

**What's in a Drink that You Call a *Chai*?:
Quality Attributes and Hedonic Price Analysis of Tea**

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Abstract

India is one of the leading producers and exporters of tea. However, in the last two decades its share in the world exports has gone down considerably. On the other hand, although the domestic market is large, the per capita consumption in India is one of the lowest in the world. Therefore, Indian growers, processors, and traders could focus their attention to cultivate and expand the domestic market as a buffer against the vicissitudes of export performance. As a first step in their competitive strategy, Indian tea industry may want to understand the valuation consumers place on various quality attributes of tea. This can be done by applying hedonic price analysis to the data on prices and the quality attributes of tea.

In this paper, we applied the hedonic price analysis to the data on 43 Indian tea brands. Based on performance of regression equations, exponential functional form was selected for the Box-Cox transformation, where price of tea brands was taken as the dependent variable and quality attributes of tea were considered as independent variables. Indian consumers seemed to attach importance to two quality attributes, aroma and colour. No significant value is attached to flavour and strength of tea. Premium is attached to the tea types CTC Leaf, Teabags, and CTC Fanning in that order over the type CTC Dust. Based on these results, stakeholders in the tea industry may want to enhance or reduce some of the quality attributes during the tea blending process. The newly blended teas may be marketed through aggressive generic promotions to increase overall consumption and/or through firm specific advertisements to improve market share.

1. Introduction

India is one of the major producers and suppliers of tea in the world. In the year 2000, Indian and the world production of tea was about 0.8 million tonnes and 3 million tonnes respectively (FAO, 2001). Although India's exports of tea amounting to about 0.2 million tonnes are quite large, her relative share among the exporting countries has been declining over the decades. The export share was 22 percent in 1978 and in two decades it came down to 16 percent in 1998 (Asopa, 2000). In the year 2001, exports declined by about 13 percent due to severe competition from Sri Lanka, Indonesia, Kenya and China (ET, 2002). Thus, export market is not as promising as it used to be two decades ago. Therefore, tea producers, processors, and traders may want to cultivate and expand the domestic tea market to offer a strong buffer against the vicissitudes of export performance.

India's domestic tea market is quite large. Currently, annual domestic sales are about 0.6 million tonnes. However, India's per capita consumption is one of the lowest in the world. It is only about 600 grams per year as compared to 950 grams in Pakistan, 1.2 kilograms in Sri Lanka and 2.5 kilograms in United Kingdom (India Infoline, 2002). Thus, there is a great potential to expand the domestic market. In the recent past, growth in this sector has also been negatively affected by the entry of carbonated drink brands, Coke and Pepsi, and the popularity of coffee shops such as Barista. Therefore, the Indian tea industry, as a part of its competitive strategy in the domestic market, would have to understand the consumers' preferences and their valuation of various quality attributes of tea. Once the relative importance of various quality attributes is understood, the industry/firms may incorporate or enhance the desired attributes at the time of blending of teas. The newly blended teas may be marketed through aggressive generic promotions to increase overall consumption and/or through firm specific advertisements to improve market share.

In this context, to understand valuations placed by consumers on various quality attributes, we applied the hedonic price analysis to data on prices and quality attributes of 43 Indian tea brands. The plan of the paper is as follows: In Section 2 we review the past literature that has used hedonic price analysis to elicit consumers' valuation of various quality attributes of a given product. The methodology used for the estimation is covered in Section 3, and the data description and regression analysis is presented in Section 4. Finally, Section 5 summarizes and draws conclusions.

2. Literature review

Hedonic price analysis is based on the hypothesis that every good can be treated as a bundle of various quality attributes which differentiates itself from other related goods. In the early part of the last century, Waugh (1928) formulated hedonic price analysis based on the observation that the different lots of tomatoes, asparagus and cucumbers in the vegetable market in Boston, Massachusetts, showed considerable variations in price. Waugh tried to identify those quality traits that were significantly influencing daily market prices. Later, Rosen (1974) presented a model of product

differentiation based on the hypothesis that any good is valued for its utility generating attributes. According to him consumers evaluate product quality attributes when making a purchase decision. The observed market price is the sum of implicit prices paid for each quality attribute. Hence, price variable could be regressed on quality attributes as independent variables, where the coefficients would indicate valuation of each quality attribute in the price of the product.

