**Domestic Production, Domestic Consumption and Exports of Indian Tea: Examining the Interlinkages**

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**1.1 Introduction**

Until recently, India has been the largest producer of tea in the world, accounting for 29% of world tea production in the nineties and 27.6% in the current decade. The country is also the largest consumer of tea, with the share of domestic consumption in all-India tea production being 70% during the eighties and nineties and 81.68% during the current decade. However, our tea-exports performance has been unimpressive, with growth rates in terms of export volumes turning negative in the past and absolute volumes of exports fluctuating and stagnating around 200 million kgs. since many decades. Although this itself is not necessarily a cause of concern since this could be due to a change in the output-mix and the export basket with the development of the economy. However, this does raise the question as to why export volumes are stagnating. Possible reasons can be high domestic demand (Kumar and Mittal, 1995; Misra, 1994; Pai, 1991; Mitra, 1991; Bandopadhyay, 1982), competition from other exporters (Sharma et al., 1995; Kumar and Mittal, 1995; Pai, 1991; Dass, 1990; Bandopadhyay, 1982; Costa, 1968) or shift in the demand of foreign consumers (Kumar et al., 2008). Since the reasons can emanate from both the supply and the demand side, we examine the interlinkages between production, consumption and exports of tea and thus provide a methodology to estimate the exports function for Indian tea.

Most of the studies estimate tea-exports as a single-equation model with explanatory variables like relative prices and world income (Kumar, Badal, Singh and Singh, 2008; Kutty, 1999, Dutta, 1965) or club together both supply and demand side factors (Kumar and Mittal, 1995; Kumar and Kumar, 1994; Misra, 1994; Dass, 1990). Yet others like Islam and Subramaniyan (1989), Bond (1987) and Goldstein and Khan (1978) specify both export supply and demand relationships separately for agricultural exports, primary commodity exports[[1]](#footnote-1) and industrial exports respectively. However, the export supply specifications in Islam and Subramaniyan (1989) and Bond (1987) are a bit simplistic in that the effect of the domestic factors on the supply of exports is captured using trend as a long run impact variable and supply and demand shocks as the short run impact variables. While it is okay to include such explanatory variables for examining the short and long run supply elasticities, it may not be adequate. In order to observe the true impact of the supply side variables on exports, we develop an economic model for tea output, which is based on the short run harvesting and the long run investment decisions of a perennial crop producer, thereafter we put forth a consumption model based on a standard utility maximization exercise for a consumer, and finally we introduce an exports model for tea, which is a variant of Thirlwall’s exports model. We then estimate output, consumption and exports jointly using the seemingly unrelated regression equations (SURE) technique. We do so because it is not always easy to ascertain the explanatory variables exhaustively and there is always a possibility of omitting out unknown variables. SURE captures the possible correlation between the unknown variables that jointly affect output, consumption and exports and therefore, by examining the interlinkages between output, consumption and exports in this framework, we can estimate the impact of both supply and demand side variables and get improved and efficient estimates of the parameters.

Section 1.2, 1.3 and 1.4 elaborate the output, consumption and exports model for tea respectively. Section 1.5 discusses the data and the methodology. Section 1.6 discusses estimation results. Section 1.7 concludes the paper.

**1.2 The Output Model**

Tea is a perennial crop and is characterized by both development and productive phases. The development phase is the one during which the producer has to undertake certain investments, also known as sunk costs. For instance, starting a new tea estate requires clearing and terracing the land, planting and nurturing the bushes, building access roads, and also constructing a factory nearby, all of which are part of the sunk cost which the producer has to undertake before he can reap any output. Once the bushes are planted, there is a gestation lag of five to six years, after which the bushes become productive and can yield output in four phases during the year, starting from March to November (the first flush being harvested between late February to mid-April, followed by a second flush harvest between May and June, a rain flush during July and August and finally an autumn flush harvest between the months of September and November)[[2]](#footnote-2) barring the dry winter months. The productive phase of the crop lasts as long as the crop yields output. However, the bushes are considered economic between 5-50 years of age, after which the productivity of the bush falls drastically.

Since tea production incurs a sunk cost, that itself creates a barrier to entry and exit[[3]](#footnote-3), and therefore producers who invest in tea cannot shift to another crop in response to a shortterm change in the relative price of tea. However producers do respond to a change in the relative price of tea by changing the yield of the crop in the medium-long run by planting high yielding tea bushes, replacement of old or uneconomic bushes, infilling of the existing area under tea[[4]](#footnote-4) etc. Also, the short-run measures would include adoption of improved cultural practices like manuring, intensive cultivation via proper use of fertilisers and pesticides, timely pruning of tea bushes, as also the plucking style adopted.[[5]](#footnote-5) Thus, with tea, short-run acreage changes are not possible but yield changes are possible. Changing the acreage is not an easy option.[[6]](#footnote-6) Rather, it is a long-run or an investment decision for the tea planter/producer, which reaps benefits with a gestation lag and hence is based upon several considerations such as expected profits and past adjustments in acreage.

Attempts at modelling the supply response of perennial[[7]](#footnote-7) crops have often relied upon the Nerlovian[[8]](#footnote-8) supply response model for annual crops, which is essentially an adaptive expectations model of area and price adjustments (some notable studies are Kalaizandonakes and Shonkwiler 1992; Hartley, Nerlove and Peters 1987; Ady 1968; Behrman 1968; Bateman 1965). Amongst the above-mentioned studies, only Ady (1968), Behrman (1968) and Bateman (1965) estimate total output (although in first difference form), but have failed to distinguish between the short term and the long term decisions of the perennial crop producer, which leads them to estimate output primarily as a function of own and substitute prices and lagged output. Also, Bateman’s (1965) assumption of an infinite life of perennial crops leaves no space for uprootings and removal aspects of such crops and hence is unrealistic. Wickens and Greenfield (1973) criticize the application of Nerlove’s adaptive expectations model to perennial crop supply response on the grounds that it is an adhoc model and typically, a structural model must be developed to highlight the investment and harvesting decisions of the perennial crop producer. However, the final supply equation in Wickens and Greenfield (1973) is a function of past prices and lagged output which is the same as what can be obtained using the Nerlovian approach.

We follow a vintage production function approach similar to Akiyama and Trivedi (1987) to explain a simple two-factor production function and then put forth a simple model of output which is guided by the different kinds of decisions that a competitive tea producer needs to make. We propose that a tea producer faces a vintage production function  where t refers to time and v refers to tea bushes of a certain vintage. Let  denote ‘capital’ which means homogenous land owned by the producer planted with tea bushes and  denotes all variable inputs used in fixed proportion to capital in the production process. We assume that output is produced only by the matured vintages[[9]](#footnote-9) and is homogenous. Aggregate tea output of the economy is given by  and is defined as the summation of all individual output, i.e.

 (1)

where  (2)

The yield per unit of capital or average productivity is given by, which implies that the productivity depends upon the age of the bushes, denoted by *t-v* and not upon the time when they are planted. This explains the gestation lag involved between planting a bush and reaping its output.

