HEDONIC PRICES OF MALAWI TOBACCO

By

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I. INTRODUCTION

Malawi is a landlocked country in South East Africa. It is bordered by Mozambique in the east and south, Zambia in the west and Tanzania in the north. The agriculture and livestock sector is the backbone of the economy. It employs 80 percent of the economically active population and accounts for more than 35 percent of the Gross Domestic Product (GDP). The sector contributes significantly to foreign exchange earnings, generating 92 percent of the domestic export earnings in 1992 (Malawi Government, 1995).

Within the agricultural sector, tobacco is the major foreign exchange earner. On average, it accounts for over 65 percent of the total domestic export earnings. Malawi produces and exports burley, flue-cured, northern dark-fired (NDDF), oriental and sun-air cured tobaccos. All these tobacco types are grown by smallholders and estates although estates produce most of the tobacco exported. Smallholders are farmers who grow crops on communally owned land. Communal land is under the custodianship of traditional authorities. Individuals are given the rights to use the land and even pass it on to their descendants but they are not allowed to sell or use it as collateral for loans. Estates are farms that grow crops on land leased from the government. Estate farmers are allowed to make improvements to the land as they desire and may use the land as collateral for loans. The Malawi agricultural policy has in the past favored the estate sector over the smallholders in terms of pricing, production and marketing policies. This has resulted in

the neglecting of the smallholder sector and the reallocation of land from the communal (customary) tenure to leasehold tenure under which estates operate. This has subsequently led to a population pressure increase on the remaining customary land, thereby presenting the estate sector with much land and cheap labor source. New policies are currently being put in place to correct these anomalies.

Tobacco is a highly specialized crop, the value of which is particularly associated with quality. Distinctive soil characteristics, as well as climatic conditions, primarily determine the types of tobacco which may be grown and the purposes for which it would be eventually used (Davidson, 1895). Tobacco end use and production methods have changed little in the past 100 years.

Tobacco is grown throughout Malawi in one growing season which runs from November to February. It requires warm temperatures and the presence of moisture at the time of planting and some moisture and rising temperatures during the growing season and dry weather during the harvesting and curing period. Variety of seed, environmental factors such as soil structure, climatic conditions and such cultural practices as weeding, disease control and harvesting and curing techniques employed affect the quality of the tobacco leaves that are produced. Tobacco production remains one of the least mechanized among field crops. Most growers still use hand labor to plant, harvest and process the leaves.

Apart from such exogenous factors as rainfall, Sims et al (1978) write 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 note that both yield and quality may be improved by using adequate amounts of required

nutrients if they are lacking in the soil. They continue to observe that fertilizer alone will not ensure maximum profits from tobacco crops. Attention must be given to the chemical and physical characteristics of the soil used, and the crops grown in rotation with tobacco. It is desirable to select the field for tobacco 1 to 3 years prior to growing the crop. If possible, select a field with soil that has good internal drainage characteristics. A good sod will provide soil with good granular structure that tobacco roots can readily penetrate. The continuous growth of tobacco in one location often leads to deteriorated soil structure, increased danger of manganese toxicity, and increased risk from such diseases as black root rot and black shank. Thus, continuous culture of the same land for tobacco (greater than 2 or 3 years) tends to lower yields and produce lower quality leaf.

Massie and Smiley (1974) argue that producers must equally pay attention to harvesting and curing. They note that a final quality of cured tobacco is determined very largely by moisture conditions which prevail inside the tobacco barn during the curing period. 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. They continue to note that curing burley is more than just drying the leaves. One must control temperature, humidity, and air circulation in order to obtain high quality tobacco. Many fine crops are injured by improper handling, inadequate housing, and lack of control over curing conditions. Furthermore, proper harvesting and curing can improve some of the poorer crops.

In an experiment on burley tobacco curing, Pack (1955) found that high moisture causes tobacco to cure too slowly, producing red or house-burned leaf and heavy losses in weight. When tobacco stays in "brittle case", it cures too fast, causing a greenish-tinged,

mottled, or pie-bold leaf. Moisture can be controlled in burley barns fairly well through proper use of ventilators, plus careful use of heat in humid weather. Burley cures favorably when temperature inside the barn ranges between 65 to 75 Farenheit over a 24 hour period.

