Dynamic Demand Analysis of

India's Domestic Coffee Market

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Abstract

Coffee, although an important commodity in India's agricultural exports, has faced fluctuating international prices and decreasing unit value realisation, especially in the post-reform period. Hence, domestic market for coffee cannot be neglected altogether. In fact, Coffee Board has proposed a promotional campaign to increase domestic demand for coffee. In this context, it becomes necessary to understand weather the emphasis should be on price incentives or non-price factors. We estimate coffee demand for the Indian domestic market using the dynamic error-correction methodology (ECM). Results show that while demand for coffee is inelastic in the long-run, it is highly inelastic in the short-run. This suggests that Coffee Board may focus efforts on non-price factors rather than price incentives in their generic coffee promotional campaign.

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1. Introduction

Coffee, cultivated predominantly in the states of Karnataka, Tamil Nadu and Kerala, is an important plantation crop in India with an annual production of about 2.28 lakh tonnes. Although coffee is considered as an export-market crop, its performance has not been encouraging in the post 1991 economic liberalisation period. Datta, Chakrabarti and Gandhi (1999) show that the relative unit value realisation and the share of coffee exports in India's total agricultural exports has decreased in the post-reform period. Despite being the traditional exporter of coffee, India does not rank even among top 11 exporting countries to Germany, where India exports maximum amount of its coffee. Further, a report by World Trade Organisation (WTO, 1997) indicates that in the post-WTO regime, coffee prices have fluctuated widely from year to year. In 1995, the spot export price of coffee increased by 2 per cent, then dropped by 25 per cent the very next year, and increased once again by 39 per cent in the following year (WTO, 1997).

Thus, although coffee remains an important exportable item, the uncertainty in the export market highlights the importance of the domestic coffee market as well. With the market size of about Rs. 1600 crore (CMIE, 1998), the domestic coffee market is very important and has a potential for growth in the beverage market. A stable and growing domestic market assumes a

great importance to the Indian Coffee growers, distributors and coffee processing companies. In fact, Coffee Board has proposed a big promotional campaign to increase the demand through generic marketing and advertising (ET, 1998). In this context it becomes essential to understand the nature of demand function for coffee in the domestic market. If the price sensitivity of coffee demand is low then it justifies the use of non-price factors such as advertising and generic marketing campaigns to promote coffee demand.

This paper attempts to estimate the aggregate domestic demand for coffee econometrically. Given this purpose, the rest of the paper is organised as follows: Section 2 gives background information on the domestic coffee market and consumption of coffee in India and Section 3 describes methodology followed in this paper. Essentially, the coffee demand is estimated using an Error Correction Model approach. Section 4 reports the data used and results of the empirical analysis. Finally, Section 5 summarises and draws conclusions.

2. The Domestic Coffee Market

With the changes in International Coffee Agreement and subsequent domestic reforms in the selling procedures, the control which Coffee Board had on domestic and export trade has been relaxed considerably. Now the growers can enter the coffee trade directly. With many growers on the supply side and fragmented and unorganised buyers on the demand side, the market appears to be competitive in structure. Besides the per capita consumption has declined from 80 grams in 1960-61 to 66 grams in 1996-97. On the other hand, the consumption of tea, a close substitute for coffee has increased from 296 grams to 657 grams during the above time

periods (GOI, 97-98). Nagarajan (1998) has documented various reasons for the slow increase in demand for coffee in India. Coffee is considered as a gourmet drink confined to middle class literate segment. It has not penetrated the low-income groups as tea did. Coffee is an acquired taste and habit formation is an influencing factor in consumption. Coffee is considered as more expensive than tea, and needs more sugar and milk for preparation than tea. However no detailed evaluation is done on these issues nor on the nature of aggregate demand function for coffee and its response to substitute product, price, income and habit formation. This study aims to concentrate mainly on the latter issues.

3. Methodology for the demand analysis

Recent advances in demand estimation show that regression equations show a good fit to the data (high R-square) due to spurious correlations between the time-series variables. A common trend in the time-series variables render the variables nonstationary, and, the regression co-efficients become biased (Davidson and Mackinnon, 1993). Therefore, one needs to correct for nonstationarity in data. Moreover, using cointegration and error correction model, one can incorporate short-run and long-run effects of explanatory variables as well as the habit formation behaviour. Cointegration technique has been used in other studies. e.g. Larue (1991), farm input-output prices; Goodwin and Schroeder (1991), cattle markets; and Behura and Pradhan (1998), marine fish markets[1]. Here a demand function for Indian domestic coffee market is estimated using the methodology followed in estimating peanut butter demand in the United States (Deodhar and Fletcher, 1998)[2]. This method not only corrects for stationarity

and cointegration problems but provides the short-run and long-run estimates of demand elasticities as well.

Consider the linear demand specification:

(1) $$Q_t = a_0 + a_1 PC_t + a_2 INC_t + a_3 PT_t + e_t$$

where Q_t is the quantity of coffee consumed in the domestic market, PC_t is the price of coffee (real price), INC_t is the real per capita income and PT_t is the price of a substitute good, tea.