Before we pose the producer’s problem, we may distinguish between extensions (meant for future new plantings), replantings, replacement plantings and uprootings (or removals) of vintage v capital in period t (denoted by  and  respectively). *Extensions* mean extending further to existing land (for possible investments in the future), *replantings* mean additions to the capital stock by planting new seedlings on currently uneconomic area under the same crop[[10]](#footnote-10) and *replacement plantings* are new plantings on land which has been obtained by clearing forest area and burning trees. *Uprooting* or removal is practiced when the productivity of the bush falls drastically and it becomes uneconomic for the producer to maintain the bush. Thus, the actual bearing acreage under tea, which is determined by the levels of and, is some fraction of the total acreage under tea at time t. The rest of the area is the non-bearing acreage which can be subsumed under the error term as follows.

 (3)

where refers to the total acreage,  refers to the bearing acreage under tea and  refers to the non-bearing area which may include a part of the uprooted area that is not replanted.

We define the total feasible or potential output, by

 . (4)

However the actual output or  is to be distinguished from the potential output because in every period, the producers’ optimization involves the choice of a subset of mature vintages which are economic and earn non-negative profits. This choice involves choosing the levels of  and which are in turn jointly determined by expected future profitability and past investment decisions. Thus, in the short run, producer decisions are guided by variables which bring about a change in the yield of the crop. However, in the long run, producer decisions are guided by variables which bring about a change in the bearing acreage of the crop.

The actual output thus, is given by

 (5)

where  is the current price of tea, is the expected price of tea and  refers to the relative price which guides the harvesting decisions of the producer in the short run.  is the actual bearing acreage at time t-1, which reflects the past investment decisions of the producer[[11]](#footnote-11) and  is a vector of variables such as labour, price of inputs and yield risk. Now, eqn. (5) contains two unobservable variables, viz.  and, which we will estimate. To estimate, we take a moving average of the auction prices prevailing in the past five years. Thus,  is used as a proxy to represent. Next, to estimate, we assume that the producers’ desired acreage under tea is a function of the previous period’s total acreage, expected profit[[12]](#footnote-12) and the desired adjustments in the current period. The desired adjustments can be in the form of extensions, replantings, replacement plantings and removals. We may write this relationship as

 (6)

We may further hypothesize that the change in acreage between periods occurs in proportion to the difference between the desired acreage for the current period and the actual acreage in the previous period, i.e.

,  (7)

The structural form equations (6) and (7) yield

 (8)

where 

(9)

The reduced form area equation is a general model which can be modified according to country-specific information. In the Indian case, we can omit the variable U(t) because part of the uprooted area is replanted (and is reflected in R(t)) and part of it is left unused (but cannot be quantified).

The expected profit variable (in (8)) can be estimated using the following profit expectation formulation (Nerlove and Bessler 2001; Narayan and Parikh 1981).

  (10)

which can be expressed as an infinite-order autoregressive process,

 (11)

This can be rewritten as the Box-Jenkins (1970) autoregressive integrated moving average (ARIMA) process of order (p,d,q) as follows.

(12)



where  is the white noise error. Thus, by regressing actual profit on the right-hand side variables in (12), we can obtain the estimated value of the dependent variable, i.e.  and use

it in lieu of expected profit or in (8).[[13]](#footnote-13)

Further, by regressing  on the right-hand side variables in (8), we obtain the estimated value of the dependent variable, i.e.  and use it as a proxy for  from (5).[[14]](#footnote-14)

Therefore, we estimate the following model for tea-output.

 (13)

If the relative price of tea rises, then it is lucrative for the producer to harvest the crop and thus raise the current level of output. On the other hand, if there is a fall in the relative price, then the producer would rather postpone his harvesting decision to the next period. Thus, in every period, the producer forms new price expectations and compares the actual price with the expected price. Depending upon whether there is a rise or fall in the relative price, the output-response is positive or negative respectively. The second regressor is the one-period lagged bearing acreage (or) under tea. A rise in the bearing acreage will have a positive impact on current as well as future output of tea, thus implying that output is positively related to acreage.

The other regressors which have an influence on output are denoted by the vector  in our model and include labour, price of inputs and yield risk. The most significant input in tea production is labour. Labour is required for a variety of field-tasks all throughout the year and is essential to raise the current and future output from tea. Output is thus positively related to labour.[[15]](#footnote-15) Price of inputs is another crucial variable affecting tea output. Since tea cultivation is labour intensive with hardly any usage of other inputs such as diesel and electricity, we simply use the absolute price of fertilisers to represent the price of inputs. We define this variable as the average all-India price of urea, DAP (di-ammonium phosphate) and MOP[[16]](#footnote-16) (muriate of potash). Higher the price of fertilisers, higher is the cost of production and lower the response of output. Producers would try to substitute cheaper inputs for relatively expensive ones but beyond a point, production might be hampered. We thus expect a negative relationship between price of inputs and output. A third variable in the list of other regressors is yield risk. Part of the variations in yield which are beyond the producer’s control can be due to a variation in rainfall from its long run average. We capture the yield risk due to abnormal rainfall by taking the coefficient of variation of the deviation in rainfall from its long run average over three previous periods, where the long run average is computed as the average rainfall of the last 30 years.[[17]](#footnote-17) The higher the yield risk, the smaller is the output produced.

**1.3 The Consumption Model**

We derive the consumption function for tea by resorting to a standard utility maximisation exercise for a typical consumer who consumes n goods. The first order conditions obtained from such an exercise can be solved to get a system of *n* Marshallian demand equations in terms of income and prices as follows.

 (14)

Assuming that individual consumption for a particular good can be summed over the entire population (let us say population size is m) to get the aggregate consumption for that good, we can write the aggregate consumption of tea as

 (15)

where *M* is domestic per capita income and *p* refers to a vector of prices which can include the own price of tea, price of its substitutes and price of its complements. We took coffee as a substitute commodity, and milk and sugar as the two complements of tea. Further, to observe the impact of ‘tastes and preferences’ of consumers on consumption of tea, we include a trend variable in the consumption function (eq. 16).[[18]](#footnote-18) Thedemand model for tea is thus given by

 (16)

where  is own price of tea,  is the price of substitutes of tea,  is the price of sugar,  is the price of milk and is the trend variable, which takes a value of 1 for 1970-71, 2 for 1971-72 and so on. Consumption of tea is negatively related to its own price and the price of its complements, and positively related to price of its substitutes and income. The impact of the trend variable is an empirical issue, depending upon whether the changing tastes and preferences of consumers have had a positive or negative impact on consumption of tea.

**1.4 The Exports Model**

Using a variant of Thirlwall’s exports function (Thirlwall 2003, 1979),[[19]](#footnote-19) we propose the following exports function for tea.