Rosen, however, recognized an identification problem for the hedonic price functions. Product prices are equilibrium prices jointly determined by supply and demand conditions. Hence, implicit prices may reflect not only consumer preferences but also factors that determine production. In order to solve the identification problem it was necessary to separate supply and demand conditions. Nerlove (1995) examined the Swedish wine market, which had no domestic producers and the wine prices were controlled by government. This allowed him to presume that prices were exogenous (as opposed to assuming supply is exogenous) and to estimate a reduced form hedonic price function regressing quantities sold on various quality attributes and prices. In effect, Nerlove assumed that wine consumers in Sweden express their valuation of a particular quality attribute by varying the derived hedonic demand for it.

In an analysis of the U.S. wine market, Schamel, Gabbert and Witzke (1998) estimated a hedonic pricing model based on sensory quality ratings, individual wine quality, and regional reputation indicators for two premium wine varieties: Chardonnay (white wine) and Cabernet Sauvignon (red wine). The estimated price elasticity of sensory quality was larger for white wine, indicating that U.S. consumers were willing to pay a higher quality premium for white wine compared to red wine. The results also suggest regional reputation and individual quality indicators seem to be more important to U.S. consumers of red wine. They concluded that differentiating wines on the basis of regional origin as a quality attribute may have a higher payoff for regions primarily growing red wine. The authors allude to the identification problem resulting out of implicit price being jointly determined by demand and supply. However, they assumed that production of quality wines was a highly technical job and supply cannot be altered in a short period of time.

Among other studies, Shapiro (1983) presented a theoretical framework to examine reputation effects on prices. He developed an equilibrium price-quality schedule for high-quality products assuming competitive markets and imperfect consumer information to demonstrate that reputation allows high-quality producers to sell their items at a premium that may be interpreted as revenue for investment in reputation. Similarly, Oczkowski (2000) examined hedonic price functions for Australian wines, and found significant reputation effects but insignificant quality effects. Recently, Weemaes and Riethmuller (2001) investigated the role of quality attributes on the consumption of fruit juices. The study involved market valuation of the various fruit juice characteristics, although it did not consider consumers' attribute valuation via their preferences. Among other sources, quality attributes were generated using information from the product label. According to the results, consumers paid a premium for nutrition, convenience and information.

Results of a similar study on *ghee* (clarified butter) by Deodhar and Intodia (2001) indicated that consumers were willing to pay a premium for branded over non-branded ghee, and, for corporate brands over cooperative brands. Flavour was an important quality attribute valued by consumers. While texture was not that important, it was very difficult to agree on an ideal colour attribute for ghee. The results implied that branding generated reputation, and, cooperatives could enhance their brand equity further. Firms may do well in improving flavour to enhance ghee quality. Studies such as the ones mentioned above are an important tool for agribusiness managers. Estimation of implicit prices for quality attributes is potentially useful for strategic quality management where a firm can innovate its product by incorporating consumers' quality perceptions. In this paper, we conducted the hedonic price analysis for tea sold in the Indian domestic market.

3. Methodology

We have adopted the model suggested by Rosen (1974), and use the notation given by Schamel, Gabbert and Witzke (1998). According to the model, the utility is enhanced not by the consumption of an economic good but by the characteristics of that good. Therefore, the market price of the good is the sum of the prices consumers are willing to pay for each characteristic that enhances its utility. The demand function derived from maximizing consumer utility function provides the foundation for Hedonic price analysis. The Hedonic price function for the i^{th} brand of tea can be described as a function of its characteristics:

$$(1) \quad P_{ti} = P_i(z_{i1}, \dots, z_{ij}, \dots, z_{in}),$$

where z_1, \dots, z_n are tea characteristics. The utility maximization problem for a representative individual can be formulated as:

$$(2) \quad \text{Max } U = U(X, Z) \quad \text{s.t.} \quad M - P_{ti} - X = 0,$$

where X is a composite, numeraire commodity and M is income. An implicit assumption is that each individual purchases only one unit of tea in a given period t . Applying first order condition for the choice of characteristics z_j we get:

$$(3) \quad \frac{\delta U / \delta z_j}{\delta U / \delta X} = \frac{\delta P_t}{\delta z_j}$$