Pack also found that the loss of a leaf appears to be closely related to its moisture content under normal curing conditions. The deep green color remains until about 20 per cent of the original weight is lost, the yellow stage is at maximum with loss of 35 to 55 per cent, and brown pigments in considerable amount do not show until the weight has diminished to 30 to 40 per cent of original. Uniformity of color in cured leaf is influenced by drying rate in that an increase in drying results in generally more uniform color. Also as the rate of drying increases, greater amounts of green color appear, while decreasing the rate favors darker shades of brown and increased amounts of red color. The higher the position of the leaf on stock, the greater is the effect of drying rate on color. Early maturing leaves seem to withstand a rapid rate of drying without becoming excessively green. However, late maturing leaves tend to develop green colors readily when cured at a rapid drying rate.

In general, estates have better access to capital and land which enables them to better manage their tobacco crop than smallholders and they therefore, produce most the of tobacco. However, there are very few quality differences between the tobacco produced by the two sectors. The relative importance of smallholder and estate subsectors to the economy of Malawi is presented in Table 1.

Table 1. Relative Importance of Smallholder and Estate Subsectors: Selected Indicators for 1992

Subsector	Contribution to GDP	Contribution to Ag.GDP	Contribution to Exports	Agricultural Employment	Ha. Cultivated (million)
Smallholder	25%	65%	10%	90%	4.55
Estate	9%	35%	90%	10%	3.00

Source: Malawi Government (1994)

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 who are either present on the auction floors or are represented by local agents. 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 job of the starter is to approximate the price of the tobacco and mark 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.

Tobacco is used in many different forms in different countries. The most common forms are cigarettes, cigars, smoking tobacco, chewing tobacco and snuff. The Food and Agriculture Organization (FAO, 1990) estimates that cigarettes account for 75 percent of the total volume of tobacco products traded internationally. Burley tobacco is used to blend with other tobaccos in the manufacture of cigarettes. Although Malawi

produces a significant amount of tobacco, most of it is exported. The following countries are the major importers of Malawi tobacco: South Africa, Brazil, Canary Islands, Denmark, Germany, Italy Poland, Spain, the United Kingdom and the U.S. The U.S is the biggest importer of burley tobacco, purchasing over 33 percent of the burley exported. World tobacco exports and market share by country of origin are presented in Table 2.

Table 2. World Exports of Tobacco ('000) by Selected Country of Origin and Market Share per cent

Country	1974-76 (average)	1984-86 (average)	1995 (projected)
world	1063.9	1034.0	1142.0
Argentina	21.8	24.7	29.5
	2.0	2.4	2.5
Brazil	100.0	189.6	244.1
	9.3	18.3	21.4
Malawi	25.2	61.2	74.4
	2.3	5.9	6.5
Zimbabwe	71.3	95.3	130.7
	6.3	9.2	11.4
USA	159.2	111.7	218.3
	14.9	10.8	19.1

Source: Food and Agriculture Organization of the United Nations (1990).

Burley Tobacco Grading

A considerable influence on tobacco price is the consideration of quality. Although difficult to quantify, buyers often refer to a concept of "value for money" in an

attempt to account for quality. This is a relationship that assesses the quality aspect of certain tobacco and assigns it a value relative to other tobaccos. These relative values are not precise and may be unique for each buyer but provide buyers a way in which to rank tobacco from different suppliers. This ranking is not an overt process nor can the "values" be calculated. It is a continuously dynamic process as 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. As these differ substantially between tobaccos, and as they attract prices from individual varying buyers, leaf tobacco is traded on the world market at a wide range of prices (FAO, 1990).

In each auction, burley is graded into more than fifty different grades. 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.

Following Card and Minton's (1974) description, the tobacco plant does not ripen uniformly, often a few of the bottom most leaves deteriorate and slough off while the topmost leaves still are growing actively. The oldest leaves at the bottom of the plant tend to be light in color, thin in body and so tissuey that they often shatter when handled. These leaves are called "Primings" and are given the group designation P.

Further up the stalk are long leaves, a little heavier than primings but still thin enough to have good burning qualities. These are called "Lugs" and are given group designation X. They are usually the most valuable part of the plant.

The next series of leaves, called "Leaf" are given the group designation L. They form later than lugs and, therefore, are not quite as mature, and thus tend to be medium-to-heavy in body and darker in color than either lugs or primings. This leaf group makes up some 45 per cent of the crop and varies in color and body with general quality of the entire crop.