 (17)

where  is exports of tea,  is the international price relative which is defined as the Indian tea export price relative to the foreign price of tea in the competing tea exporting countries;  is the domestic price relative, defined as the ratio of the export price and the domestic price of Indian tea; YIM is income of all those countries which import tea from India, and V is the exchange rate volatility. The period of late 1980s (early 1985 onwards) is marked by the gradual collapse of the Soviet Union or the USSR into independent nations. Resistance against the central power and increasing democratization weakened the central government of USSR and finally led to its collapse in 1991 and subsequent formation of Russia and the CIS.[[20]](#footnote-20) This collapse had a detrimental effect on India’s trade relations with the former Soviet Union.[[21]](#footnote-21) USSR was the largest importer of CTC teas from India, accounting for about 50% of India’s tea exports. It is possible that the disintegration of the USSR has significantly altered the response of exports to the various regressors which we have discussed above. First, we introduce a dummy to mark the disintegration of USSR, which is defined as =1 for 1991 and 0 otherwise. To examine the differential impact of the USSR period and the post-USSR period, we define  =1 for t <1992, and 0 for the latter years, and include this dummy variable along with its interaction with other regressors in our export model. We thus observe both the ‘level effect’ and the ‘slope effect’ of. Therefore,

 (18)

where  is the dummy for disintegration of the U.S.S.R,  is the dummy for the U.S.S.R period and  stands for the interaction variables, namely \*, \*, \* and \*. The international price relative () measures the extent of competitiveness of Indian tea exports relative to tea exported by other competing countries. A rise in the relative price of Indian tea exports makes Indian tea relatively less competitive and leads to a fall in the demand for our tea exports. Ideally,  should be defined as the ratio of the export price of Indian tea and the average tea export price in competing countries. However, due to lack of explicit information on export prices in competing countries, we use an average of the auction prices prevailing in those countries[[22]](#footnote-22) with each country’s percentage share in global exports as the weight attached to the respective country’s price. The second price variable () reflects the allocation of output for exports versus the domestic market. Intuitively, greater is this price ratio; higher is the incentive to export. To represent this variable, we take the ratio of the export price of Indian tea and the all - India wholesale / auction price of tea.[[23]](#footnote-23) The third regressor, i.e. per capita income of the tea importing countries () is expected to affect the demand for Indian tea exports positively. To capture this variable, we use a weighted average of the real per capita GDP of all those countries which import tea from India, with the weights being the share of each country’s per capita GDP in the sum total per capita GDP.

The impact of exchange rate volatility on exports is largely an empirical issue. Since exchange rate is agreed upon at the time of the trade contract, and payments are made in future when the actual delivery takes place, there is an uncertainty associated with the profits to be made, which may lead risk-averse traders to indulge in less foreign trade. On the other hand, some traders can anticipate movements in the exchange rate based upon their knowledge and past experience in trade. So, if they have better knowledge than the average market participant, then they can make profits which might offset the risk due to exchange rate volatility (Bailey and Tavlas, 1988; Tavlas and Swamy, 1997).[[24]](#footnote-24) We represent exchange rate volatility for a year (t) by taking the coefficient of variation of the real effective exchange rate () differentials from the trend () over the current and last two years (i.e. t-2, t-1, t), where the trend is first estimated for the entire period.[[25]](#footnote-25)

**1.5 The Data Set and Methodology**

Variables of the output, consumption and export function are expressed in natural logarithms. Estimation is conducted at the all-India level for the period 1970/71 to 2005-2006. Data on all the variables has been accessed from the Tea Board of India and online databases of various

organizations.[[26]](#footnote-26) For price variables appearing in the output function, we have used wholesale or auction prices whereas for those appearing in the consumption function, we have used retail prices as far as possible. Since it was difficult to procure retail prices of complement products such as milk and sugar, we have instead used the wholesale price indices to represent these variables. Domestic per capita income is represented by the per capita net national product at constant prices.

To represent actual profit, we simply deducted the total wage bill from revenue.[[27]](#footnote-27) The means, standard deviations and units of the variables (untransformed) to be used in the analysis are reported in Table 1.1.

**Table 1.1**

Means and Standard Deviations of Variables, 1970/71 – 2005/06

|  |  |  |
| --- | --- | --- |
| Variable (Units) | Mean | Standard Deviation |
| *Q* (million kilograms) | 679.16 | 148.02 |
| *C* (million kilograms) | 469.24 | 162.50 |
| Variable (Units) | Mean | Standard Deviation |
| *X* (million kilograms) | 198.75 | 17.482 |
| (ratio) | 1.22 | 0.21 |
| (estimated value of log (area) from equation (17) | 0.01 | 0.01 |
| (number) | 966848.7 | 166979.8 |
| (Rupees/kg.) | 3.67 | 2.89 |
| (unit-free) | 0.08 | 0.03 |
| (ratio) | 0.99 | 0.10 |
| (ratio) | 1.31 | 0.35 |
| (unit-free) | 75.37 | 44.94 |
| (unit-free) | 80.33 | 55.96 |
| (unit-free) | 95.57 | 30.41 |
| (ratio) | 1.52 | 0.23 |
| (ratio) | 1.34 | 0.16 |
| (USD constant,1996 prices) | 24979.1 | 5514.5 |
| (unit-free) | 0.008 | 0.005 |

Note: The variables are Output (Q), Consumption (C), Exports (X), Relative price (), lagged bearing acreage (), Labour (L), Fertiliser price (), Yield risk (), Own price of tea (), Price of coffee

(), Price of sugar (), Price of milk (), Domestic per capita income (), International price relative (), Domestic price relative (), Per capita income of tea importing countries (), and Exchange rate volatility ()

We estimate the three equations (eq. (13), (16) and (18)) jointly using the Seemingly Unrelated Regression Equations (SURE) technique.[[28]](#footnote-28) However, in the presence of time-series, we put forth the following error-correction framework[[29]](#footnote-29) which describes both the short-run dynamics and the long-run equilibrium, captured by the error correction term.

 [[30]](#footnote-30) (19)

where , , ,, is the first-difference operator and  is the vector of disturbance terms from the three equations. and are the parameter vectors. In other words,  is the vector of dependent variables,  is the vector of explanatory variables of the three equations, and  is the vector of lagged error terms obtained from the OLS estimates of the three equations. The appropriate lag length for the explanatory variables of the ECMs is chosen by looking at the residuals from each equation. A lag length of zero indicates the evidence of no serial correlation at conventional levels of significance and the Jarque-Bera (JB) statistic is also insignificant, which means that the residuals are normally distributed.[[31]](#footnote-31) The Dolado-Jenkinson-Sosvilla-Rivero test[[32]](#footnote-32) reveals that log (*Q*), log(*C*), and log (*YIM*) are integrated of order 2; log (), log (*L*), log () and log (*V*) are integrated of order 0; all other variables are integrated of order 1.[[33]](#footnote-33) We thus first - difference I (2) variables once and then estimate the error-correction model.[[34]](#footnote-34)

**1.6 Estimation Results**

The estimation results of our SURE model presented in Table 1.2 are quite good. The hypothesis that all the slope coefficients are equal to zero is rejected for the output, consumption and exports equations (with p-values equal to zero)[[35]](#footnote-35). The hypothesis that the USSR-period (1970-1991) and the post-USSR period regressions are the same (i.e. the USSR period dummy and its interactions are all zero) is rejected for the exports equation. This means that the response of exports to various factors was significantly different in the USSR and the post-USSR period. Exports are found to be highly responsive to the international price relative and income (*YIM*) in both periods but remained responsive to the domestic price relative only in the post-USSR period. Let us examine the regression results in detail.

