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A hedonic analysis of Bursa's Black Fig bid prices and product quality characteristics in Turkey

S. Turhan [1], M. Nargeleçekenler [2]* and B. Cetin [1]

[1] Uludag University, Faculty of Agriculture, Department of Agricultural Economics, 16059 Gorukle Bursa, Turkey. [2] Uludag University, Faculty of Economics and Administration Department of Econometrics, 16059 Gorukle Bursa, Turkey.
**e-mail: mnargele@uludag.edu.tr*

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Abstract

This paper quantitatively analyzed the relationship between Bursa's Black Figs characteristics and prices. Most of production comes from the Aegean Region, which is located in the western part of the country. In Turkey, fig trees are common in all of the coastal areas; however, the climatic conditions especially during the fruit maturation and drying period limit the production of dried figs on commercial basis. With the research on hedonic price theory serving as background, this study shows that bid prices for Bursa's Black Figs in Turkey are very associated with color, hull, and splotch, overripe and unripe. Bursa's Black Fig is inversely related with the prices producers get at the packers. A one percent reduction in overripe and unripe (ceteris paribus) would decrease Bursa's Black Fig price of by about 19 cents at the packers. It is an interesting result that the effects of overripe and unripe variables on price are almost the same. A negative relation has been determined between the hull and splotch variables and price. Namely, one percent increase in hull and splotch (ceteris paribus) would decrease Bursa's Black Fig price of by about 25 and 67 cents, respectively, at the packers. Color percentage is positively related with prices. One percent increase in color (ceteris paribus) will increase its price by $1.08. The results are consistent with theory, and it is concluded that increased buyer concentration favors growers, due to a special product. In addition, the study provides information for marketing, accounting and buyer decisions.

Key words: Quality attributes, Bursa's Black Fig, hedonic analysis, Turkey.

Introduction

In Turkey, fig production's contribution to the country's economy increases every year. Figs also have an important status in country's fruit exports. Figs are 5th or 6th among the exported agricultural products of Turkey. Also Turkey is the leading country in fig production and trade worldwide. According to 2006 FAO data, Turkey's total value of fig exports is $18 million and production amount is 380,000 MT [1]. Most of production comes from the Aegean Region, which is located in the western part of the country. In Turkey, fig trees are common in all of the coastal areas; however, the climatic conditions prevail especially during the fruit maturation and drying period limits the production of dried figs on commercial basis. Due to the high humidity levels, it neither may nor be possible to get sound and intact fresh fruits in some crack-susceptible varieties. Among fig varieties, there is a significant variation in terms of crack resistance; therefore, the right selection of the variety will ensure a good crop in coastal areas.

There are two types of figs that are preferable and that have the highest quality. One of them is the fig varieties that are advised to be used in gardens and the other is the black fig, which is produced in Bursa Region of Turkey.Among black figs the most demanded an exported one is the Bursa Black Fig, which grows in Bursa and has purple and black color. According to data of Bursa region in 2006, the production value of black fig is 75% and its exporting ratio is 78% [2]. Bursa Black Fig has the highest quality in the world and it is not hard to understand why there is a very high demand for this fig. Its distinctive features include amazing taste, hard flesh structure, black color, long storage life as well as its alluring shape and size. There is no pesticides used during the growth of Bursa's Black Fig; therefore its safety level is very high. Quality of the fruit is controlled with EUREPGAP standards through private institution from the very first stage of the production to the exportation.

Hedonic models have been used to derive implicit values of product characteristics for an array of agricultural products, including grapes [3], wine [4-6], swine [7] and tomatoes [8]. Previous applications of hedonic pricing deal with to attributes embodied in agricultural products. Brorsen *et al.* [9] used a hedonic model to investigate the factors affecting acceptance of a rough rice bid, and Carew [10] used a hedonic model relating apple prices to the quality and market characteristics of apples, which is important for packers and marketers. Brown and Ethridge [11] present appropriate specific functional form for daily cotton prices as many other studies in this area.

The hedonic pricing of Bursa's Black Fig in Turkey is based partly on grades that established by the buyers. Grades are influenced by color, hull, and splotch, overripe and unripe. In addition to grades, hedonic prices are also influenced by other characteristics, including cultivar and fruit size. These quality characteristics have become very crucial over the years because of the great number of Bursa's Black Fig cultivars in the bid marketplace and because of buyers' desire to seek unique traits

that are profitable to merchandise.