The fourth 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. Still other smaller leaves, at the top of the plant are also harvested and they are called the "Cutter" group and designated by C. Three other group designations also are used: "Mixed" M for tobacco containing two or more of the above mentioned groups. 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.

Card and Minton describe quality as the second character in the grade symbol which is given in number form (1 to 5) and relates to quality within the group and color. 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 choice or fine qualities occur in tip group.

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), S(dark red). Other color variations called substandard are (J), bleached (E), offcolor (K), running green (V) and green (G). The buff color occurs only in lugs white red and tannish red occur mainly in leaf and tips. A grade symbol of X20 would thus, represent tobacco belonging in the lug group, of fine quality and tan in color.

When grading a tobacco bale, a representative sample of the hands (a number of tobacco leaves tied together by the stalk) in the bale is drawn and a determination of the grade is made. While mixed grade bales are strongly discouraged, when they do occur, the predominant grade is the one that is chosen for the bale.

Problem Statement

Because of the major influence the characteristics of a given tobacco type have on its price, it is important for farmers, auction managers and policy makers to clearly understand how different tobacco characteristics affect the prices of its various grades. For instance, if the market is favoring tips and certain colors as opposed to leaves, the producer must harvest and cure tips in order to profit. Auction managers would benefit from knowledge of effect of lot sizes on prices and guide suppliers accordingly and policy makers may fund or guide industry into researching and producing tobacco varieties that are lower in nicotine if consumers so prefer.

Hypothesis and Objectives

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. This study focuses on price

discovery. The hypothesis of this study is that grades and the reputation of the farmer are related to the price the farmer receives. 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 grade, prices in the world markets, and reputation of the producer.

Organization of the Thesis

The rest of the thesis is organized in five chapters. The conceptual framework is in Chapter II. The data and empirical model are in chapter III. Results are discussed in chapter IV and chapter V gives the conclusions of the research.

II. HEDONIC PRICING, REPUTATION SELLING AND AUCTION THEORY

The modeling of Malawi burley tobacco auction price determination requires concepts from microeconomic, hedonic pricing, reputation selling and auction theory.

Hedonic Price Theory

Products are wanted because of the utility they provide. The utility provided depends upon the product characteristics. Hence, the total amount of utility a consumer enjoys from his purchase of products depends upon the total amounts of product characteristics purchased (Ladd and Suvannunt, 1976).

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 (Rosen, 1974). Hedonic prices are revealed by regressing the market transaction cost of a good upon its traits. The individual contribution of each trait to the aggregate good price is thus revealed through market observations (Mendelsohn, 1987).

Following Rosen , Mendelsohn summarizes the hedonic model as:

$$p(z)=G(Z) \tag{1}$$

where $p(z)$ is the marginal price gradient of the characteristic z and Z is a vector of all characteristics. The hedonic gradient represents the equilibrium prices of a competitive

affected by market demand and/or supply considerations; for example, they may change as quantities of the demanded product change. 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 and provide a means for comparing of hedonic prices at different points in time when cross section data are used (Ethridge and Davis, 1982).

Epple (1987) argues that applications of Rosen's modeling strategy have often used inappropriate estimation procedures that give rise to inconsistent estimates of parameters of demand and supply functions. He notes that equilibrium conditions in hedonic models impose restrictions on the relationships among measured variables and random components. Some seemingly natural specifications of the stochastic structure of hedonic models prove to be incompatible with these equilibrium conditions. By carefully specifying sources of error and orthogonality conditions, it is possible to obtain stochastic structures that are compatible with the equilibrium conditions that permit identifying and estimating of the parameters in the model. The requisite orthogonality conditions prove to be relatively strong. For these conditions to be satisfied in practice, one must measure a relatively exhaustive set of product, demander and supplier characteristics. If important characteristics are unmeasured and they are correlated with measured characteristics, these coefficients on measured characteristics will be biased. This study seeks to measure an exhaustive set of product characteristics of tobacco.

Hedonic prices analyses have been used for tea (Ardiansyah, 1993), apples and wheat (Espinosa and Goodwin, 1982), apples (Stephens, 1990), urban air quality (Murdoch and Thayer, 1988), rice (Brorsen, Grant, and Rister, 1984), barley (Wilson,

1984) and cotton lint (Ethridge and Davis, 1982), but hedonic price analysis for burley tobacco has not been published.

Reputation Selling Theory.