**1.6.1 *Output Response***

Output is positively and significantly related to bearing acreage and the relative error of price expectation, with 95% confidence intervals of (0.26, 1.77) and (0.04, 0.12) respectively. The estimates show that a 1% increase in the bearing acreage would increase output by 1.02 % (significant at the 1% level) whereas a 1% increase in the relative error of price expectation would increase output by 0.1 % (significant at the 1 % level). Fertilizer price is found to be statistically significant, with the corresponding coefficient being -0.03 (significant at the 5% level) and a 95% confidence interval of (-0.04, 0.00) which lies close to 0. Further, output is found to be unresponsive to labour.[[36]](#footnote-36) Lagged output is positively and significantly related to current output with a coefficient value of 0.47 and 95% confidence interval of (0.23, 0.72). Finally, the error correction term is found to be negative significant (-1.59) with a large confidence interval (95% confidence interval being (-2.02,-1.16)), which implies that a long run equilibrium relationship exists between the variables of the output function.

The standardized beta coefficients (Refer Table 1.3) of the relative error of price expectation and lagged bearing acreage are almost equal in magnitude (=0.33 and 0.3 respectively), thus implying that the short-run harvesting decisions and the long-run investment decisions are both equally important in the determination of tea output. Further, the coefficient of lagged output is also equal to 0.47 which means that persistent effect is also high, or in other words, last period’s output is an important determinant of current output. Our output model thus highlights the importance of the short-run and the long-run decisions of a tea producer and in that sense, scores over the published literature on perennial crop output models (Rahman, 2007; Dwibedi, 1999; Elnagheeb and Florkowski, 1993).[[37]](#footnote-37)

**1.6.2 *Consumption Response***

The estimates of the consumption function reveal that consumption of tea is responsive to its own price, domestic per-capita income, price of sugar and the trend variable. Although the estimates are extremely small in value (own price elasticity of demand = -0.007; income elasticity of demand = 0.04, cross price elasticity = -0.008 and trend coefficient = -0.0000795), they are statistically significant. However, the 95% confidence intervals for the above estimates are (-0.01, 0.00), (0.00, 0.06), (-0.01, 0.00) and (0.00, 0.00) respectively.[[38]](#footnote-38) An argument in favour of the small elasticity coefficients is that bulk of the demand is already being met by the domestic market, and hence further changes in income or prices do not evoke much response in domestic consumption. One-period lagged change in consumption is found to be statistically insignificant. The error correction term is negative significant (-0.55) at conventional levels of significance with a 95% confidence interval of (-0.12, 0.46) which is large.

The standardized beta coefficients indicate that income is the most important variable in determining consumption, followed by price of sugar and the trend variable. The own-price of tea is the variable of least importance in determining consumption of tea. The related literature reports very high income elasticities[[39]](#footnote-39) and very low (and even insignificant in some studies) price elasticities[[40]](#footnote-40) (Singh, 1991; Misra, 1990; Costa, 1968). Low price elasticity, which is a common finding in this study and in other studies, indicates that price does not play a very significant role in determining consumption of tea. Unless suitable measures are taken, such as creating awareness amongst consumers regarding the health benefits of tea or inventing newer products like flavoured/specialty teas[[41]](#footnote-41) and convenient products like instant teas for the domestic market, the tea industry would increasingly lose out to other competing

beverages. This is also evident from the trend variable, which captures the adverse impact on consumption due to a change in the tastes of consumers over time.[[42]](#footnote-42)

**1.6.3 *Exports Response***

In the post-USSR period, a 1% rise in the international price relative leads to a 0.57% fall in exports. The coefficient is statistically significant at the 1% level with a 95% confidence interval of (-0.89, -0.26), which is quite large (Table 1.2). This implies that a rise in the price of Indian tea vis-à-vis competing countries’ tea price will make Indian tea comparatively less competitive thus leading to a fall in demand for Indian tea exports.[[43]](#footnote-43) Contrary to the negative coefficient obtained in the post-USSR period; we find a positive and significant coefficient of the same in the USSR period, the elasticity being 0.47 (which is similar to the estimates obtained by Kumar and Kumar (1994), with a 95% confidence interval of (0.12, 0.81) which points to the fact that since in the USSR period, especially from mid-eighties up till 1991, more than half of India’s tea exports was sold to the Soviet Union based upon favourable terms of trade between the two, even with a rise in the international price relative (which made Indian tea comparatively less competitive), India was assured a certain level of exports and so, overall tea exports did not fall. However, after the disintegration of USSR, India lost a huge market for its tea, exports became market-dependent and competition began to play an important role in determining exports. [[44]](#footnote-44)

The domestic price relative (), i.e. the export price of tea relative to the domestic price of tea is found to be positive significant in the post-USSR period but insignificant in the USSR period, with the elasticity in the former being 0.37. The 95% confidence interval for the estimate is (0.06, 0.68), which is quite large. The positive sign of the domestic price relative indicates that greater is the margin between the export price and the domestic price of tea, greater is the incentive to export.[[45]](#footnote-45)

Per capita income of the tea importing countries (*YIM*) is found to be negative significant in the post-USSR period and positive significant in the USSR period with corresponding elasticities being -2.12 and 1.76 respectively. The estimates have large confidence intervals (95% confidence intervals are (-3.34 and -0.89) and (0.47, 3.05) respectively in the post-USSR and the USSR period). Whereas Were, Ndung’u, Geda and Karingi (2002) reveal an insignificant coefficient for income in the estimation of Kenyan coffee exports, and a negative significant coefficient of the same in case of tea;[[46]](#footnote-46) income elasticity of tea exports is positive significant (=0.3) in Dutta (1965) and (=0.74) in Kumar and Kumar (1994), given that both studies cover only up till the USSR period. Thus our income elasticity estimates are comparatively much higher.[[47]](#footnote-47) An argument in favour of the negative coefficient of income in the post-USSR period is that a rise in the income of tea importing countries was perhaps associated with a shift towards better quality teas exported by other competing countries or towards other beverages.

Exchange rate volatility (*V*) has been found to be negative significant in the post-USSR period and positive significant in the USSR period with elasticity values of -0.042 and 0.085 respectively (both coefficients being significant at the 1% level) lying between 95% confidence intervals of (-0.07, 0.09) and (0.03, 0.13) respectively which are not very large.[[48]](#footnote-48)

The dummy variable representing the U.S.S.R period () has a positive coefficient (=0.43) and has a significant level effect on exports (statistically significant at the 1% level). The 95% confidence interval of (0.19, 0.67) is also quite large. This means that the USSR period was a favorable period for Indian tea exports. In fact, a closer look at the graphical representation of exports reveals that in the post disintegration period, exports dropped to a very low level and then gradually began to pick up in the subsequent years, yet could never reach the higher volumes attained during the U.S.S.R period. As discussed before, this distinct decline in exports in the post USSR period is partly explained by the fact that Russia and the CIS states began to show a preference towards orthodox teas which India did not produce sufficiently, and partly because Indian teas in these markets was also competing heavily with cheaper CTC exports of newly competing countries like Kenya, as also from China and Vietnam.

