Hedonic Prices of Malawi Burley Tobacco

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Abstract

Tobacco is notorious for being one of the most difficult commodities to grade. Here, we determine the implicit prices of various tobacco characteristics using a hedonic price model. The factors affecting the price received for burley tobacco include reputation of the producer, month of auction and lot size in addition to most of the twenty-six different variables representing quality characteristics. Many of these factors can be controlled by producers through production, harvesting, and curing practices. The implicit prices should help farmers evaluate whether they should adopt processes to increase quality.

In spite of the large number of factors included, only about half of the price variation across lots could be explained. Thus, the difficulty of grading tobacco is confirmed. Since a universally acceptable grading system is unlikely, any attempts to develop an electronic market will likely need to include pictures of the tobacco and may need to measure additional characteristics such as texture and aroma.

Introduction

Quality has a considerable influence on tobacco price. However, quality in tobacco is difficult to quantify. FA0[1] notes that buyers often refer to a concept of "value for money" in an attempt to account for quality. Buyers assess quality of tobacco offered for sale and assign it a value relative to other tobacco. These relative values may be unique for each buyer but provide buyers a way in which to rank tobacco from different suppliers. This ranking is a continuously dynamic process because the quality definitions differ across the industry and change over time. The "value for money" concept usually takes into account the chemical properties of the leaf, its physical appearance, aroma, maturity, uniformity within a given lot, the continuity and reliability of supplies, uniformity of the processed product and the filling capacity of the leaf.

Sims et al.[2] note that producers have a great influence on the quality of tobacco through site selection, variety selection, nursery management, field cultural practices, harvesting and curing. They observe that both yield and quality may be improved by using adequate amounts of required nutrients if they are lacking in the soil. Massie and Smiley[3] argue that producers must pay even more attention to harvesting and curing. They note that the final quality of cured tobacco is determined largely by moisture conditions inside the tobacco barn during curing. They observe that a well-cured burley crop depends on cutting tobacco at the right time, harvesting it correctly, practicing good barn management, and properly bulking it. One also needs to control temperature, humidity, and air circulation in order to obtain high quality tobacco.

It is important for farmers, auction managers and policy makers to clearly understand how different tobacco characteristics affect the prices of its various grades. Such knowledge would help producers to produce tobacco with characteristics demanded by consumers and thereby, producers would maximize their profits.

Much work that has been done on tobacco marketing has focused on market structure (industrial organization) and effects on supply and demand of tobacco due to changing consumer demands and governmental regulation.[4,5] This study focuses on price discovery. The general objective is to provide producers, government officials and the tobacco industry in general, with a better understanding of the variation in tobacco prices due to quality aspects of the leaf. The specific objective is to determine the relationship between price received for a given lot of Malawi tobacco and its quality characteristics.

Malawi produces and exports burley, flue-cured, northern dark-fired (NDDF), oriental and sun-air cured tobaccos. All these tobacco types are grown throughout Malawi in one growing season which runs from November to February. On average, tobacco accounts for over 65 percent of the total domestic export earnings. In this paper, a hedonic price model is developed to determine the implicit values of the quality characteristics of burley tobacco based on auction data. Burley tobacco is blended with other tobaccos when making cigarettes.

Hedonic price analysis has been used to study implicit prices for attributes embodied in products such as Japanese wagyu beef, Australian wheat and flour, tea, wheat, apples, rice and barley.[6-13] The hedonic model used here is similar to those used in past research. We use a maximum likelihood procedure to correct for heteroskedasticity so that our approach is asymptotically more efficient than ordinary least squares.