Why do reputations matter? Because perfection and completeness are rarely achieved in competitive markets and information flows. In agriculture, a homogenous product is assumed. But traders, processors, and producers know that differences in quality are important in value. In fact, the current trend in agribusiness is toward branded, differentiated products (Turner, McKissick and Dykes, 1993). Reputations are simply another form of product differentiation.

Shapiro (1983) states that a firm which has a good reputation owns a valuable asset. This is often referred to as the "goodwill" value of the firm brand name or loyal customer patronage. He then demonstrates that the idea of reputation makes sense only in an imperfect information world.

A firm has a good reputation if consumers believe its products to be of high quality. If product attributes were perfectly observable prior to purchase, then the previous production of high quality products would not enter into consumer evaluations of firm product quality. Instead, quality beliefs would be derived solely from inspection (Shapiro).

Shapiro also argues that reputation needs to be built gradually and need not carry market power nor barriers to entry although there are costs incurred when building it. He notes that reputation can operate only imperfectly as a mechanism for assuring quality.

High quality items sell for a premium above cost. The premium provides a flow of profits that compensate the seller for the resources expended in building up reputation.

Auction Theory.

An auction is a market institution with an explicit set of rules determining resource allocation and prices on the basis of bids from the market participants (McAfee and McMillan, 1987).

In principle the auctioneer acts on behalf of the seller, but the auction house typically receives compensation from both the buyer and the seller for items that are sold. The buyer *premium* is a percentage of the sale price paid to the auctioneer by the buyer. In most auction houses the buyer *premium* is 10% of the sale price, and the amount is generally not negotiable. The seller *commission* is a percentage of the sale price paid to the auctioneer by the seller. If an item goes unsold, the auctioneer will receive neither buyer premium nor seller commission. To make sure the sellers bear some cost of auctioning but not selling an item, auctioneers usually charge the seller a fee on unsold items (Ashenfelter,1989).

McAfee and McMillan identify four types of auctions: the English auction (also called the oral; open, or ascending-bid auction); the Dutch auction (or descending-bid auction); the sealed-bid auction; and the second-price sealed (or Vickrey) auction.

The English auction form is the most commonly used for selling goods and the Malawi tobacco is sold through this auction form. Milgrom (1979) describes the English auction as an auction type where an auctioneer begins with the lowest acceptable price -

the reserve price- and proceeds to solicit successively higher bids from customers until no one will increase the bid. Then the item is "knocked down" (sold) to the highest bidder. Milgrom then demonstrates that the bidders' dominant strategy in an English auction is to bid until the price exceeds his willingness to pay. That is, at equilibrium, the item will be awarded to the bidder who values it most highly for a price equal to the second highest valuation.

Once an item has been "knocked down" it does not necessarily mean that a sale has been made. As Ashenfelter (1989) observes, the seller will generally set a "reserve price" and if the bidding does not reach this level, the item will go unsold. Auctioneers say that an unsold item has been "bought in" (a somewhat misleading terminology since unsold items are rarely, if ever, bought by the auction house). An item that has been bought in may be put up for sale at a later auction, sold elsewhere, or taken off the market. In tobacco auctions in Malawi, sellers or their representatives sometimes withdraw some lots of tobacco when they are not satisfied with the price offered by buyers. The sellers are allowed to put up the tobacco for sale at a later date but they must declare to the auction house that the said lot is a reoffer otherwise the whole lot is withdrawn and never allowed in the auction house again. This is done to discourage dishonesty in lot declaration among producers.

Which type of auction a seller chooses depends on several factors including type of product being sold and availability of the different auction types. Both McAfee and McMillan and Milgrom agree that generally there are very little differences among the auction types with regard to how much yield a seller gets. However, both studies seem to agree also that the English auction form is the most popular and, that under fixed-quantity

environments, it generates more receipts on average than the Dutch/sealed-bids, it leads to efficient outcomes in a wider range of environments and it economizes on information gathering and bid preparation.

III. DATA AND THE EMPIRICAL MODEL

Data

Data from 56 tobacco auctions held from April through September 1995 at Limbe Auction Floors are used. The data were obtained from two smallholder and four estate burley tobacco producers from four districts of southern Malawi. The data sources were selected because they had complete data spanning the entire 1995 tobacco auction season and because they represent all three categories of tobacco producers. In total, 415 lots are used. The data are from the auction managers' records.