As we just noted, the disintegration of USSR was a severe jolt to Indian tea exports. This is evident from the negative coefficient (-0.13) of the second dummy variable (), which is statistically significant at the 1% level with a 95% confidence interval of (-0.20, -0.05). Thus, USSR’s breakdown meant that Indian tea suddenly lost the comfortable cushion provided by the erstwhile Soviet Union Market (which accounted for more than 50% of India’s tea exports) and was faced with tough competition in terms of creating newer markets for its tea. Further, lagged exports are found to be statistically insignificant but the error correction term is significant at the 1% level with a coefficient value of -0.95 lying between a 95% confidence interval of (-1.34, -0.55), which means that we have a long run equilibrium relationship between the variables of the export function.

The standardized beta coefficients (Table 1.3) indicate that the USSR period was an extremely important period for Indian tea, the coefficient being very high (=3.5). Also, in the post-USSR period, both the international price relative and income of importing countries were the most important variables in determining tea exports (coefficients are almost equal), followed by the domestic price relative. On the other hand, in the USSR period, exchange rate volatility turned out to be the most important variable (coefficient = 3.7), followed by the international price relative and income of importing countries (coefficients are equal to 0.7 for each).

**Table 1.2: Estimates of Seemingly Unrelated Regression Equations Model: Output, Consumption and Export equations**

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Output (Q) | Consumption (C) | Exports (X) |
|  | -1.592\*\*\*  (0.218) | - | - |

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Output (Q) | Consumption (C) | Exports (X) |

|  |  |  |  |
| --- | --- | --- | --- |
|  | 0.084\*\*\*  (0.022) | - | - |
|  | 1.02\*\*\*  (0.384) | - | - |
|  | -0.033  (0.021) | - | - |
|  | -0.026\*\*  (0.011) | - | - |
|  | 0.477\*\*\*  (0.124) | - | - |
|  | - | -0.554\*\*\*  (0.144) | - |
|  | - | -0.007\*  (0.004) | - |
|  | - | -0.008\*\*  (0.004) | - |
|  | - | 0.04\*\*\*  (0.015) | - |
|  | - | -0.0000795\*  (4.91E-05) | - |
|  | - | 0.17  (0.151) | - |
|  | - | - | -0.95\*\*\*  (0.201) |
|  | - | - | -0.575\*\*\*  (0.160) |
|  | - | - | 0.371\*\*  (0.158) |
|  | - | - | -2.12\*\*\*  (0.625) |
|  | - | - | -0.042\*\*\*  (0.017) |
| Variable | Output | Consumption | Exports |
|  | - | - | 0.099  (0.124) |
|  | - | - | 0.434\*\*\*  (0.122) |
| \* | - | - | 0.471\*\*\*  (0.175) |
| \* | - | - | -0.223  (0.178) |
| \* | - | - | 1.764\*\*\*  (0.659) |
| \* | - | - | 0.085\*\*\*  (0.024) |
|  | - | - | -0.127\*\*\*  (0.038) |
| Constant | 0.45  (0.293) | 0.0002  (0.001) | -0.206\*\*\*  (0.083) |
| Wald(  (p-value) | 85.12  (0.00) | 30.21  (0.00) | 85.51  (0.00) |
| p-value ( and interactions=0) | - | - | 0.00 |
| p-value ( interactions=0) | - | - | 0.00 |

Note: The variables are Output (Q), Consumption (C), Exports (X), Relative error of expectation (), lagged bearing acreage (), Labour (L), Fertiliser price (), Yield risk (), Own price of tea (), Price of coffee (), Price of sugar (), Price of milk (), Domestic per capita income (), International price relative (), Domestic price relative (), Per capita income of tea importing countries (), Exchange rate volatility (), USSR-period dummy (),dummy for disintegration of USSR (), and the lagged error correction terms (,and ). All variables, except the dummies are in natural logs. Standard errors are reported in parentheses below corresponding coefficient estimates.

\*\*\*, \*\* and \* indicate significance at the 1%, 5%, and 10% levels, respectively.

**Table 1.3: Standardized Beta-Coefficient Estimates of Seemingly Unrelated Regression Equations Model: Output, Consumption and Export equations**

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Output (Q) | Consumption (C) | Exports (X) |
|  | -0.902\*\*\*  (0.218) | - | - |
|  | 0.336\*\*\*  (0.022) | - | - |
|  | 0.30\*\*\*  (0.384) | - | - |
|  | -0.176  (0.021) | - | - |
|  | -0.208\*\*  (0.011) | - | - |
|  | 0.477\*\*\*  (0.124) |  |  |
|  |  | -0.554\*\*\*  (0.144) |  |
|  | - | -0.233\*  (0.004) | - |
|  | - | -0.293\*\*  (0.004) | - |
|  | - | 0. 4\*\*\*  (0.015) | - |
|  | - | -0.279\*  (4.91E-05) | - |
|  |  | 0.17  (0.151) |  |
|  |  |  | -0.475\*\*\*  (0.201) |
|  | - | - | -1.01\*\*\*  (0.160) |
| Variable | Output (Q) | Consumption (C) | Exports (X) |
|  | - | - | 0.55\*\*  (0.158) |
|  | - | - | -0.989\*\*\*  (0.625) |
|  | - | - | -0.494\*\*\*  (0.017) |
|  | - | - | 0.099  (0.124) |
|  | - |  | 3.573\*\*\*  (0.122) |
| \* | - | - | 0.761\*\*\*  (0.175) |
| \* | - | - | -0.293  (0.178) |
| \* | - | - | 0.764\*\*\*  (0.659) |
| \* | - | - | 3.72\*\*\*  (0.024) |
|  | - | - | -0.351\*\*\*  (0.038) |
| Constant | 0.45  (0.293) | 0.0002  (0.001) | -0.206\*\*\*  (0.083) |
| Wald(  (p-value) | 85.12  (0.00) | 30.21  (0.00) | 85.51  (0.00) |
| p-value ( and interactions=0) | - | - | 0.00 |
| p-value ( interactions=0) | - | - | 0.00 |

Note: The variables are same as in Table 1.2.

\*\*\*, \*\* and \* indicate significance at the 1%, 5%, and 10% levels, respectively.

**1.7 Concluding note**

This paper focused on the interlinkages between production, consumption and exports of tea in India and thereby provided a sound methodology to estimate the exports function for Indian tea. The published literature on tea exports does not consider the mutual interdependence between production, consumption and exports of tea, thereby leading to improper theoretical models and untenable empirical results. In the light of these studies, we use the SURE technique which exploits the correlation between the disturbances in the three equations and jointly estimates the same using generalised least squares, after first recognizing the time series properties of the variables.

The estimation results point to several noteworthy findings. First, the coefficient of the international price relative () changed from positive in the USSR period to negative in the post-USSR period, which meant that whereas in the U.S.S.R period, India did not experience a fall in its tea exports due to favourable terms of trade with the U.S.S.R; in the latter period, competition began to play an important role and India was competing with cheaper teas from China, Vietnam and Kenya in Russia and the CIS markets. Second, our estimates indicate that the responsiveness of exports to foreign income was positive in the USSR period but negative in the post-USSR period. This indicates a shift in the demand patterns of foreign consumers with a rise in their incomes in the latter period. Third, the estimates of the domestic consumption function point to low price and income elasticities and the adverse impact of the trend variable. Low price and income elasticities suggest that bulk of the output is already being absorbed by the domestic market and so further increases in price or income will have little impact on consumption. This is also suggestive from falling growth rates in consumption over successive decades (decadal growth rates in consumption have fallen from 6.5% p.a. during the fifties to 2.6% p.a. during the current decade). Therefore, consumption does not necessarily rise with a rise in the income levels of consumers, more so because tea is a necessity good[[49]](#footnote-49). Further, the negative significant coefficient of the trend variable in the consumption function indicates that the willingness of domestic consumers to switch to better varieties of teas or other beverages also depends upon their tastes and preferences and not just on prices and income.