Hedonic Price Theory

Products are wanted because of the utility they provide. The utility provided depends upon the product characteristics. Hence, the utility a consumer enjoys from purchasing a product depends upon the amounts of product characteristics purchased.[14]

Hedonic price theory assumes that values of goods are determined from the characteristics they possess. Hedonic prices are implicit prices for attributes or characteristics embodied in a commodity as opposed to the price of the commodity itself.[15] Hedonic prices are revealed by regressing the market price of a good against its traits.[16] The price of a good is equal to the summation over characteristics of the marginal utilities of the characteristics of the good times the marginal yields of the characteristics.[10,12, 17,18]

Rosen[15] notes that estimated hedonic price functions typically identify neither demand nor supply. However, both observed prices and implicit prices of embodied attributes may be affected by market demand and/or supply considerations. Because of market characteristics (regional, end use etc.), the hedonic estimation process may then have to adjust for effects of changes in market forces over time when time series data are used.[14]

Malawi Burley Tobacco Auction Data

Tobacco in Malawi is marketed simultaneously at three different locations through an "English" auction system where bidding is progressive upwards. The bidding is in U.S. dollars and the auction is open to international buyers. On the auction floor, the selling team made up of a starter, an auctioneer and a ticket marker faces buyers over rows of tobacco bales being offered for sale. The starter approximates the price of the tobacco and marks it on the bale. The auctioneer then begins his/her chant based on the price so marked and normally raises the price depending

on the signals he/she is receiving from buyers. This process continues until no buyer offers a higher price, at which point, the bale is said to be “knocked down” (sold). However, producers; who are either present or represented reserve the right to withdraw the tobacco if they are not satisfied with the price. Withdrawn tobacco may be offered at a later auction but the seller must acknowledge that it was offered previously. Not accepting the highest bid rarely occurs.

In each auction, burley is graded into several different grades. A representative sample of “hands” (a number of tobacco leaves tied together by the stalk) in each bale is drawn and a determination of the grade is made by a grader/classifier. The grading follows a system of sorting burley tobacco on the basis of three distinguishable characteristics: group, quality, and color. The grade symbols have three characters in sequence; first, a letter indicating the group; second, a number indicating the quality within the group; and third, a letter or letters signifying color of the group.

The first character of a tobacco grade is the group. There are five main groups which are determined by the position of the leaves on the stalk. Tobacco does not ripen uniformly so the bottom most leaves deteriorate and fall off while the topmost leaves are still growing actively. The oldest leaves at the bottom of the plant, about five of them, tend to be light in color, thin in body and so light that they often shatter when handled. These leaves are called "Primings/Flyings" and are given the group designation P. Further up the stalk are about six long leaves, a little heavier than primings but not very different from primings in texture. They are thin and have good burning qualities. These are called “Lugs” and are given group designation X. The next series of leaves, on the middle of the tobacco plant are broader, longer and tend to be medium-to-heavy in body. They are darker in color when compared to either primings or lugs. These are called “Cutters” and are given group designation C. Next to cutters are narrower, long and pointed-tip

leaves which make up about 45% of the tobacco plant. One can harvest up to eight leaves from this section. These are called the "Leaf" group and are given the group designation L. The last regular group is made up of topmost leaves harvested. These leaves are shorter and heavier in body and darker in color than the leaf group. This group of leaves is called "Tips" and is given the designation T. The groups are further broken into subgroups of "Strip" A and "Scrap" B. These are tobaccos that do not meet the minimum specifications of the lowest grade in other groups. In general, high nicotine content is observed on the upper part of the tobacco plant, from leaf group upwards, while the bottom leaves are higher in sugar content.

Quality is the second character in the grade symbol and is given in number form (1 to 5) and is measured subjectively. The five degrees of quality are based on elements in tobacco such as: smoothness, maturity, body, texture, injury, finish and uniformity. They are Choice (1), Fine (2), Good (3), Fair (4) and Low (5). No low qualities were observed in the entire data set.

Color is the third character in the grade symbol and is referred by a letter or letters. The colors and letters assigned to them from light to dark are: Buff (L), Tan (O), Red (R), and dark red (S). Other color variations are (J), bleached (E), offcolor (K), running green (V) and green (G). The priming (P), lug (X), and cutter (C) groups only develop colors E, L, and O while the leaf (L), tip (T) and Strip (A) groups may develop any of the colors above. A burley tobacco grade would thus, for example be written as X2O to represent tobacco belonging in the lug group, of fine quality and tan in color.