The data are described by company of origin, area where the tobacco is grown, lot number, sale number, date, grade; which is represented by a letter representing tobacco group, a number representing quality and a letter representing tobacco color, 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.

The United States all tobacco products producer price index is used to proxy United States tobacco prices and was obtained from various issues of the United States Department of Agriculture *Tobacco Situation Outlook.*

Empirical Model

The model reported in this study is estimated by a linear functional form. A log linear form was also estimated but the results were not very different from the linear form. The linear form imposes a restriction that the premiums and discounts are constant in cents per kilogram and the parameters indicate change in price (in cents) given a one unit change an the independent variable.

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

$$3)\ P_{tk} = \alpha + \sum_{i=1}^{12} \delta_i GROUP_{itk} + \sum_{j=1}^{11} \gamma_j COLOR_{jtk} + \sum_{n=1}^{5} \lambda_n QUALITY_{ntk} + \sum_{m=1}^{6} \varphi_m COMPANY_{mtk} +$$

$$\sum_{g=1}^{6} \omega_g MONTH_{gtk} + \beta_1 USPPI_t + \beta_2 LOT_{tk} + e_{tk}$$

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 is the United States all tobacco products producer price index.

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

e_{tk} is the error term.

The hypotheses are:

1. Burley tobacco characteristics as measured by grade influence the price paid for a given lot tobacco.
2. Producer reputation influences the price received at the auction above and beyond factors the factors measured by grade variables.
3. The month when the tobacco is brought to the market influences the price received either upwards or downwards.

4 Lot size is positively related to the price of tobacco.

5 Price of tobacco in Malawi is positively related to prices in other world markets.

The model was analyzed using the SHAZAM econometric software package. To estimate the model, one of the variables in each of the group, color quality producing company and 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), producing company, *COMPANY*A (company A, Mavuto estate).

The model was first estimated using ordinary least squares (OLS). The R^2 was 0.50 and the log of the likelihood function coefficient was -22.59 The Jacque-Bera

asymptotic normality test had a chi-square of 2.6462 with 2 degrees of freedom which indicates that the errors terms in model are normally distributed. The R^2 is rather low when compared with comparable studies. This shows that there is still a lot of variation in tobacco price which the current grading system does not capture. The "diagnos het" command was used to test for the presence of heteroskedasticity and the test showed that there was heteroskedasticity as indicated by the Harvey test with a chi-square of 3804.027. To correct for it, the model was re-estimated using Harvey's method. Harvey's method generates weights for error terms of the original OLS. If the error terms are weighted differently, the diagonal elements of the variance-covariance matrix should show constant variance, and no nonzero off diagonal elements.

IV. RESULTS

Descriptive statistics for the data are presented in Table 3 and estimates of equation 3 are in appendix Table 4. The joint test of the 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 not significant is rejected as shown by the Wald chi-square statistic of 34.932. 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 base dummies for group, quality and color are *GROUP*0 (no group assigned), *QUALITY*0 (quality 0), and *COLOR*0 (color 0) respectively.

The joint test of the null hypothesis that group (H_0: all δ are zero) is not significant is rejected as shown by the Wald chi-square statistic of 81.617. Group does provide buyers with useful information that influences price of tobacco at the auction. Positive coefficients are observed for groups X(lugs), XA (mixture of lug and strips) and B (scraps) suggesting that premiums are paid for them while groups P (priming), XT (mixture of lug and tips), A(strips) and LA (mixture of leaf and strips) have negative coefficients suggesting that discounts are paid for them. Premiums for lugs and mixtures containing lugs are expectetd since lugs are the most valuable part of the tobacco plant.

Table 3. 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	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 3. (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
GROUP0	0.07	0.270	If tobacco lot is from group 0, zero otherwise
GROUPP	0.13	0.330	If tobacco lot is from group 0, zero otherwise
GROUPX	0.13	0.331	If tobacco lot is from group 0, zero otherwise
GROUPC	0.07	0.246	If tobacco lot is from group 0, zero otherwise

Table 3. (continued)