The above findings enable us to deduce the following. First, the USSR period was a favourable period for Indian tea whereas the period after, was a difficult one, because with the disintegration of the USSR, India realised the need to create newer markets for its tea as well as the need to gain a strong foothold in markets which are skewed in favour of orthodox teas. Given that India did not have a strong foothold in orthodox varieties, supply was short and as a result there was a sudden fall in exports to a very low level immediately after the disintegration. Second, the shift in demand of the foreign consumers with a rise in income levels was either toward other competing beverages or toward better quality teas exported by the competing tea exporting countries.

Looking at the shift in demand patterns of foreign consumers, policy measures must necessarily aim to achieve diversification of tea production in favour of orthodox and green teas, which is a must for the sustenance of the Indian tea industry. With consumption of orthodox tea picking up all over the world, this means that resources have to be geared towards production of orthodox teas by investing in more capital that is exclusively suited for orthodox tea production. In other words, India has to follow two separate strategies, viz. to produce adequate orthodox teas to cater to foreign markets, and to continue to produce CTC teas, primarily for the domestic market. The first strategy would be beneficial in terms of lowering the cost of production and making the price of orthodox tea relatively more competitive as against Sri Lankan and Indonesian orthodox varieties. The second policy prescription is to create further demand by boosting both domestic consumption and exports. This can be achieved by way of innovation and creation of newer products such as flavoured or specialty teas, convenient products like instant teas, organic and decaffeinated varieties of teas and promote the health benefits of tea using techniques like campaigning and advertising, for both the domestic and international consumer so that tea remains not just a cheap but an attractive beverage.

To confirm that the results obtained using the SURE technique are superior to those obtained by using ordinary least squares, we have estimated error-correction models for output, consumption and exports separately using the same set of regressors as used in the SURE model.[[50]](#footnote-50) Results indicate that bearing acreage and labour are both statistically insignificant in the output model; own price of tea, lagged consumption and trend turn insignificant in the consumption model; and lastly, domestic price relative, exchange rate volatility, and the level effect of the dummy representing the USSR period as well as two interaction variables are statistically insignificant in the estimated exports model. Although many of the regressors in the export function are statistically significant, the coefficients have comparatively higher standard errors and hence lower t-ratios. Besides, the dummy for disintegration of USSR is found to be significant, but this result seems to contradict the insignificant impact of the USSR period dummy. On the contrary, the results obtained from the simultaneous equations model can be substantiated by economic theory. Thus, the fact that the SURE technique gives better results than OLS only proves that it is important to recognise the mutual interdependence between output, consumption and exports.

It is to be noted that the export function can be augmented by introducing several other relevant variables; for instance, the exchange rate or tea production in the world other than that in India (as in Kumar et al., 1994); however, our sample size is not very large and hence it is not prudent to introduce too many regressors. Reinstated, one of the important contributions of this paper is to examine the interlinkages between the three broad aggregates, namely production, consumption and exports of tea, and then to estimate the exports function for Indian tea using an appropriate methodology.

**Appendix**

Figure 1 Scatter Plot of the Absolute Levels of Consumption (CO) and Income (PCY)



A1 B-G Lagrange multiplier test of serial correlation: ECM (Equation (19))

|  |  |  |
| --- | --- | --- |
| Auxiliary Equation (Dependent Variable) |  | Critical Chi-Square (5%) |
|  | 0.534 | 3.841 |
|  | 2.184 | 3.841 |
|  | 0.171 | 3.841 |

Inference: Since the computed chi-squared statistic is less than the tabulated value at the chosen level of significance, we cannot reject the null hypothesis of no serial correlation.

A2 Jarque-Bera Statistic for the residuals of the ECMs (Equation (19))

|  |  |  |
| --- | --- | --- |
| Residuals | J-B Statistic | Probability |
| Output Eqn. | 2.194 | 0.333 |
| Consumption eqn. | 1.995 | 0.368 |
| Exports Eqn. | 0.576 | 0.749 |

Inference: Residuals from the Error Correction Models are normally distributed.

Figure 2



Figure 2 (contd.)



Figure 2 (contd.)



Figure 2 (contd.)



Figure 2 (contd.)