Table 1 shows the levels and product external characteristics of the packers firm, applicable to Bursa's Black Fig. These quality properties commonly accept by buyers and packers, which classify three different grades.

Table 1. Grades and characteristics of Bursa's Black Fig.

Quality Attributes	Grade 1 (18-22)*	Grade 2 (23-25)*	Grade 3 (26-28)*
Color	90-100	89-70	69-
Hull	3-8	9-20	21-
Splotch	3-10	11-30	31-
Overripe	3-20	21-50	51-
Unripe	5-10	11-20	21-

Rosen [12] proposed the hedonic method to empirically determine the implicit price of objectively measured characteristics that - when considered collectively - completely describe a market product. Product characteristics are not the only factors that influence price. Outside influences such as supply and demand conditions - in different periods or locations- may also be important. The technique has also been used to examine the appropriateness of food grading systems. Since Bursa's Black Fig quality is graded on a subset of characteristics that varies by company and is measured by both buyers and sellers, the hedonic technique is particularly appropriate for this product.

The purpose of this paper is to determine which characteristics of Bursa Black Fig can be used to explain the variation in price bids observed in its market, in Bursa province of Turkey. This paper develops a framework to analyze quality differentials for Bursa's Black Fig prices observed in bid markets. Empirical model of price characteristics are presented in the following section.

Materials and Methods

Data were obtained from Bursa in Turkey. It is one of the top actors that determine fig price at country level and has 700 growers. They collected data from the Caglayan and Dundar markets, recording bid prices Bursa's Black Fig and the quality or characteristics of the Bursa's Black Fig. The data were collected at the end of June and middle of September.

The hedonic technique can provide unique and important information for a variety of uses. A hedonic price function is a regression of the observed price of a commodity against its quality attributes [13]. The underlying assumption is that goods are valued for their utility-bearing characteristics and prices of goods vary with the specific amounts of each characteristic the goods contain. Typically, estimated hedonic price functions identify neither demand nor supply functions [12]. In this study of bid markets, demand can be identified. So, both observed prices and implicit prices of embodied attributes may be affected by aggregate demand conditions. The bid price can be viewed as representing demand. Demand is estimated by including the bid price as the dependent variable. Hedonic price functions are regressions of the form [13]:

$$P_i = P(Z_{i1}, ..., Z_{ij}, u_i), \quad (1)$$

where P_i the observed price of commodity i, Z_{ij}, j=1,……., J measures the amount of some "intrinsic quality" per unit of commodity i, which the variables are defined in Table 2 and u_i is a disturbance term jointly determined by supply and demand conditions. In order to estimate the hedonic equation, a functional form needs to be specified. Unfortunately, economic theory does not specify a correct functional form for hedonic equations. The specific form of equation 2 can be linear or log-linear [14]. The MacKinnon-White-Davidson (MWD) test was adopted for the study since it best captured the relationship between bid prices and the quality characteristics. The hypothesis test to determine the "best" functional form to use for empirical analysis indicated that the linear model only achieved. Contrary to our expectations, the linear form proved to be the most effective way to specify the model: linear, then the implied price function is constant. Evaluating $P_i(Z_i) = \partial P_i/\partial Z_i$ at observed characteristic levels generates the implicit price of each characteristic. These prices are frequently referred to as marginal implicit prices (MIPs) [12]. The advantage of the linear functional form is that the parameters are directly interpretable [15]. Consequently; we choose the linear form,

$$P_i = \alpha + \beta_1 Z_1 + \beta_2 Z_2 + \beta_3 Z_3 + \beta_4 Z_4 + \beta_5 Z_5 + \upsilon_i \quad (2)$$

Z_i (i = 1, 2, 3, 4, 5) represents the quality characteristics, which are the independent variables in the model, i.e. represents color, hull, splotch, overripe, unripe, respectively. α and β, (i = 1, 2, 3, 4, 5) represent the coefficients that are going to be estimated and υ is the random error.

Summary statistics of the data are provided in Table 2. Average Bursa's Black Fig price was $2.68. Prices ranged from $2.87 to $2.07. The Bursa's Black Fig demanding buyers may prefer to pay more to higher quality products than the lower quality products. The high grade profile is due to willing to export. Hence, seventy-three percent of the Bursa's Black Fig sold grades number one. Similarly, average quality properties confirms demanding grade by buyers (Table 2).

Table 2. Descriptions, grade definitions and average quality of each characteristic.