Data from 56 tobacco auctions held from April through September 1995 at Limbe Auction Floors in Malawi are used. The data were obtained from six producers differentiated by the amount of tobacco they produced. All the producers were from southern Malawi. The data are described by name of producer, area where the tobacco was grown, lot number, sale number, date,

grade, weight of lot in kilograms, price paid for lot in U.S. cents, total value received by seller/producer, buyer identity and a statement declaring whether or not the sale was completed. In total 415 lots are used. The data set also includes a United States all tobacco products producer price index which is used to proxy United States tobacco prices and was obtained from various issues of the United States Department of Agriculture *Tobacco Situation and Outlook*.[19]

Empirical Model

Theory does not provide a basis for selecting a particular functional form for hedonic pricing models. In this paper, a linear functional form is used to estimate the hedonic price function. The linear form restricts the premiums and discounts to be constant in cents per kilogram and the parameters indicate change in price (in cents) given a one unit change an the independent variable. The advantage of the linear functional form is that the parameters are directly interpretable and thus the results are easier to explain to producer groups. Since all but two of the variables are dummy variables, there is little need to calculate elasticities.

The equation includes dummy variables to test for the effect of the producer, month and grade. The empirical hedonic price model for Malawi burley tobacco is:

$$P_{tk} = \alpha + \sum_{i=0}^{12} \delta_i GROUP_{itk} + \sum_{j=0}^{11} \gamma_j COLOR_{jtk} + \sum_{n=0}^{5} \lambda_n QUALITY_{ntk} + \sum_{m=1}^{6} \varphi_{mCOMPANY_{mtk}} + \sum_{g=1}^{6} \omega_{gMONTH_{gtk}} + \beta_1 USPPI_t + \beta_2 LOT_{tk} + e_{tk} \quad 1)$$

where:

t is the number of tobacco auction, t = 1, 2, 3, ..., 56;

k is the lot number in auction t, k = 1, 2, 3, ..., k_t;

P_{tk} is price received in U.S. cents per kg for lot k;

$GROUP_{itk}$ are dummy variables for tobacco group, 1 if lot k from auction t is from group i, zero otherwise;

$COLOR_{jtk}$ are dummy variables for tobacco group, 1 if lot k from auction t is from group i, zero otherwise;

$QUALITY_{ntk}$ are dummy variables for quality 1 if lot k from auction t is from quality l, zero otherwise

$COMPANY_{mtk}$ are dummy variables for producer, 1 if lot k from auction t is from company m, zero otherwise

$MONTH_{gtk}$ dummy variable for month, 1 if auction t was sold between April and September 1995, zero otherwise;

$USPPI_t$ is the United States all tobacco products producer price index. (1982=100)

LOT_{tk} is the number of kilograms in a given lot; and

e_{tk} is the error term.

The model was estimated using the SHAZAM[20] econometric software package. To estimate the model, one of the variables in each of the group, color, quality and producing company is omitted (included in the intercept) . The following are included in the intercept: the

group variables, *GROUP*0 (no group assigned); color, *COLOR*0 (no color assigned) ; quality, *QUALITY*0 (no quality assigned), producer, *COMPANYA* (Mavuto).

The model was first estimated using ordinary least squares (OLS). The R^2 was 0.49. The Jarcque-Bera asymptotic normality test had a chi-square of 5.83 with 2 degrees so the null hypothesis that the error terms are normally distributed could not be rejected at the 5 per cent significance level. The R^2 is rather low when compared to studies of other commodities. This shows that there is still a lot of variation in tobacco price which the current grading system does not capture. Heteroskedasticity was indicated by the Harvey test with a chi-square of 4399.45. To correct for it, the model was re-estimated using maximum likelihood methods following Harvey's procedure.[21]

Results and Discussion

Descriptive statistics of the data are presented in Table 1 and estimates of the hedonic equation (1) are in Table 2. The joint null hypothesis that group (H_0: all δ are zero); quality (H_0: all λ are zero) and color (H_0: all γ are zero) is rejected as shown by the Wald chi-square statistic of 574001.49. This indicates that group, quality and color provide buyers with useful information that influences the price of tobacco at the auction. Based on the discounts and/or premiums to the price received, group followed by color and quality, is the most important grade characteristic for buyers because it receives the biggest premiums/discounts. This result is expected since the other two characteristics merely further describe the tobacco characteristics of a given group.