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1. In Bond (1987), primary commodities include food, beverages and tobacco, agricultural raw materials, energy and minerals. [↑](#footnote-ref-1)
2. During the harvest season, every bush is plucked at an interval of 4-7 days. [↑](#footnote-ref-2)
3. Sunk costs represent barriers to exit. A firm which has incurred high sunk costs will have difficulties in deciding to exit the market even if it sees good opportunities outside. Conversely, a firm that is deciding whether to enter into a certain business will have to keep in mind that the sunk costs might not be recovered. Sunk costs, in this perspective, represent barriers to entry. High sunk costs make an investment irreversible, and coupled with uncertainty about the future, impacts the level of investment by industry. [↑](#footnote-ref-3)
4. Infilling refers to filling the gaps between existing tea bushes by planting high yielding varieties or clonal bushes. See Dwibedi H.N. “Production of Tea in India”, K P Bagchi & Company, Calcutta. [↑](#footnote-ref-4)
5. The plucking style adopted can either be two leaf and bud (called fine plucking) or three or four leaf and bud (called coarse plucking). Whereas fine plucking ensures better quality with a lower output, coarse plucking results in a higher output of lower quality. [↑](#footnote-ref-5)
6. Increasing the acreage can lead to a greater output, but there is a gestation lag involved. Similarly, decreasing the acreage is not preferred due to huge sunk costs already incurred. [↑](#footnote-ref-6)
7. In a broad sense, perennial crops are the crops which live for more than two years and are characterized by both development and productive phases (E.g. tea, coffee, cocoa, rubber, grapes, apples, oranges, alfalfa, bush berries etc.). [↑](#footnote-ref-7)
8. Nerlove (1958). [↑](#footnote-ref-8)
9. Matured vintages refer to tea bushes aged between 5-50 years of age during which the bushes are considered economic. [↑](#footnote-ref-9)
10. Generally, ‘uprootings’ or removal of old tea bushes precedes replantings. Whereas in case of Bangladesh and Sri Lanka, data reveals how much area is uprooted and how much is replanted; in India, information on uprootings and replantings are not separately available. Thus, one can only tell from the data on replantings that atleast as much or maybe a greater area is uprooted. [↑](#footnote-ref-10)
11. We use one-period lagged acreage to avoid the problem of simultaneity between current output and current acreage. Using lagged acreage as an instrumental variable helps to deal with the same. [↑](#footnote-ref-11)
12. We would have used relative expected profits if it were possible for the tea producer to shift in and out of tea production. All other crops that the producer may choose to produce along with tea are produced on a small scale for home consumption and hence cannot be considered as substitutes for a tea producer. For instance, in Kerela, rubber, pepper, bananas, ginger, lemon grass, mangoes, jackfruit, coconut etc. are grown along with tea because the latter does not require labour all around the year and this enables the small growers to grow a part of the food that they consume. Thus, such crops cannot be treated as substitutes of tea from the producer’s point of view. For a discussion, see Dwibedi H.N. “Production of Tea in India”, K P Bagchi & Company, Calcutta. [↑](#footnote-ref-12)
13. For estimating (12), we need to specify *p*,*d* and *q*. On the basis of various stationarity tests, we first choose *d=*1*.* Next, allowing *p* ={1,2} and *q*={1, 2}, we estimate a variety of models and choose the best combination (*p,q*) by considering the invertibility criterion, the significance of the ARMA terms, the Schwarz criterion, the Ljung-Box-Pierce test and various error properties. This enables us to estimate the expected profit (). [↑](#footnote-ref-13)
14. We first check the variables of eq. (8) for their stationarity properties (stationarity test results are available with the author on request) and then estimate several ordinary least squares regressions and choose an appropriate model by looking at the Akaike’s information criterion and the mean squared error. Diagnostic tests performed on the chosen model reveal the presence of heteroscedasticity and autocorrelation of the first order, which means that the OLS estimates are not efficient. But since we have a reasonably large sample (n=50), we still use OLS after correcting the standard errors using a procedure developed by Newey and West (1987). The corrected standard errors, known as HAC (heteroscedasticity-and-autocorrelation-consistent) standard errors or Newey-West standard errors, correct for both heteroscedasticity and autocorrelation. According to Griliches and Rao (1969), GLS and HAC might do worse than OLS if the sample is relatively small and the coefficient of autocorrelation () is less than 0.3. However, given that our sample size is 50 and  roughly lies between 0.44 and 0.47 (=0.47 using the formula 1-d/2 whereas  =0.44 obtained by estimating an AR (1) process), we can safely use HAC estimates. The estimated coefficients and the  thus obtained are the same as those obtained before correcting the standard errors. But more importantly, the HAC standard errors are much greater than the OLS standard errors and therefore, the HAC t-ratios are much smaller than the OLS t-ratios. [↑](#footnote-ref-14)
15. Labour is required intensively for fertilising, pruning and harvesting (or plucking). Fertiliser-application is a manual operation wherein the more productive fields require additional rounds involving more labour. Pruning is important to maintain the tea bush in the right form and height for growing and plucking. It also involves removal of dead or decayed branches so as to ensure a clean and healthy plant. Unlike other field activities, pruning is mostly done by men workers. Some activities like weeding earlier required intensive use of labour but with introduction of chemical weeding, the workforce involved in this activity has shrunk over time. As regards plucking, in some areas, mechanization is being tested in the form of shear harvesters, but the results do not compare quality-wise with hand plucking. Other activities such as new plantings, infilling, and especially replanting which involves uprooting old bushes, rehabilitation of soil, planting tea bushes and maintenance of young bushes are overwhelmingly labour intensive. [↑](#footnote-ref-15)
16. MOP or muriate of potash is potassium chloride, which is used as a fertiliser. [↑](#footnote-ref-16)
17. We first compute the deviations in rainfall from the long period average rainfall for three previous periods. Let the deviations be denoted by where  is the actual rainfall in year t and is the long period average rainfall in year t (i.e. the average of previous 30 years). We measure the yield risk or the coefficient of variation as the standard deviation of divided by the mean of. [↑](#footnote-ref-17)
18. Refer Singh (1991). [↑](#footnote-ref-18)
19. Thirlwall’s export function is based upon his Balance-of-payments-constrained growth (BPCG) model (Thirlwall 2003; Thirlwall 1979). The BPCG model, which has been applied extensively in the context of the developed and the developing world, estimates the price and income elasticities of exports and imports (Penelope Pacheco-Lopez 2005; Perraton 2003; Thirlwall and Hussain 1982) and finally the Balance-of-payments-constrained growth rate. Also see Essays on Balance of Payments Constrained Growth: Theory and Evidence by J.S.L Mc Combie and A.P. Thirlwall, 2004. [↑](#footnote-ref-19)
20. CIS refers to the Commonwealth of Independent States, a modern political entity consisting of eleven former Soviet Union republics. [↑](#footnote-ref-20)
21. The collapse of the Soviet Union disrupted Indo-Soviet tea trade as well as the long-standing military supplies from the former Soviet Union. [↑](#footnote-ref-21)
22. Competing countries would include Sri Lanka, Kenya, Bangladesh, Indonesia and Malawi. So, we take a weighted average of the auction prices prevailing in the respective auction centres, viz. Colombo, Mombasa, Chittagong, Jakarta and Limbe, to represent the average export price in the competing countries. [↑](#footnote-ref-22)
23. The all - India wholesale price is constructed by taking an average of the auction prices prevailing in the regional auction centres, viz. Kolkata, Siliguri, Guwahati, Cochin, Coonoor and Coimbatore. [↑](#footnote-ref-23)
24. Although most empirical work treats exchange rate volatility as a risk variable which may have a negative impact on exports (examples are Arize et. al. 2008, Kiptui (2008), Choudhury 1993), a positive relationship between the two variables has been found in case of many countries (refer Baum et al. (2004), Doyle (2001) and Qian and Varangis (1994). [↑](#footnote-ref-24)
25. We first fit a log-linear trend to the data and derive the estimated value, . We then derive (-) or the deviation of the real effective exchange rate from its trend value for the entire sample and compute the coefficient of variation as the standard deviation of () divided by the mean of (). Choudhury (1993) and Arize et al. (2000) use a moving-sample standard deviation of the real effective exchange rate with the order of the moving average being 8 and 7 respectively. Choudhury (1993) further claims that the results are robust even when the value of m is changed to 4 or 12. For an alternative measure of exchange rate volatility, see Pozo (1992). However, Pozo’s results are not sensitive to the particular measure of exchange rate volatility employed. [↑](#footnote-ref-25)