Equation (3) is nothing but stating the law of equimarginal utility between two goods, X and z_j . $\delta P_t / \delta z_j$ is the marginal implicit price for characteristic z_j and corresponds to the regression coefficients when estimating equation (1). Further, the utility function U can be rewritten as:

$$(4) \quad U = U(M - P_{ti}, z_{i1}, \dots, z_{ij}, \dots, z_{in}).$$

Inverting equation (4) and solving for P_{ti} with z_j as a variable and U^* and $z_{\cdot j}^*$ being held constant at their optimal values associated with problem in (2), we can write a bid curve B_j as follows:

$$(5) \quad B_j = B_j(z_j, z_{\cdot j}^*, U^*)$$

Holding other things at the optimal level, (5) describes the maximum amount an individual would be willing to pay for a unit of tea as a function of z_j . A well-behaved bid curve is ought to exhibit a diminishing willingness to pay with respect to z_j . Based on their individual preferences and/or incomes consumers can have different bid curves $B^1_j(z_j)$ and $B^2_j(z_j)$ as shown in Figure 1.

On the supply side as well, firm's cost of production depends on the characteristics of the product. Offer curve for the characteristic z_j derived from the firm's cost function can be represented by:

$$(6) \quad C_j = C_j(z_j, z_{-j}^*, \pi^*)$$

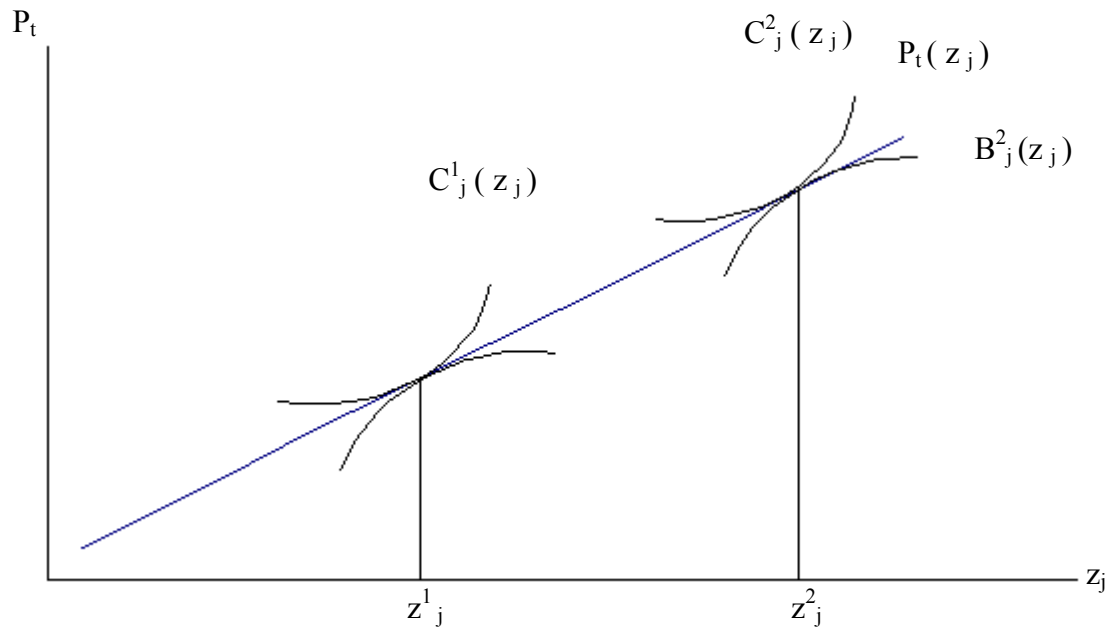
Equation (6) explains the minimum price a firm would accept to sell a unit of tea as function of z_j , holding other attributes and profit at the optimal level. Offer curves $C^1_j(z_j)$ and $C^2_j(z_j)$ for two individual tea producers are also shown in Figure 1. Now, the equilibrium condition is that bid and offer curves for all quality attributes and for each market participant must be tangent to the Hedonic Price Function $P_t(z_j)$, which is an equilibrium locus for all individual bid and offer curves.