Variable	Means	Standard Deviation	Description
GROUPL	0.28	0.452	If tobacco lot is from group L, zero otherwise
GROUPT	0.28	0.449	If tobacco lot is from group T, zero otherwise
GROUPA	0.002	0.145	If tobacco lot is from group A, zero otherwise
GROUPB	0.01	0.069	If tobacco lot is from group B, zero otherwise
GROUPPA	0.002	0.049	If tobacco lot is from group PA, zero otherwise
GROUPXA	0.002	0.049	If tobacco lot is from group XA, zero otherwise
GROUPLA	0.02	0.002	If tobacco lot is from group LA, zero otherwise
QUALITY1	0.07	0.07	If tobacco lot has quality1, zero otherwise
QUALITY2	0.34	0.34	If tobacco lot has quality2, zero otherwise
QUALITY3	0.48	0.48	If tobacco lot has quality3, zero otherwise

Table 3. (continued)

Variable	Means	Standard Deviation	Description
QUALITY4	0.02	0.02	If tobacco lot has quality 4, zero otherwise
COLOR L (buff)	0.24	0.42	If tobacco lot has color L, zero otherwise
COLOR R (red)	0.002	0.04	If tobacco lot has color L, zero otherwise
COLOR S (dark red)	0.06	0.23	If tobacco lot has color L, zero otherwise
COLOR J (standard)	0.014	0.119	If tobacco lot has color L, zero otherwise
COLOR K (off color)	0.012	0.109	If tobacco lot has color L, zero otherwise
COLOR LK (off color buff)	0.012	0.109	If tobacco lot has color L, zero otherwise
COLOR LJ (standard buff)	0.07	0.27	If tobacco lot has color L, zero otherwise
COLOR LO (tan buff)	0.002	0.049	If tobacco lot has color L, zero otherwise
COLOR OK (off color tan)	0.045	0.20	If tobacco lot has color L, zero otherwise
COLOR OJ (standard tan)	0.002	0.049	If tobacco lot has color L

Table 4. Parameter Estimates for the Hedonic Price Equation for Malawi Burley tobacco

Variable	Estimated Coefficient	t-Statistic
CONNSTANT	98.108	381.000
LOT	0.13933	1.585
USPPI	-41.333	-0.737
COMPANY 2	0.13424	2.598**
COMPANY 3	0.11320	0.971
COMPANY 4	- 0.6250E-01	-1.281
COMPANY 5	0.24877E-01	0.278
COMPANY 6	0.43741E-01	0.836
MAY	0.15765	-2.138**
JUNE	- 8.40640E-02	-1.017
JULY	- 0.27772	-2.683**
AUGUST	- 1.92660E-02	-0.155
SEPTEMBER	- 0.1402	-0.757
GROUPP (priming)	- 0.14864	-2.926**
GROUPX (lug)	0.67216E-01	1.723*
GROUPA (strip)	- 0.33118	-5.117**
GROUPB (scrap)	0.2936	0.550
GROUPXA (lug strip)	0.59178	4.757
GROUPXB (lug scrap)	- 0.25765	-2.199

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

Table 4. (continued)

Variable	Estimated Coefficient	t-Statistic
GROUPLA	-.0.26348	-1.474
QUALITY1	0.16724	1.215
QUALITY2	9.46370E-02	0.7251
QUALITY3	-1.13440E-02	-8.6550E-01
QUALITY4	6.54960E-02	0.4155
COLOR L (buff)	0.16301	4.301**
COLOR R (red)	-6.05710E-02	-0.5324
COLOR S (dark red)	0.10444	0.7267
COLOR J (standard)	-1.30980E-02	-0.1019
COLOR K (off color)	0.11127	1.498
COLOR LK (off color buff)	-0.12825	-1.21**
COLOR LJ (standard buff)	0.14965	2.73**
COLOR LO (tan buff)	0.29962	2.724**
COLOR OK (off color tan)	-0.30375	-6.142
COLOR OJ (standard tan)	0.15272	1.373

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

The positive premiums received for scraps however is surprising as these are really poorer leaves which did not make it into any identifiable group. Primings (P), strips (A) and scrap (B) were all significant at 5 per cent level base. Both primings and scraps receive discounts. This is expected since primings are the bottom most leaves and oldest on the stalks and are the first to be harvested so they do not have as much desirable characteristics as leaf and lugs. Strips receive discounts because the are a poorer quality leaf.