Equation (1) in an Autoregressive Distributed Lag (ADL) form with one lag and no intercept term is of the form:

(2) $$Q_t = a_{01} PC_t + a_{02} INC_t + a_{03} PT_t + a_{11} PC_{t-1} + a_{12} INC_{t-1} + a_{13} PT_{t-1} + a_{14} Q_{t-1} + e_t$$

By adding and deleting $Q_{t-1,}\ a_{01}\ PC_{t-1}$, $a_{02}\ INC_{t-1,}\ a_{03}\ Pt_{t-1,}$ re-arranging the terms and using difference operator, equation (2) can be written in the ECM format as follows:

(3) $$\Delta Q_t = a_{01} \Delta PC_t + a_{02} \Delta INC_t + a_{03} \Delta PT_t + (1-a_{14}) \left[[(a_{01} + a_{11}) / (1-a_{14})] PC_{t-1} + [(a_{02} + a_{12})/(1-a_{14})] INC_{t-1} + [(a_{03} + a_{13}) / (1-a_{14})] PT_{t-1} - Q_{t-1} \right] + e_t$$

The generalised form of this equation for k lags and an intercept term is as follows:

(4) $$\Delta Q_t = a_{00} + \sum a_{i1} \Delta PC_{t-i} + \sum a_{i2} \Delta INC_{t-i} + \sum a_{i3} \Delta PT_{t-i} + \sum a_{i4} \Delta Q_{t-i} + m_0 [m_1 PC_{t-k} + m_2 INC_{t-k} + m_3 PT_{t-k} - Q_{t-k}] + e_t$$

where $\mu_0 = (1 - \sum \alpha_{k4})$ and $\mu_j = \sum \alpha_{ij} / \mu_0$, $j=1,2,..3$

If all the variables are integrated of order 1, I (1), i.e. they are stationary in first differences, then all the summations in equation (4) are stationary. Moreover, if the variables are co-integrated, the ECM term i.e., the linear combination of variables represented in parentheses is also stationary. The α_{ij} coefficients capture the short-run effects and μ_j coefficients represent the stationary long-run impacts of the right hand side variables. The parameter μ_0 measures the rate of adjustment of short-run deviations towards the long-run equilibrium. Theoretically, this parameter lies between 0 and 1. The value 0 denotes no adjustment and 1 indicates an instantaneous adjustment.

4. Data and empirical estimation

Data on the quantum of coffee sold and price realised in the domestic market through pooled auctions were collected for the period 1970 to 1992 from the various issues of *Indian Coffee* published by Coffee Board, Bangalore[3]. These are the total monthly release of coffee from the pool in the internal (domestic) market for consumption. The price of tea, close substitute for coffee, was collected from various issues of *Tea Statistics* published by Tea Board of India. The per capita income at current prices and Consumer Price Index (CPI) at current prices at All-India level, were collected from *Economic Survey* (various issues) published by Ministry of Finance, Government of India.

The definition of variables in levels and their descriptive statistics for the quarterly data are presented in Table 1. All the variables are measured in log forms and were tested for stationarity and cointegration (Table 2 to Table 4).

Table 1 : Descriptive Statistics

Variable	Description	Mean	Std. Deviation
Q_t	Quantity of coffee/quarter (tons)	12038	2284.3
PC_t	Real price of coffee (Rupees/ton)	2763.3	463.39
INC_t	Real per capita income (Rupees)	107.22	15.742
PT_t	Real price of tea (Rupees/ton)	4118.5	653.49

Table 2 : Stationarity Tests (Dickey-Fuller) for I (0)

Variable	Test statistic (g)
ΔQ_t	-2.4153
ΔPC_t	-2.4350
ΔINC_t	-2.9275
ΔPT_t	-3.5222

Note: The critical values are -3.96 and -3.41 at 1 per cent and 5 per cent respectively. Since test statistics (absolute) are smaller than the critical value (absolute), there is non stationarity.

Table 3 : Stationarity tests (Dickey-Fuller) for I (1)

Variable	Test statistic (g)
ΔQ_t	-3.1673
ΔPC_t	-4.9494
ΔINC_t	-3.6202
ΔPT_t	-3.5133

Note: The critical values are -3.96 and -3.41 at 1 per cent and 5 per cent respectively. Since test statistics (absolute) are greater than the critical value (absolute), there is stationarity. Variable ΔQ_t will be significant at a value little higher than 5 per cent.

Table 4 : Stationarity tests (Phillips Tests) for cointegrating regression

Test statistic (g)	Critical value	
	(1%)	(5%)
-8.3495	-4.64	-4.10

Note: Since test statistics (absolute) are greater than the critical value (absolute), there is stationarity. All variables are measured in natural logarithms

Using the Dickey Fuller unit root test we could not reject the hypothesis that the variables are nonstationary in levels. However, we could reject this hypothesis for variables in their first differences, i.e., these variables were integrated of order I (1). Based on the Phillips test on the residuals of cointegrating regression, it is concluded that the linear combination of the variables in levels was stationary. A seasonal dummy (S) for the summer quarter was introduced to measure the change in demand if any during hot summer months. Having performed these tests, we estimate Equation (4) econometrically.

