^2	0.58			
F- Value	11.89			

* = Significant at 5% level of confidence
** = Significant at 10% level of confidence
NS = Non Significant

V. Concluding Remarks

This study estimates the impact of major quality attributes (staple length, strength, color, low evidence of contamination and free from pesticides, etc.) on the price of seed cotton in Punjab, Pakistan. The findings of this study confirm that prices of seed cotton were highly dependent on fiber color, length, and strength of seed cotton. Therefore, in order to improve the cotton pricing system in Pakistan, an awareness campaign should be started to inform the farming community about importance of these quality traits, so that cotton growers may be motivated to produce quality seed cotton.

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