The joint test of the null hypothesis that quality characteristic of the group (H_0: all λ are zero) is not significant is rejected as shown by the Wald chi-square statistic of 21.229 Quality of the tobacco group provides important information to buyers. Qualities (1) choice, (2) fine and (4) fair have positive coefficients and therefore receive premiums while quality (3) good has a negative coefficient and thus receives a discount. This result is surprising as one would expect a 'good' quality to receive a premium over a 'fair' quality. None of the quality coefficients is significant at five percent level. This reflects the difficulty of categorizing or defining tobacco into a set of quality differences especially if the said differences must be based on such elements of tobacco as leaf smoothness, maturity, body, texture, injury, finish and uniformity. Quality is perhaps the most subjectively determined characteristic of a grade classification of tobacco. Compared to the premiums and or discounts received among the various grade components, quality receives the least.

The joint test of the null hypothesis that color (H_0: all γ are zero) is not significant is rejected as shown by the Wald chi-square statistic of 82.775. Colors L (buff), S(dark red), J (substandard), K (off color), LJ (substandard buff), LO (buff tan)

and OJ (Substandard tan) have positive coefficients , indicating that premiums are received for them with the most premium paid for color LO. Colors R (red), S (dark red), LK (off color buff) and OK (off color tan) receive discounts. Buff color (L), substandard buff (LJ), off color buff (LO) receive premiums and are significant at 5 per cent level. This is as expected since buff color occurs only in lug group of tobacco which happens to be the most valuable part of tobacco. The mixture of tan and off color (OK) is significant but receives a discount. Tan color often occurs in leaf and tip..

Joint test for the company of origin is significant at five percent level. This is shown by the Wald chi-square statistic of 20.343 The model considered four groups of companies categorized by their production quotas per year. Companies 4 (Nkhalamba Estate) and 2 (Mavuto Estate) are categorized as large with a quota 100,000 kg and above, companies 1 (Liwanjalo Estate)and 6 (Chalimba Estate) are categorized as medium with a production quota of 50-100,000 and companies 3 (Limbanazo Farm) 5 (Nkachelenga Farm)are categorized as small holders with a production quota of between 5,000-50,000 kg. Only company 2 (Mavuto Estate), a large company significantly affects prices received. The rest of the companies are not significantly different from base (company 1, Liwanjalo Estate).

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

The lot size coefficient is positive but not significant. Indicating that larger lots receive higher prices than smaller lots. The possible explanation for this preference by buyers could be that larger lots 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, although not significant, coefficient, suggesting that prices received for tobacco in Malawi are inversely related to tobacco prices in the United States. This is supported by the United States Department of Agriculture (1995) who note that United States leaf exports for 1995/96 season may decline because of competition from countries such as Brazil, Zimbabwe, and Malawi.

V. 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 with existing systems.

The general hypotheses of the thesis is that variation in prices received for tobacco at the auction can be explained by tobacco grades, company of origin, and prices in other markets. The hypotheses are tested using data from six producers who sold their tobacco at Limbe auction floors during the 1995 and 1996 season. The general hypotheses are supported.

The results suggest that company of origin, month of auction, lot size and grade components (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. Cigarette manufacturers rarely change their blending techniques. Using a study like this one with data covering several seasons, one can pick out a pattern of which group, color and type factors buyers are seeking. This information can then be passed on to producers through extension advice on cultural and curing techniques. Thus way, producers would produce the most desired by the market. Producers also do have control over color through processing and at what stage they

harvest the tobacco leaf , how long and at what temperatures the process takes place and through storage. Knowing which colors are receiving premiums may help producers to adjust their processing techniques accordingly.

None of the degrees of quality are significant and quality as a characteristic receives the least premium/discounts among grade components. This reflects both the difficulty of placing leaf tobacco into a set of finite qualities as well as the need for the industry to come up with a better definition of quality. The result has demonstrated the need to refine this characteristic of tobacco group since in its present form it does not provide any meaningful information.

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 color picture and a way to sense 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 and management practices

Limitations and Suggestions for Future Research

The time series data used in the study are short, they only cover one season and come from only six producers and one area of the country. The relatively short period of the data used, the small number of producers used may affect the results of the model. In future, the data set should be expanded, more producers added and more than one area covered in order to improve the results.

References

Ardiansyah, M. "Hedonic Prices of Indonesian Tea." Unpublished M.S. thesis, Oklahoma State University, 1993.

Ashenfelter, O. "How Auctions Work for Wine and Art." *Journal of Economic Perspectives* 3(3) (Summer 1989): 23-36.