26. Data on labour is obtained from the Tea Board of India (a); and  are computed from data available in Tea Board of India (a) and (b); Fertiliser price is constructed using the all-India prices of urea, DAP and MOP (defined before) which are obtained from the Fertiliser Association of India; yield risk computed using annual rainfall data, is obtained from the India Meteorological Department;  is constructed by taking the average of the retail price of cheap quality loose tea prevailing in cities, namely, Bangalore, Cochin, Chennai, Coimbatore, Mumbai, Gujarat, Delhi, Kolkata and Lucknow, and then deflating it using the consumer price index (CPI) of food (base 2001=100);is represented by the average price of coffee powder in coffee consuming centres located at Bangalore, Chennai and Hyderabad (Coffee Statistics, Coffee Board of India, various issues), which is again deflated using the CPI of food; Domestic per capita income (*YIM*) was obtained from the Economic Survey, Government of India;  and  are computed from data in Tea Board of India (a) and International Tea Committee, London; YIM is a weighted average of the real per capita GDP (RGDP) estimates of several countries (RGDP is obtained from Penn’s World Tables and is defined as the sum of consumption, investment, government expenditure and exports minus imports in international dollars using 1996 as the reference year); *V* is computed from online data on real effective exchange rate indices computed by the Reserve Bank of India using 36- country bilateral weights. Data on extensions, replantings and replacement plantings, which have been used in estimating the area variable () are obtained from various issues of the Tea Statistics, published by the Tea Board of India. [↑](#footnote-ref-26)
27. Since data on cost of production is not available for the sample period, except during 1958-62 and 1963-65, we were only able to consider the daily minimum wage rate of the labourers as the single most component of cost. So we first computed the average daily minimum wage rate of men, women and children by pooling across district level wages in every state. Thereafter we obtained the average daily wage rate of a worker in every state and then obtained the average all-India annual income which is then multiplied with the total number of plantation labourers (which is inclusive of men, women and children) to obtain the wage bill (W). Subtracting W from revenue gives us, which is a proxy measure for actual profit. [↑](#footnote-ref-27)
28. The SURE is a two stage procedure, where in the first stage; OLS is used to calculate the covariance of the error terms across equations. In the second stage, Generalised Least Squares (GLS) is used to estimate all the parameters of the system as if it were one large equation. [↑](#footnote-ref-28)
29. The Error Correction Model (ECM) was first used by Sargan (1984) and later popularized by Engle and Granger (1987). [↑](#footnote-ref-29)
30. The Error Correction Model states that a change in the dependent variable can be explained by changes in the explanatory variables (current and lagged), lagged changes in the dependent variable and lagged error term from the cointegrating relationship. The coefficient of the lagged error correction term represents the proportion of long run disequilibrium in the dependent variable, which is corrected in every short term period, and is thus expected to be negative. [↑](#footnote-ref-30)
31. Diagnostic tests of serial correlation and normality are conducted using the Lagrange Multiplier statistic and the JB statistic respectively. See tables A1 and A2. [↑](#footnote-ref-31)
32. Refer J. J. Dolado, T. Jenkinson, Simon Sosvilla-Rivero (1990). [↑](#footnote-ref-32)
33. Graphs of the (logs of) explanatory variables of our simultaneous equations model are given at the end of this paper (Figure 2). Stationarity test results are available with the author on request. [↑](#footnote-ref-33)
34. The system of equations also satisfies the rank and order conditions of identification. [↑](#footnote-ref-34)
35. See Wald  statistics reported in Table 1.2 at the end of this section. [↑](#footnote-ref-35)
36. Yield risk was also found to be insignificant and after dropping the variable, the fit of the model was significantly improved. [↑](#footnote-ref-36)
37. Our estimates find support in Mitra (1987) which finds lagged area to be highly significant, with a large area elasticity(=5.33). Certain other studies like Wickens and Greenfield (1973) and Behrman (1967) find output to be unresponsive to all the explanatory variables in the supply equation. [↑](#footnote-ref-37)
38. Elasticities with respect to price of coffee and price of milk were found to be statistically insignificant and we dropped these variables from our model. Besides, in case of coffee prices, data from 1989-1993 were missing and although we had used estimates, there was still a big difference in the prices before 1989 and after 1993 in the existing data set. We thus felt that the data is not very reliable. [↑](#footnote-ref-38)
39. Singh (1991), Misra (1990) and Costa (1968) report income elasticities equal to 1.25-1.3(various specifications), 1.78 and 1.49 respectively. [↑](#footnote-ref-39)
40. Price elasticities in Singh (1991) and Misra (1990) are of the order, -0.04 to -0.09, -0.1-0.1 respectively. Costa (1968) reports insignificant price elasticities in all the models. Insignificant price elasticities obtained may be due to the fact that from a consumer’s point of view, the correct price variable should be the price of tea relative to the price of substitutes of tea or simply the absolute price of tea, whereas Costa (1968) uses the domestic price relative to the export price of tea as a regressor in the consumption function. [↑](#footnote-ref-40)
41. Flavoured or specialty teas refer to herbal, fruit and spiced varieties of tea. [↑](#footnote-ref-41)
42. Contrary to our estimates of the trend variable, Singh (1991) finds the trend coefficients to be positive and comparatively much larger thus varying between 0.13-0.15 in the estimation of per capita consumption in different specifications. [↑](#footnote-ref-42)
43. Kumar and Kumar (1994) find the coefficient of  to be positive (=0.47) and insignificant, Kutty (1999) reveals positive and significant coefficients of the same in some of the import demand functions for Indian tea, estimated separately for different tea importing countries. On the other hand, Dutta (1965) reveals a 0.1% fall in Indian tea exports with a 1% fall in the country’s price competitiveness. Yet others such as Arize, Osang and Slottje (2000) reports price elasticities varying between 0.1- 1.52 for exports of thirteen LDCs whereas Bond (1987) reports a price elasticity equal to -0.33 for beverage and tobacco exports of developing countries. Also see Goldstein and Khan (1984) and Behrman (1977) for price and income elasticity estimates of beverage exports. [↑](#footnote-ref-43)
44. Whereas before the disintegration of the Soviet economy, USSR imported 78.3% of its tea from India (average for the period 1970/71-1990/91); after the disintegration in 1991, Russia and CIS imported 46.4 % of their total imports of tea from India on an average (average for the period 1991/92-2005/06). [↑](#footnote-ref-44)
45. Kumar and Kumar (1994) obtain a negative coefficient for  (= -0.40) and their argument is that it implies that the export market and the domestic market are mutually competitive. [↑](#footnote-ref-45)
46. Were et. al. (2002) argues that the negative sign of income in the exports function for tea can be explained by shifting markets for Kenyan commodities. [↑](#footnote-ref-46)
47. Arize, Osang and Slottje (2000) finds income elasticities varying between 1.1 – 4.19, whereas Moreno-Brid and Perez (2003) report income elasticities ranging from 1.07-2.64. Even Kiptui (2008) reports income elasticites of similar order (=1.01). These are comparatively higher than those obtained in other studies. In this context, Adler (1970) argues that income elasticities reflect the extent to which exports have been adapted to the importing countries’ local tastes. Thus, high income elasticity provides evidence of greater adaptation. [↑](#footnote-ref-47)
48. The related literature reports both positive and negative impacts of exchange rate volatility on exports. For instance, Hongwei Du and Zhen Zhu (2001) report positive significant elasticities (=0.02 and 0.04 respectively for different specifications of the model) whereas Kiptui (2008) and Arize, Osang and Slottje (2000) report negative significant elasticities (0.02 and between 0.1- 0.85 respectively with respect to exchange rate risk). Arize, Osang and Slottje (2008) reports even lower elasticities with respect to exchange rate volatility, thus varying between -0.001 to -0.26. Yet others like Santos-Paulino (2003) and Moreno-Brid and Perez (2003) find the real exchange rate variable to be insignificant in the estimation of exports. [↑](#footnote-ref-48)
49. Rather, an increase in income can lead to qualitative changes in consumption of tea or even a switch to other competing beverages. [↑](#footnote-ref-49)
50. The OLS estimates of the three equations (equations 13, 16 and 18) are available with the author. [↑](#footnote-ref-50)