Variable	Description	Expected Sign	Units	Grade		Mean	Std.
				Max.	Min.	Quality	Dev.
	Price		$	2.87	2.07	2.68	0.12
Z1	Color	+	%	1.00	0.40	0.88	0.07
Z2	Hull	+	%	0.42	0.01	0.07	0.05
Z3	Splotch	-	%	0.09	0.01	0.04	0.02
Z4	Overripe	-	%	0.90	0.01	0.11	0.14
Z5	Unripe	-	%	0.80	0.01	0.09	0.08

Results

Following the hedonic price model [13], observed prices of Bursa's Black Fig are regressed on variables that represent characteristics of products and price level. The dependent variable is U.S. dollar price per kg, where the price is based on the wholesales and transport. The characteristics include color (Z1), hull (Z2), splotch (Z3), overripe (Z4), unripe (Z5).

The first empirical test is the MWD test. MWD test consists of 2 stages. In the first stage, the hypothesis of logarithmic model versus the null hypothesis of linear model is being tested. In the second stage, the hull hypothesis of logarithmic model versus the hypothesis of linear model is being tested. For further detail in MWD see Gujarati [14]. The result of the MWD test is given in Table 3.

Table 3. MWD test results.

Model Tips	Hypotheses	New Variable	Coefficient	Std. Error	t-Statistic	Prob.
Linear Model	H_0: linear model is valid H_1: logarithmic model is valid	NV1	0.767446	0.536812	1.429635	0.1533
Logarithmic Model	H_0: logarithmic model is valid H_1: linear model is valid	NV2	-0.516478	0.071020	-7.272242	0.0000

H_0 hypothesis is rejected since the NV1 variable added in the first row in Table 3 is statistically not significant. Thus, we conclude that the linear model is the right form. H_0 hypothesis is rejected on the other hand since the NV' variable in the second row of Table 3 is statistically significant. This result shows that linear model is applicable.

When the results of the two alternative models estimated for the MWD test, it is concluded that the tight model is supposed to be the linear model. Thus, the hypothesis test to determine the "best" functional form to use for empirical analysis indicated that the linear model is the only applicable one. Table 4 provides coefficients for the ordinary least squares model of the hedonic price function.

Table 4. Estimation of results of hedonic model.

Variables	Descriptions	Coefficients	Std. Errors	t-statistics	Prob.
α	Constant	1.803	0.050	36.051	0.000
Z1	Color	1.078	0.055	19.567	0.000
Z2	Hull	-0.247	0.067	-3.667	0.000
Z3	Splotch	-0.673	0.154	-4.352	0.000
Z4	Overripe	-0.192	0.027	-7.151	0.000
Z5	Unripe	-0.187	0.046	-4.044	0.000

There are some econometric problems in Table 4. The first problem is the existence of autocorrelation. The results of the diagnostic test are given in Table 5.

The cross-section nature of the data suggests potential problems of heteroskedastic errors, and degrading collinearity. Similarly, serial correlation, a common problem in the analysis of regression, would invalidate the assumptions of the classical linear regression model and make OLS estimates inefficient, which are consistent.

We test the regression equation for heteroscedasticity using White's General Heteroscedasticity [16] and Glejser tests. The estimated x^2 values are significant at 0.01 significance levels. Hence, we can reject the null hypothesis of homoscedasticity. We also analyzed the residuals of the estimated models to detect the possible presence of serial correlation. The Durbin–Watson test, which is appropriate when there is no lagged dependent variable, was used for model. The null hypothesis of non-autocorrelation was not rejected at the 0.01 level for model. Multiplicative heteroskedasticity and autocorrelation problems are corrected by using the Newey-West HAC correction procedure. In addition, we tested for the multicollinearity problem. The analysis was carried out by means of auxiliary regressions to assess the extent of the collinearity problem. As per the Klien's rule, we found all the auxiliary R^2 values much lower than the overall R^2 confirming absence of multicollinearity. The auxiliary regressions clearly indicate that is not collinearity. Degrading collinearity was not identified as a problem.

According to base on the t-test, F-test and the R^2 values above, we can conclude that the hedonic price function gives good and realistic results.

The t-statistics on the estimated coefficients tend to be quite large. Five variables in the model are significant at 5% level, implying a high level of confidence of the coefficients. The coefficients represent the direct effect of the characteristics on the price of the Bursa's Black Fig that is the marginal value of characteristics. Results indicate Bursa's Black Fig quality characteristics have a significant impact on the prices by buyers in bid markets. The expected signs were obtained for all of the significant coefficients, which is consistent with the estimation of the hedonic regression of equation.