Brorsen, B.W., W., W.R. Grant, and M. E. Rister. "A Hedonic Price Model for Rough Rice Bid/Acceptance Markets." *American Journal of Agricultural Economics* 66 (May 1984) : 156-163.

Card, Dana G. and Willard H. Minton. "An Index of General Quality of Burley Tobacco." Kentucky Agricultural Experiment Station, Lexington, KY, Research Report 19: (April, 1974).

Davidson Robert J. "The Analyses of Different Grades of Manufacturing Tobacco." Virginia Agricultural and Mechanical College Agricultural Experiment Station Bulletin 51. (1895): 57-62.

Djunaidi, H., D.S. Tilley, and Brorsen, B.W. "Statistical Analysis for Management Information Systems: An Indonesian Cocoa Exports Example." *Jurnal Manajemen Prasetiya Mulya* 1(2) (1994): 43-50

Espinosa, J.A., and B.K. Goodwin. "Hedonic Price Estimation for Kansas Wheat Characteristics." *Western Journal of Agricultural Economics* 7 (December 1982):293-300.

Ethridge, Don E., and Bob Davis. "Hedonic Price Estimation for Commodities: An Application to Cotton." *Western Journal of Agricultural Economics* 7. (December 1982): 293-299.

Epple, D. " Hedonic Prices and Implicit Markets: Estimating Demand and Supply Functions for Differentiated Products." *Journal of Political Economy* 95 ((January 1987): 58-79.

Food and Agriculture Organization of the United Nations. " Tobacco: Supply, Demand and Trade Projections, 1995 and 2,000." *F.A.O. Economic and Social Development Paper* 86, Rome, (1990).

Ladd, G. W., and V. Suvannunt. " A Model of Consumer Good Characteristics." *American Journal of Agricultural Economics* 58 (August 1976): 504-510.

Lucas, R.E.B. " Hedonic Price Functions." *Economic Inquiry* 13 (June 1975): 157-178.

McAfee, Preston R., and John McMillan. "Auctions and Bidding." *Journal of Economic Literature* 35 (June 1987): 699-738.

Massie Ira E and Jones H. Smiley. "Harvesting and Curing Tobacco." University of Kentucky College of Agriculture Extension Service. AGR-14 (1974)

Malawi, Government of. Agricultural Sector Memorandum: Strategy Options in the 1990s, Vol 2: Main Report, Lilongwe, Malawi. (June 1994).

Malawi, Government of, "Agriculture and Livestock Sector Strategy Document." Ministry of Agriculture and Livestock Development, Lilongwe. 1995.

Mendelsohn, Robert. "A Review of Identification of Hedonic Supply and Demand Functions." Growth and Change 18 (1987): 82-91

Milgrom, Paul R. "A Convergence Theorem for Competitive Bidding with Differential

Information." Econometrica 47 (May 1979): 679-88.

Murdoch, J.C., and Thayer, M.A. "Hedonic Price Estimation of Variable Urban Air Quality." *Journal of Environmental Economics and Management* 15 (June 1988):143-146.

Pack, Boyd A. "The Influence of Drying Rate During Curing on Physical Properties and Quality of Shade-Grown Tobacco" *Connecticut Agricultural Experiment Station Bulletin* 599, (June 1955):110-128.

Rosen, S. "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition." *Journal of Political Economy* 82 (Jan./Feb. 1974):34-55

Shapiro, C. " Premiums for High Quality Products as Returns to Reputations." *Quarterly Journal of Economics* 98 (November 1983): 659-679.

Stephens, L.V. "A Hedonic Price Model for the National Apple Market Implications for Arizona Apple Growers." M.S. Thesis, The University of Arizona, 1990.

Sims, J.L., W. O. Atkinson, and H.F.Miller "Fertilizing Tobacco." University of Kentucky College of Agriculture Extension Service. AGR-49 (July, 1978).

Turner, Steven C., John McKissick and Nancy S. Dykes." Reputation Selling in Feeder Cattle Teleauctions." *Review of Agricultural Economics* 15 (January 1993): 7-19.

United States Department of Agriculture "Tobacco Situation Outlook Report." Economic Research Service, *TBS-231*, (June, 1995).

White Kenneth J. *SHAZAM User's Reference Manual* Ronalds Printing, 1993, ISBN 0-07-069862-7

Wilson, W. W. "Hedonic Prices in the Malting Barley Market." *Western Journal of*

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