The joint test of the null hypothesis that group (H_0: all δ are zero) is unimportant is rejected as shown by the Wald chi-square statistic of 460.457. Group does provide buyers with useful information that influences price of tobacco at the auction. Positive coefficients are observed for lug, spotted lug, cutter and scrap groups while the priming, spotted primings, torn lug,

tip, leaf, strip and spotted leaf groups have negative coefficients. Premiums for lugs and cutters are expectetd since these are the most valuable parts of the tobacco plant. Equally expected are the big discounts received for torn lugs. Spotted lugs are worth 84¢/kg. more than torn lugs. These price differences are substantial considering that the average price observed was 161¢/kg.(Table 1). The positive coefficient for scraps is surprising. The scrap subgroup however, is not statistically significant. Strips, spotted lugs, torn lugs, cutters and tips are significant at 5 the per cent level.

The joint test of the null hypothesis that subjective quality (H_0: all λ are zero) is unimportant is rejected as shown by the Wald chi-square statistic of 86.216. Quality of the tobacco group provides important information to buyers. Price generally decreases as quality decreases. The exception is $QUALITY_4$ fair, for which few observations were observed and whose coefficient is statistically insignificant. The quality differences are based on such elements of tobacco as leaf smoothness, maturity, body, texture, injury, finish and uniformity of the leaf. This definition relies on the subjective interpretation of the grader. The premiums and or discounts received for quality are less than those for other grade components. The price differences of up to 25¢/kg. are still sizeable.

The joint test of the null hypothesis that color (H_0: all γ are zero) is unimportant is rejected as shown by the Wald chi-square statistic of 136.59. Only buff color and its different variations; substandard buff, tannish buff and substandard tan have positive coefficients with the most premium paid for buff color. Buff and tan colors were expected to be preferred over red and dark red colors. All the colors except for the "false" colors of off color, tannish off color and tannish substandard are significant at the 5 per cent level. The range between the highest valued and lowest valued color was 44¢/kg.

Joint test for the producer dummies is significant at the five percent level. This is shown by the Wald chi-square statistic of 48.884 The model considered four groups of producers categorized by their production quotas per year. Producers 4 (Nkhalamba) and 2 (Mavuto) are categorized as large with a quota 100,000 kg and above, producer 1 (Liwanjalo) and 6 (Chalimba) are categorized as medium with a production quota of 50-100,000 and companies 3 (Limbanazo) and 5 (Nkachelenga) are categorized as small holders with a production quota of between 5,000-50,000 kg. Only producer 4 (Nkhalamba), a large producer significantly affects prices received at the 5 per cent level. The rest of the producers are not significantly different from base (Liwanjalo).

Month of the auction is significant at the five percent level. The tobacco auction season starts in April and goes through October. The base month for auction in the model is April. Each month of auction is significant in determining tobacco prices at 5 per cent except for the month of May. Relative to the base month, highest prices were received in September followed August, June and May. The lowest prices were received in July.

The lot size coefficient is positive and significant at 1 per cent level indicating that larger lots receive higher prices than smaller lots. Larger lots may provide economies of size due to fixed costs. The United States all tobacco products producer price index (*USPPI*) was used to proxy the average prices for tobacco in 1995 in the United States. The index has a negative coefficient. The sign is unexpected. This may be due to the differences in season between the U.S. and Malawi and the short time period covered by the data. The monthly dummy variables may be capturing the change in overall price level.

