Demand for Coffee: Prices, Preferences and Market Power

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Abstract

The purpose of this study is to evaluate the role of prices in determining demand for roasted coffee in Sweden. This is of interest because many believe that lower consumer prices would increase exports from developing countries, which are the main coffee-bean producers. In the first part it is argued that the presence of trends in the data can provide information about market power. When there is a trend in consumption but not in relative prices, firms do not control quantities with prices, or vice versa. In the second part coffee demand is estimated on Swedish data. In the long-run changing preferences determine demand, and a reduction in consumer prices only has a short-run impact. Our results indicate that lower prices will only have a temporary impact on coffee exports to Sweden.

Keywords: Coffee Prices, Demand, Market Power, Multinationals, Preferences, Sweden, Trends.

JEL Classification: L13, L66, L81.

1 Introduction

In the late 1990s coffee-bean prices started to decline and by 2002 they were on average more than 60 percent lower than in 1997. The extent of the decline can be exemplified with the price of Santos coffee beans, which in nominal terms was at the same level in 2002 as it had been in the1960s.[1] One consequence of the price collapse has been a large drop in export revenue for several developing countries and the impoverishment of many coffee farmers.

The sharp price decline has spurred interest in the question of market power in coffee markets. Since large multinational companies are active both as buyers of coffee beans and suppliers of roasted coffee, they have been held responsible, directly or indirectly, for keeping producer prices down while maintaining high consumers prices, and thereby limiting demand for coffee beans (see Dicum and Luttinger, 1999; Fitter and Kaplinsky 2001; Gooding 2003; Moore 2002; Oxfam, 2002; Ponte, 2002; Talbot, 1997)

Morisset (1998) analyzed coffee markets, as well as several other markets for commodities, and found symptoms of market power in all of them. Due to asymmetric transmission of changes in coffee-bean prices to consumer prices, the average spread between world coffee-bean prices and consumer prices in a sample of six industrialised countries increased on averaged by 186 percent from 1975 to 1994. Morisset (1997) simulated the impact of a reduction in the spread due to a reduction in consumer prices and found it to have a strong effect on export revenue in developing countries.

The objective of this paper is to evaluate the potential gain for coffee growers from a reduction in Swedish consumer prices. This is done by estimating demand for roasted coffee with a focus is on how much of the variation in demand that can be explained by prices, and what role other factors play. However, before carrying out the empirical analysis, we illustrate the role of trends in the data and how they affect the interpretation of prices in the demand function. When there is a stochastic or deterministic trend in the quantity consumed, but not in relative prices, it is unlikely that firms control quantities with prices, or vice versa, in the long run. In such cases prices are likely to be determined by marginal costs and a permanent reduction in the spread between import and consumer prices would only affect consumption temporarily. The exception is when the same trend also is present in marginal costs, which in general seems to be unlikely. In the first part of the paper this argument is illustrated with some simple oligopolistic models.

In the second part of the paper, demand for roasted coffee in Sweden is estimated for the period 1968 -2002. To model coffee demand, we start by specifying the long-run equilibrium. Then we develop an empirically stable dynamic model. In estimating the model, we first test for (and find) stationary vectors using the Johansen maximum likelihood procedure (Johansen 1988, 1995). The stationary vectors are identified and then included in a general dynamic model, which is tested in order to make sure that

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[1] The information on prices are from the International Financial Statistics database of the IMF and refer to the composite indicator of the International Coffee Organization and Santos coffee traded in the New York market.

the assumptions regarding its stochastic properties are fulfilled. Next, the model is reduced in order to obtain a parsimonious representation. Finally, the stability of the model is investigated using recursive estimation, and diagnostic tests.

Our main findings are that the long-run evolution of coffee consumption per adult is determined by a proxy variable for differences in preferences across generations in combination with population dynamics, while permanent changes in prices only have short-run affects on consumer demand. Our results thus indicate that there is a high degree of competition in the Swedish market for roasted coffee since prices and consumption are unrelated in the long run. Consequently, a reduction in spreads, due to lower consumer prices, will not permanently improve export revenue for coffee-producing countries.

The paper is organised as follows: Section 2 provides a theoretical background by illustrating the importance of trends in consumption and prices for the interpretation of the Cournot model with a homogenous product, where firms determine quantities, and the Bertrand model with differentiated products, were firms set prices. Section 3 presents the empirical approach and Section 4 describes the data. In Section 5 the results from the empirical analysis are reported. Section 6 summarises and draws some conclusions.