Ideally, to study the valuation of quality characteristics by the buyers of tea one would like to model both the demand and supply sides. However, for estimation purpose we have considered only the demand side of the tea market. Freeman (1992) shows that assuming the markets to be competitive and in equilibrium, implicit price of an i^{th} brand of a product can be specified without modelling the supply side. With 43 brands of tea in the market, tea industry is certainly competitive in structure. Also, with no significant changes expected in the tea supply in the short-run, and, only a cross-sectional data at a point in time being available for the analysis, we assume that supply is exogenously determined. Moreover, only the data on sensory and other attributes relevant for the demand side estimation were available.

4. Data and Regression Analysis

Our objective was to estimate a hedonic price line as discussed in equation (1) and as shown in Figure 1. It involved regressing tea prices on explanatory variables that are measures of quality attributes for tea. There are various sensory and analytical quality attributes of tea. The sensory attributes are essentially the organoleptic attributes, which a consumer is able to detect. The analytical attributes are related to chemical properties, measures of pesticide and heavy metal residues, and adulteration which a consumer cannot detect. One of the quality attributes of tea is its flavour. Flavour is a combination of sensations one feels after taking beverage in the mouth. Another important attribute is aroma which in common parlance means smell of the tea. strength is the substance in cup, which imparts body to the liquor. It is related with the thickness of the water extract. One more sensory attribute is the colour. Ideally liquors should be bright and clear when first poured, with a distinct reddish tinge.

Figure 1: Bid and Offer Curves in Hedonic Pricing*



* Adopted from Schamel, Gabbert and Witzke (1998).

The data on prices of tea brands and their scores on organoleptic quality attributes were taken from a test report published by CERC (1997). The use of organoleptic scores made sense as consumers' perception about different tea brands is based on their experience about these quality attributes. The test covered 43 national and regional tea brands available in India. The brands were rated on a scale of 1 to 100 for 4 organoleptic variables, namely, aroma, flavour, colour and strength. The highest score of 100 indicated extreme liking for a given sample. The brands also represented 4 varieties of teas, namely, CTC Dust, CTC Fanning, Leaf Orthodox, and Teabags. The data description of these variables is presented in Table 1. The data included national brands such as Tata, Hindustan Lever, and Nestle, and regional brands such as Girnar and Wagh Bakri.

In hedonic price analysis, researchers have used various Box-Cox transformations to estimate equation (1). The most appropriate functional form is chosen according to the performance of the estimation. We estimated equation (1) using semi-log (LogLin) transformation. The general form of this equation is given by:

$$(7) \quad \ln P = \alpha + \beta Z + e_i$$

Equation (7) can be written in its original exponential form as:

$$(8) \quad P = e^{\alpha + \beta Z}$$

Table 1: Description of Variables*

Variable	Description	Mean	St. Dev.
P	Max. retail price of Tea/1000 gm	140.94	119.42
Z ₁	A score for the attribute: Aroma	61.88	5.94
Z ₂	A Score for the attribute: Flavour	60.60	7.62
Z ₃	A Score for the attribute: Colour	64.38	9.48
Z ₄	A Score for the attribute: Strength	62.96	7.42
Z ₅	= 1 if CTC Fanning, else 0	0.42	0.50
Z ₆	= 1 if Leaf Orthodox, else 0	0.16	0.37
Z ₇	= 1 if Teabag, else 0	0.07	0.26

* Adapted from CERC (2001) for variables P and Z₁ to Z₄.

The function is defined only for positive values of P, which is quite all right as tea prices are always positive. In this format, the coefficient β represents a constant percentage change in value of P due to a unit change in the value of Z. i.e., $\beta = (dP/dZ)/P$. We estimated equation (7) econometrically. The data for the regression equation was such that the Rupee values of dependent variable (P) were very large relative to the values of the independent variables. As a result, the constant term in the regression equation would have captured most of the variation in the dependent variable. To understand the relative importance of various independent variables we forced the equation to go through origin. In fact, results of the regression were significantly better when we forced it to go through origin. In terms of equation (8), it means that the value α is zero. It also means that if all of the attributes of tea had a value of zero, a consumer at best may pay a price of Rs. 1 per kilogram of tea. The estimation of regression equation and its diagnostic tests are reported in Table 2 and Table 3 respectively.

The adjusted R² and the Raw-moments R² both had a value of 0.99. The regression equation meets the goodness of fit test. In fact, the F statistics of 860.838 is quite high and significant as well. Cross sectional data is prone to heteroscedasticity problem. Hence, we tested the regression equation for heteroscedasticity using B-P-G and Glejser tests. The estimated χ^2 values are not significant at 0.01 significance level. Hence we cannot reject the null hypothesis of homoscedasticity. We also tested for the multicollinearity between non-dummy explanatory variables. As per the Klien's rule, we found all the auxiliary R² values much lower than the overall R² which confirms absence of multicollinearity.