Summary and Conclusion

A thorough understanding of the factors that influence the price of tobacco may help producers, auction managers and policy makers to evaluate the profitability of alternative production, grading and marketing strategies vis-a-vis existing systems. The results suggest that producer reputation, month of auction, lot size and grade characteristics (group, quality, and color) affect the price received for burley tobacco. Each of these variables is significantly related to the selling price at the five percent level. The grade characteristics (group, quality and color) provide useful information to buyers. Group followed by color and quality receives the most premium/discounts, making it the most important component of grade.

The same six buyers were present at every auction. Malawi government would likely wish to increase the number of buyers. One way of increasing the number of buyers would be an electronic market. Even with the large number of characteristics included here, much of the price variation across lots is still unexplained. A successful electronic market would likely also have to provide some visual information such as a color picture and a way to sense or accurately measure the texture smoothness of the tobacco leaf. Because of the large number of important characteristics, a futures market for tobacco is unlikely because there would be too much basis risk as the cheapest-to-deliver grade of tobacco changed and because any grading system can not adequately define the value of tobacco.

The results of this study may be useful to auction managers, government officials and producers in determining the appropriateness of the current tobacco grading system. The model may be used to show how varying tobacco characteristics affect the prices received for a given lot. Producers would know the premiums/discounts associated with various characteristics and make appropriate decisions to maximize profits depending on whether or not additional costs of achieving desired standards are compensated by premiums so received. Auction managers can use

the study to determine what lot sizes and the presentation methods on the floor to recommend. Government and the tobacco industry can use the study to determine which tobacco varieties are receiving premiums and therefore gear research and develop extension messages towards such varieties.

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Table 1. Means and Standard Deviation of Variables Used in the Hedonic Price Equation for Malawi Burley Tobacco

Variable	Means	Standard Deviation	Description
PRICE	161.02	32.896	Dependent variable, in U.S. cent per kg of tobacco
LOT	87.45	21.109	The size of lot of tobacco sold in kgs
USPPI (1982=100)	233.71	0.119	The U.S. all tobacco products price index
$COMPANY_1$	0.15	0.359	1 if company of origin is Mavuto, zero otherwise
$COMPANY_2$	0.24	0.429	1 if company of origin is Liwanjalo , zero otherwise
$COMPANY_3$	0.02	0.160	1 if company of origin is Limbanazo, zero otherwise
$COMPANY_4$	0.42	0.494	1 if company of origin is Nkhalamba, zero otherwise
$COMPANY_5$	0.05	0.224	1 if company of origin is Nkachelenga, zero otherwise
$COMPANY_6$	0.10	0.305	1 if company of origin is Chalimba, zero otherwise
APRIL	0.06	0.251	1 if auction took place in the month of April, zero otherwise

Table 1. (continued)

Variable	Means	Standard Deviation	Description
MAY	0.23	0.420	1 if auction took place in the month of April, zero otherwise
JUNE	0.23	0.419	1 if auction took place in the month of June, zero otherwise
JULY	0.94	0.292	1 if auction took place in the month of July, zero otherwise
AUGUST	0.33	0.471	1 if auction took place in the month of August, zero otherwise
SEPTEMBER	0.05	0.219	1 if auction took place in the month of September, zero otherwise
$GROUP_0$	0.07	0.270	Dummy variable for group 0
$GROUP_1$	0.13	0.330	Dummy variable for primings, group P
$GROUP_2$	0.002	0.049	Dummy variable for torn lugs, group XT
$GROUP_3$	0.13	0.331	Dummy variable for lugs, group X
$GROUP_4$	0.07	0.246	Dummy variable for cutters, group C
$GROUP_5$	0.28	0.452	Dummy variable for leaf, group L

Table 1. (continued)