2 The Role of Trends in Oligopoly Models: Some Illustrations

In applied industrial economics little attention is paid to trends in data. Although they sometimes are captured by a deterministic trend, usually there are no comments about trends when the results are interpreted (see for example, Bettendorf and Verboven 2000; Genovese and Mullen 1998; Koerner 2002a, 2002b). To show how the presence of trends in consumption may affect the impact of price changes prices, and how one can evaluate the adequacy of oligopoly models by estimating demand functions, we use two models: the Cournot model where firms determine quantities, and the Bertrand model with differentiated products, were firms set prices.

We begin by analysing the Cournot model with a homogenous product. To keep the model as simple as possible, assume two firms that have the same marginal costs, *w*. They face the demand function,

$$q = \alpha - p + t \tag{1}$$

where q is the sum of output of the two firms ($q_1 + q_2$), α is a constant, p is the relative price and t is the trend in q, which could be stochastic or deterministic. The trend is usually due to income or population growth, but could also result from different preferences across population cohorts.

Both firms maximize profit by setting marginal revenue equal to marginal costs, taking the output of the other firm as given. Their first order conditions are,

$$\begin{aligned} MR_1 &= q_1 + \frac{1}{3}t + \frac{1}{3}\alpha = w \\ MR_2 &= q_2 + \frac{1}{3}t + \frac{1}{3}\alpha = w. \end{aligned} \tag{2}$$

By calculating the response functions and solving for Cournot equilibrium, here $q_1 = q_2$, and plugging in the values in the demand function, we get the determinants of the price level,

$$p = \frac{1}{3}\alpha + \frac{1}{3}t + 2w. \tag{3}$$

Equation (3) shows that the price is a function of the constant, marginal costs and the trend. When *t* represents a stochastic trend, either *p* or *w,* or both, have to contain the same stochastic trend as *t* for Equation (3) to be valid, in other words, *t* should be cointegrated with either *p* or *w,* or both. When *t* is a deterministic trend, either *p* or *w,* or both have to be stationary around a deterministic trend.

Next we look at the Bertrand model with differentiated products where firms set prices. The demand curves of the two firms are assumed to be,

$$\begin{aligned} q_1 &= \alpha - \beta p_1 + p_2 + t \\ q_2 &= \alpha - \beta p_2 + p_1 + t. \end{aligned} \tag{4}$$

The first order conditions for profit maximization for firm 1 gives its response function,

$$p_1 = \frac{\alpha}{2\beta} + \frac{t}{2\beta} + \frac{p_2}{2\beta} + \frac{w}{2}. \tag{5}$$

We use the response function for firm 2 to solve out p_2 in Equation (5). This gives the determinants of p_1,

$$p_1 = \left(\frac{2\beta + 1}{4\beta^2 - 1}\right)\alpha + \left(\frac{2\beta + 1}{4\beta^2 - 1}\right)t + \left(\frac{2\beta^2 - \beta}{4\beta^2 - 1}\right)w \tag{6}$$

Equation (6) shows that, as in the Cournot model, either price or marginal costs, or both, have to have the same trend as *t*, for the model to be valid.

These two simple examples show that when there is a trend in the demand function, it should appear in prices, marginal costs, or as a linear combination of prices and marginal costs. However, when there is perfect competition price is equal to marginal cost and the trend in demand does not influence prices. Since it seems unlikely that marginal costs have the same trend as demand while the price variable is stationary, except by coincidence, these insights can be used to evaluate whether there is market power or not.[2] In coffee roasting and marketing, in the Swedish market as well as in many other markets, changes in costs seem to be almost completely dominated by variations in coffee-bean prices, as indicated by the close correlation between consumer prices and import prices (see Durevall 2003, 2004; Sutton 1991). In fact, there is a very tight relation between the amount of coffee beans required to make roasted coffee, and marginal costs are often considered to be constant (Bettendorf and Verboven, 2000, Sutton, 1992). Hence, to accept any of the oligopoly models a description of the behaviour in the Swedish coffee market, we require prices to have the same trend as coffee demand. If it has not, a price change will only have a short-run impact on consumption.