The dummy variables for tea types were chosen such that the base type (all D_i= 0) was CTC Dust. Regression coefficient showed that consumers were willing to pay 191 % more for Leaf Orthodox over CTC Dust. Similarly CTC Fanning and Teabags had a price premium of around 34 % and 90 % respectively. These dummy variables captured attributes that are different than the organoleptic attributes. For example, while the teabag dummy captures the convenience factor and packing cost, Leaf Orthodox dummy captures the value consumers attach to traditional tea processing method and high altitude tea leaves. Similarly, an important advantage of CTC Fanning over CTC Dust is that while straining the tea, dust particles do not appear in the prepared tea.

Table 2: Regression Estimate

Variable	Coefficients	Std. Error
Z ₁	0.0482 ^a	0.011
Z ₂	0.0155 ^b	0.015
Z ₃	0.0161 ^c	0.010
Z ₄	-0.0118 ^b	0.019
Z ₅	0.344 ^a	0.162
Z ₆	1.907 ^a	0.184
Z ₇	0.895 ^a	0.259

^a Significant at 0.01, ^b not significant at 0.10 two-tailed test, ^c significant at 0.10 two-tailed test.

Table 3: Diagnostic Tests of the Regression Equation

Diagnostics	Test	Value
1. Coefficient of Determination	Adjusted R ² Row-moment R ²	0.99 0.99
2. Overall significance:	F statistics	860.838 ^d
3. Homoscedasticity Tests:	B-P-G χ^2 Glejser χ^2	13.154 ^e 13.756 ^e
4. Multicollinearity	Klien's Rule	R ² _{Z1} = 0.354 ^f R ² _{Z2} = 0.622 ^f R ² _{Z3} = 0.520 ^f R ² _{Z4} = 0.748 ^f

^d Significant at 0.01, ^e not significant at 0.01, ^f auxiliary R²'s less than overall R²

Regarding the organoleptic scores, *ceteris paribus*, aroma seemed to be an important consideration in tea quality. The regression coefficient for aroma was statistically significant at 0.01 level. It showed that consumers were willing to pay an additional 5% for each unit improvement in aroma. Similarly for a unit improvement in colour attribute consumers were willing to pay 1.6 % more. The coefficient was significant at 0.10 level two-tail test. Flavour and strength attributes were not statistically significant indicating that these attributes were not as important to Indian consumers as aroma and colour were. It must be noted that Indians drink tea with cream and sugar. Moreover, preparing tea with *chai masala* is also very common. This could explain the fact that tea flavour and strength by themselves are not important quality attributes. On the other hand, with the addition of cream to the tea, getting the right colour could be important to them. Aroma can also be experienced by smelling the dry tea powder/leaves which may give an indication to the Indians about the quality of tea.

5. Summary and Conclusion

India is one of the major producers and suppliers of tea in the world. However, for sometime now, her share in exports among the major world exporters is going down. On the other hand, India's domestic market is very large, but her per capita consumption

is one of the lowest. Therefore, to protect against the vicissitudes of export performance, Indian tea growers, processors and traders may want to exploit the potential of domestic market further. As a critical step in their strategic approach to expand the domestic tea market, they have to understand the consumers' perceptions and valuation of various attributes of tea quality. Based on the importance of specific attributes, newer tea blends can be developed and generic promotion or firm-specific aggressive marketing may be undertaken to promote tea sales.

In this paper we attempted to understand the importance of various quality attributes of tea. Through hedonic price analysis we were able to identify aroma and colour as the two quality attributes Indians value a lot. Given the fact that Indians take tea with cream and sugar, and, sometimes with *chai masala*, flavour and strength might not be critical quality attributes. The dummies for tea types also indicated average premiums consumers are willing to pay over the CTC dust type of tea. Indian tea board and other private stakeholders in the tea business could change their tea blends suitably and inform the consumers about their new tea brands through generic promotions or firm-specific tea advertisements. This could expand the domestic tea market in India, and, at the same time act as a buffer to face the vicissitudes of export performance.

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