Variable	Means	Standard Deviation	Description
$GROUP_6$	0.28	0.449	Dummy variable for tips, group T
$GROUP_7$	0.002	0.145	Dummy variable for strips, group A
$GROUP_8$	0.01	0.069	Dummy variable for scraps, group B
$GROUP_9$	0.002	0.049	Dummy variable for spotted primings, group PA
$GROUP_{10}$	0.002	0.049	Dummy variable for spotted lugs, group XA
$GROUP_{11}$	0.02	0.002	Dummy variable for spotted leaf, group LA
$QUALITY_1$	0.07	0.07	Dummy variable for choice quality
$QUALITY_2$	0.34	0.34	Dummy variable for fine quality
$QUALITY_3$	0.48	0.48	Dummy variable for good quality
$QUALITY_4$	0.02	0.02	Dummy variable for fair quality
$COLOR_0$	0.139	0.34	Dummy variable for non assigned color
$COLOR_1$	0.24	0.42	Dummy variable for buff, color L

Table 1. (continued)

Variable	Means	Standard Deviation	Description
$COLOR_3$	0.002	0.04	Dummy variable for red, color R
$COLOR_4$	0.06	0.23	Dummy variable for dark red, color S
$COLOR_5$	0.014	0.119	Dummy variable for standard, color J
$COLOR_6$	0.012	0.109	Dummy variable for off-color, color K
$COLOR_7$	0.012	0.109	Dummy variable for off color buff, color LK
$COLOR_8$	0.07	0.27	Dummy variable for standard buff, color LJ
$COLOR_9$	0.002	0.049	Dummy variable for tannish buff, color LO
$COLOR_{10}$	0.045	0.20	Dummy variable for off color tan, color OK
	0.002	0.049	Dummy variable for standard tan, color OJ

Table 2. Parameter Estimates for the Hedonic Price Equation for Malawi Burley Tobacco

Variable	Estimated Coefficient	t-Statistic
CONSTANT	39034.000	3.992**
LOT	0.124	1.792*
USPPI (1982=100)	-166.370	-3.975**
$COMPANY_2$	6.155	1.388
$COMPANY_3$	25 037	1.666*
$COMPANY_4$	-13.529	-3.522**
$COMPANY_5$	8.797	1.305
$COMPANY_6$	2.457	0.551
MAY	5.790	1.033
JUNE	19.539	2.941**
JULY	-36.892	-4.489**
AUGUST	40.946	4.215**
SEPTEMBER	40.745	2.913**
$GROUP_1$ (primings)	-6.886	-0.831
$GROUP_2$ (lugs)	9.077	1.041
$GROUP_3$ (strip)	-27.164	-1.991**
$GROUP_4$ (scrap)	37.159	1.082
$GROUP_5$ (spotted lug)	53.967	5.001**
$GROUP_6$ (torn lug)	-30.005	-3.182**

Table 2. (continued)

Variable	Estimated Coefficient	t-Statistic
GROUP$_7$(spotted leaf)	-7.946	-0.596
GROUP$_8$ (Cutters)	20.184	2.288**
GROUP$_9$(spotted primings)	-22.590	-1.752*
GROUP$_{10}$ (tips)	-18.167	-2.029**
GROUP$_{11}$(leaf)	13.009	1.433
QUALITY$_1$(choice)	-0.794	-0.149
QUALITY$_2$(fine)	-9.100	-1.853*
QUALITY$_3$ (good)	-25.468	-5.012**
QUALITY$_4$(fair)	-13.806	-1.253
COLOR$_1$ (buff)	14.642	4.362**
COLOR$_2$ (red)	-29.428	-6.083**
COLOR$_3$ (dark red)	-24.143	-1.979**
COLOR$_4$ (standard)	-24.835	-2.676**
COLOR$_5$ (off color)	-5.978	-0.644
COLOR$_6$ (off color buff)	-20.043	-2.312**
COLOR$_7$ (substd buff)	11.840	2.389**
COLOR$_8$ (tannish buff)	13.918	4.526**
COLOR$_9$ (off color tan)	-6.896	-0.938
COLOR$_{10}$ (substandard tan)	2.265	0.576

Note: Single asterisk indicates significance at 0.1 level; double asterisk indicates significance at the 0.05 level.