3. Modelling Coffee Demand: The Empirical Approach

Demand for non-durable consumer goods is usually assumed to depend on income, the price of the good modelled and the prices of substitutes. When modelling demand at an aggregate level we also have to include population, and possibly some other variables. Equation (7) shows a static linear demand function supposed to represent equilibrium demand for coffee in Sweden:[3]

$$Q = \alpha_0 + \alpha_1 P + \alpha_2 Y + \alpha_3 G. \tag{7}$$

In Equation (7) *Q* is the quantity of roasted coffee per adult, *P* is the relative price of coffee, *Y* is income, *G* is a variable capturing other factors influencing demand, and α_0 α_1, α_2 and α_3 are parameters. The relative price of coffee is defined as the nominal price divided by the consumer price index since it hard to find substitutes or complements for roasted coffee. Tea is sometimes considered to be the most relevant substitute. However, tea is unlikely to be an important substitute in Sweden where coffee drinking dominates heavily, though it might be different in tea-drinking countries such as Great Britain. Other empirical studies have failed to find a significant effect from tea prices (see Bettendorf and Verboven, 2000, for the Netherlands, and Feuerstein, 2002, for Germany). A possible explanation is that price increases reduce consumption mainly because of reduction in wastage of coffee; according to a study in the Netherlands spilling can be as much as 25% (Bettendorf and Verboven, 1998).

The second variable in the demand function is income. Normally an increase in income is expected increase consumption. However, this might not be the case in a

[2] In general productivity growth, capital formation, and variations in input prices are likely to make marginal costs independent of demand in the long run.

[3] The functional form used in studies of coffee demand varies but linear and log-linear models seem to be the most common, although Bettendorf and Verboven (2000) also estimate a non-linear model, and Olekalns and Bardsley (1996) estimate a model with forward looking expectations. We tried all four specifications; the linear and log-linear version did equally well, while there was little empirical support for the other two.

market that is saturated; even if a consumer can afford to consume more coffee he/she will not.

Finally we have *G*, which is supposed to capture population dynamics. A common assumption is that a growing population generates higher demand, given prices. However, consumption patterns can differs significantly between different age groups. According to the Swedish coffee industry, there has been a slowdown in coffee consumption due to a change in preferences; people born around 1960 and later do not drink as much coffee as those born before the 1960s, who quite often consume about six cups per day. This process seems to have started at the end of the 1970s, and continues as the number of those born before 1960 declines. We measure this change in preferences in the population, the variable *G,* as the share of the population at the age of 18 and above who are born before 1960 to total population over the age of 17.

An important aspect of Equation (7) is that it describes the static state of a dynamic process. Hence, even though the variables do not have time indexes they evolve over time. Moreover, as most economic time series they are likely to contain stochastic and/or deterministic trends. The model we end up estimating is a restricted version of the following autoregressive distributed lag model:

$$Q_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} Q_{t-i} + \sum_{i=0}^{k} \alpha_{2i} P_{t-i} + \sum_{i=0}^{k} \alpha_{3i} Y_{t-i} + \alpha_4 G_t + \varepsilon_t . \qquad (8)$$

where α_0 contains the constant and a dummy variable capturing the effects of frost in Brazil in 1977, the variable *G* is treated as a deterministic variable because it changes very slowly over time, and ε_t is a mean zero white noise process.

Since some or all of the variables in Equation (7) might be non-stationary we start the econometric analysis by using Johansen's (1988, 1995) procedure to test for cointegration, and whether some individual variables are stationary.[4] This is done by estimating a vector autoregressive model, VAR, in error correction form. The long-run responses of the system are collected in an *n* times *n* matrix defined as Π and the hypothesis of cointegration is about the rank of Π. When it is of reduced rank we can write $\Pi = \alpha\beta'$, where α and β' have smaller dimensions than Π. The reduced rank is tested with the trace test, a likelihood ratio procedure. By testing for the significance of the components in β', the long-run coefficients, we can evaluate what variables that enter the cointegrating vector, and by testing the components of α, the adjustment coefficients, we can determine whether there is feedback between *Q* and *P*, that is, if *P* is weakly exogenous or whether we need to estimate demand and pricing simultaneously.

4. A Look at the Data

The two core variables explaining demand are usually assumed to be price and income. In Figure 1, coffee consumption per adult[5] is depicted together with per capita income, measured by total consumer expenditure. Note that the mean and

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[4] See Juselius (2001) for very clear illustration of the use of the Johansen approach in a study on demand for cigarettes.

variance of the income variable has been adjusted to highlight the relation between the two variables. Coffee consumption per adult was constant until the 1977, when it declined due to a sharp, but temporary, increase in prices. After 1978 there was a downward trend in consumption until 2002. Income per capita, on the other hand, grew almost continuously between 1968 and 2002. It is thus obvious that income did not determine coffee consumption during the period of analysis. The reason is probably that the level of income was so high already in the 1960s that the vast majority of the population could afford to buy all the coffee it needed. Hence, there must be other factors driving coffee consumption in the long run.