Bursa's Black Fig attributes such as actual color, hull, splotch, overripe and unripe percentages area had significant impact on the implicit Bursa's Black Fig price. From an examination of the regression coefficients or estimated marginal implicit price of Bursa's Black Fig with respect to the Bursa's Black Fig attributes (Table 6), it is found that overripe and unripe in Bursa's Black Fig is inversely related with the prices producers get at the packers. A one percent reduction in overripe and unripe (ceteris paribus) would decrease Bursa's Black Fig price of by about 19 cents at the packers. It is an interesting result that the effects of overripe and unripe variables on prices are almost the same. A negative relation has been determined between the hull and splotch variables and price. Namely, one percent increase in hull and splotch (ceteris paribus) would decrease Bursa's Black Fig price of by about 25 and 67 cents, respectively, at the packers. Color percentage is positively related with prices. One percent increase in color (ceteris paribus) will increase its price by $1.08. If the sizes of the coefficients are meaningful, then color percentage, hull, overripe and unripe seemed to have the most impact on prices received at the packers. Splotch, although significant at 0.05, which is inversely related with the prices producers.

This model of 700 observations on Bursa's Black Fig bid prices explains 41% of the variation in prices, as given by the $\overline{R}^2$. This value looks a little bit low, but for cross sectional data like in this study is quite normal. By using *F*-test, we test the overall significance of the regression and found that the computed F value is very high and statistically significant at 1% level. It means that not all slope coefficients in this regression are simultaneously zero. Hence, we reject the null hypothesis.

Table 5. Diagnostics tests for regression model.

Diagnostics	Test	Values
Coefficient of Determination	Adjusted R^2	0.4101
Overall Significance	F-statistics	98.350 [a]
Multicollinearity	Klien's Rule	$R^2_{Z1} = 0.024$, $R^2_{Z2} = 0.022$ $R^2_{Z3} = 0.023$, $R^2_{Z4} = 0.018$ $R^2_{Z5} = 0.018$
Heteroscedasticity	Glejser t-statistics	$t_{Z1} = 18.673$ [a], $t_{Z2} = -0.990$ $t_{Z3} = -4.188$ [a], $t_{Z4} = -4.854$ [a] $t_{Z5} = -4.765$
	White's General Het.	209.433 [a]
Autocorrelation	Durbin-Watson	1.101 [a]

[a] Significant at 1%.

Table 6. Robust estimation of results of hedonic model.

Variables	Descriptions	Coefficients	Robust Std. Errors	t-statistics	Prob.
α	Constant	1.803	0.093	19.473	0.000
Z1	Color	1.078	0.102	10.528	0.000
Z2	Hull	-0.247	0.124	-1.985	0.047
Z3	Splotch	-0.673	0.173	-3.890	0.000
Z4	Overripe	-0.192	0.034	-5.573	0.000
Z5	Unripe	-0.187	0.045	-4.160	0.000

Discussion and Conclusions

The hedonic pricing technique was used to make explicit the impact of implicit Bursa's Black Fig characteristics. Product external characteristics considered include color, hull, splotch, overripe, and unripe, while marketing attributes is packaging and quality certificate. The study concludes that color is the principal characteristics positively influencing fig prices, with hull, splotch, overripe and unripe explaining negatively a relatively significant proportion of prices. Overall, the explanatory variables explained 41% of the total variation in price. The color, hull, splotch, overripe and unripe variables were all significant and consistent with the estimation of the hedonic regression of equation.

The survey results indicate that wholesale fig buyers are willing to pay a premium price for quality certificate. Contract farming is carried out for the production of black fig in the Bursa region. Under the terms of these contracts production in accordance with EUREPGAP has started. EUREPGP would be a solution for the problems that are faced during the export of black figs and would give us the opportunity to increase our export to the EU. The adoption of EUREPGAP by our producers and exporters as soon as possible is essential. Consequently, producer incentives should be provided to speed the replacement of traditional produce by quality standards. Black fig production has advantages depending on two reasons as follows; it has no other rival and the region's climate conditions are appropriate for black fig production. In order to evaluate these advantages and to increase income, one should give more importance on particular quality characteristics (color, hull, splotch, overripe, unripe) rather than sticking on to the conventional production methods. This would not only create opportunities to grow larger and better quality figs but could increase consumer preferences.

In addition, this study may be useful to exporter firms, government officials and producers in determining the appropriateness of the fig grading system and external characteristics. The model may be used to show how varying fig characteristics affect the prices received for a given kilogram.

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