Based on the significance of parameters and R^2 values, one lag length is found more appropriate as with the higher lag-lengths, many of the variables became insignificant and resulted in lower R^2. The estimated parameters along with their significant levels are shown in the Table 5.

Table 5: Regression estimates: Demand Equation

Variable	Estimated coefficient	t-ratio
Constant	6.9603	6.487
ΔPC_t	-0.29182	-1.960*
ΔINC_t	0.44856	2.044*
ΔPT_t	0.038546	0.2613
PC_{t-1}	-0.57548	-6.108**
INC_{t-1}	0.65539	5.612**
PT_{t-1}	0.29023	3.197**
$-Q_{t-1}$	0.83951	8.547**
S (Dummy)	-0.0089774	-0.3407

$R^2 = 0.50$. RHO = 0.01487, Durbin H statistic 0.40615 df = 83

** Significant at 1 per cent level and * at 5 per cent level respectively

All coefficients are having the expected signs and most of the variables are statistically significant. The coefficients of the variables, namely the price of coffee, lagged income and lagged price of tea and one period lagged quantity (previous period consumption) are significant at 1 and 5 per cent levels. The seasonal influence on coffee consumption is insignificant.

The R^2 value for the demand equation is 0.5. Since the Durbin-Watson statistic is not applicable when explanatory variables contain lagged endogenous variable, the Durbin H test is performed and the null hypothesis that the first-order autocorrelations are zero could not be rejected. Using equation (4) and the estimated demand regression coefficients in Table 5, we measure the short-run and long-run demand elasticities. In Table 6, short-run and long-run own price elasticity of demand for coffee are presented.

Table 6: Short and long-run own and cross price elasticity of demand

	Own price	Cross price
Short-run	-0.29182	0.038546
Long-run	-0.68549	0.3457

The short-run and long-run own price elasticity of demand for coffee is sufficiently less than 1. This means that demand is not very responsive to price of coffee. Moreover, the short-run elasticity is much smaller than the long-run elasticity. With regard to substitute product, tea, although coffee demand is more responsive in the long-run, the elasticity is low. The income variable also showed a significant influence on the demand for coffee. The statistical significance of the variable, lagged quantity of coffee, implies that coffee consumption is characterised by habit formation. Besides, the coefficient of this variable (adjustment parameter, m_0), 0.84, is

closer to 1. This implies that any exogenous or external shock to the demand for coffee gets adjusted fairly quickly towards the long-run equilibrium values.

5. Summary and Conclusion

Coffee is one of the important plantation crops in the country. Although it is an important exportable item, the domestic market for coffee also assumes importance as the growers and traders are vulnerable to the vagaries of export market fluctuations. In fact, in the post-liberalisation period, the relative value realisation has declined for coffee exports. Moreover, since the beginning of the implementation of the WTO agreement, spot export prices of coffee have fluctuated a lot. Therefore, coffee growers may have to tap and nurture domestic market as well. The objective of the paper is to analyse the domestic demand for coffee in India. Our study, by applying the Error Correction Model to quarterly time-series data, estimated the short-run and long-run price elasticity of demand and the influence of other variables on the demand for coffee.

The results showed that although price elasticity of demand for coffee is low, it is much lower in the short-run than in the long-run. This suggests that temporary price incentives will not achieve any significant demand increase. Moreover, coffee demand is characterised by habit formation. Therefore, demand for coffee can be increased by non-price factors like improving quality standards and communicating the same to the consumers via generic promotion campaigns and/or brand advertising. Coffee Board's decision to go for a promotion campaign

to increase the demand for coffee in the domestic market seems justified as non-price factors will affect coffee demand more than the price.

Endnotes

1. Goodwin and Schroeder (1991) establish spatial linkages between regional cattle markets by performing cointegration tests on regional price series. In this paper, we apply the concept to demand function to estimate long-run effects of explanatory variables on demand for coffee.

2. Indira and Giriappa (1992) have analysed the domestic demand for coffee using linear regression. Our study is an improvement on theirs for a number of reasons: First, their data is old (last year is 1981) and we need to update demand estimates based on relatively newer data-set. Second, they do not report Durbin-Watson test, an important and a standard test for checking autocorrelation. Third, we correct for nonstationarity of the quarterly data which otherwise would have rendered biased estimates of demand coefficients. Fourth, we estimate both short-run and long-run effects of explanatory variables including the short-run and long-run price elasticities of demand.

3. The data used in the analysis are related to period upto 1992. The domestic consumption data after 1992 are neither published by Coffee Board nor available from other reliable sources. Nevertheless, estimate of the domestic demand function is useful since liberalisation has affected mostly the export market rather than the domestic consumption. Of course, as and when latest/post-WTO and reliable data becomes available, it will be worth studying.

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