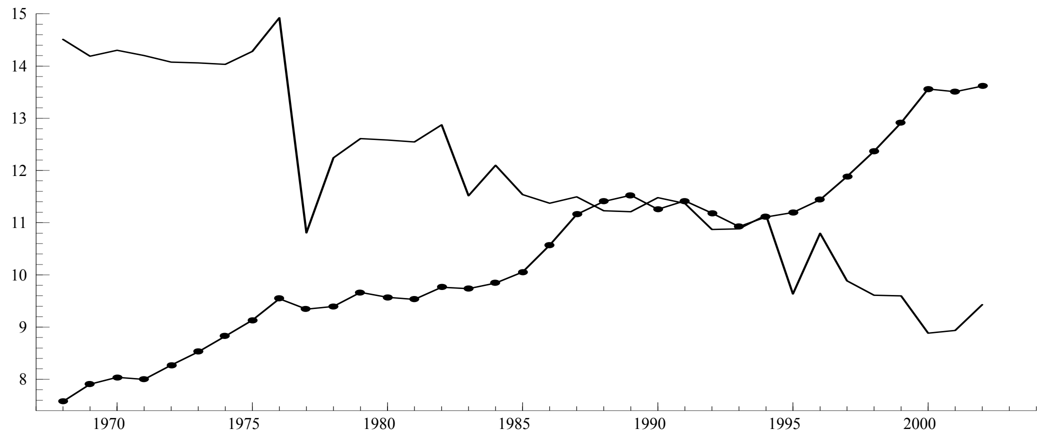

Figure 1: Coffee consumption, kilo per adult ——, and mean and variance adjusted income •—•—•.

Figure 2 illustrates the evolution of coffee consumption per adult and the mean and variance adjusted relative price of coffee (the retail price of roasted coffee divided by the consumer price index). The negative relation is visible during the end of the 1970s and around 1995, but in general the two variables move in the same direction. It is clear that price and income cannot explain coffee consumption by themselves.

[5] Coffee consumption per adult is defined as consumption per person at the age of 18 and older.

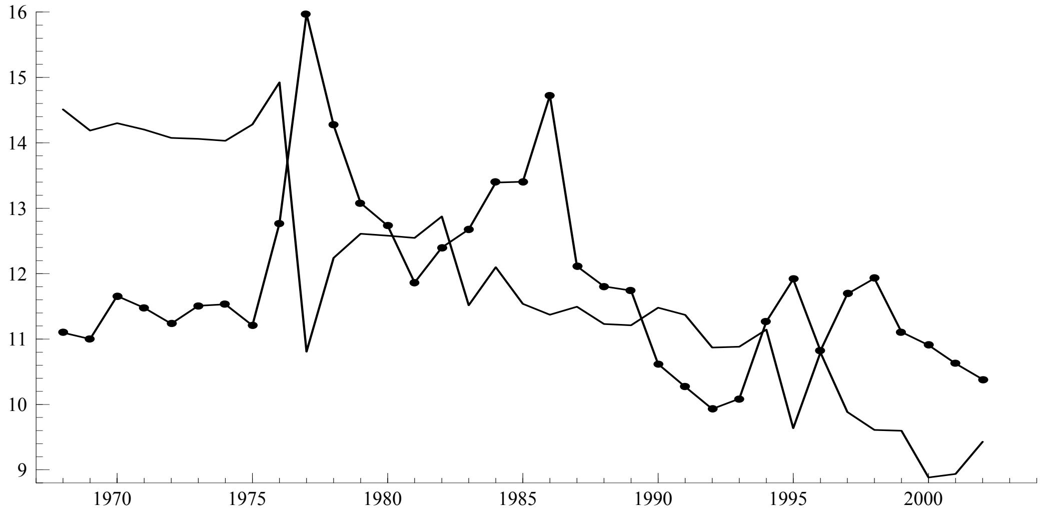

Figure 2: Coffee consumption per adult ——, and mean and variance adjusted price of coffee in 1995 Swedish kronor •—•—•.

Since the slowdown in coffee consumption has been attributed to a difference in preferences between those born around the 1960s and later, and older generations, we constructed a variable that measures the share of the total population at the age of 18 and above who are born before 1960.[6] This preference effect started at the end of the 1970s and continues as the share of those born before 1960 declines. As Figure 3 shows, the preference variable seems to explain the downward trend in coffee consumption.

Finally we graphed the price series and consumption net of the preference effect, that is, a series obtained by regressing *G* on *Q*. As shown by Figure 4, there is a strong negative relation between the two series. Hence, the change in preferences seems to explain the long run evolution of coffee consumption and the relative price level explains the movements around the trend.

[6] The view of the coffee roasting industry about the causes of the decline in consumption can be found on the homepage of the association of Swedish coffee producers (www.kaffeinformation.se).

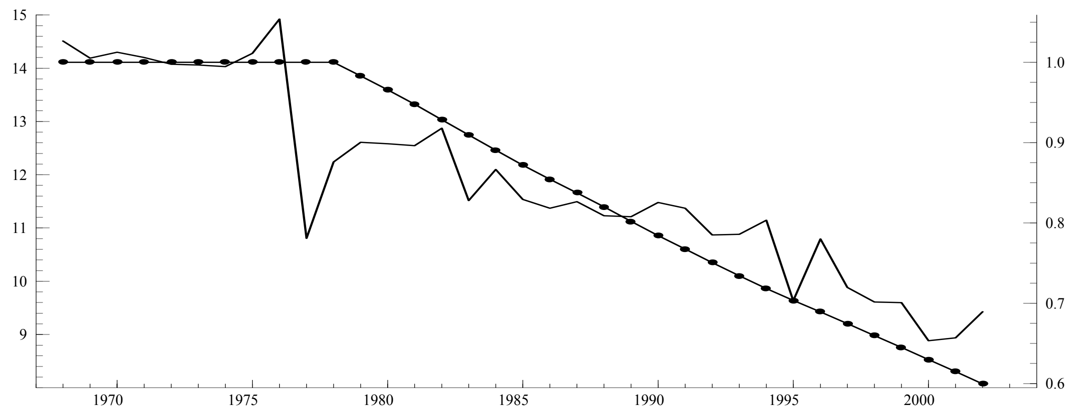

Figure 3: Coffee consumption per adult (left scale), ——, and the share of adults born after 1959 in total adult population (right scale), •—•—•.

Figure 4: Price of roasted coffee, —— , and coffee consumption net of cohort effect, mean and variance adjusted, •—•—•.

5. Empirical Analysis

The data analysis is performed in two steps. First, we use the Johansen (1988, 1995) approach to test for integration and cointegration, and then we estimate a general single-equation autoregressive model, which tested to make sure that the assumptions regarding its stochastic properties are fulfilled. The single-equation autoregressive model is reduced in order to obtain a parsimonious model. Finally, the stability of the model is investigated using recursive estimation.

The cointegration analysis was carried out for the period 1968 - 2002 with *Q* and *P,* as endogenous variables, where *Q* is coffee consumption per person over 17 years of age, *P* is the retail price of roasted coffee per kilo relative to the consumer price index, measured in constant 1995 Swedish kronor. The variable capturing changes in preferences between age groups, *G*, was entered as a deterministic variable, and income was included as a weakly exogenous variable in first differences (*ΔY)* since, as evident from Figure 1, the level of consumption does not affect coffee consumption. We also included an impulse dummy for the sharp increase in coffee-bean prices in 1977. The number of lags was determined by first estimating the model with two lags over the period 1969 – 2002 and testing for misspecification. None of the tests for autocorrelation, non-normality, and heteroscedasticity were significant at the 5 percent level. Then a likelihood ratio test for reducing the model to one lag was implemented. It was not significant so one lag of *Q* and *P* seems to capture the dynamics adequately. The first lag of *ΔY* was insignificant so it was also removed. The test statistics for the likelihood ratio test and the diagnostic tests are reported in Table 1.

Table 2 reports the main results from the application of Johansen's maximum likelihood procedure. The first row lists the estimated eigenvalues of the Π–matrix, the matrix with coefficients of the long-run solution of the model. The smallest one is 0.35, so both of them are all clearly larger than zero, indicating the rank is two. On the following lines the trace test for the rank of the Π–matrix and critical values are reported. Since the trace test has low power in small samples, the 90 percent critical values were used, and since *G* behaves as a deterministic variable, the critical values are based on the asymptotic distributions for restricted trend and unrestricted constant.

The null hypotheses of a rank of zero and one are clearly rejected. Information about the rank of the Π-matrix is also provided by the adjustment coefficients. In both columns of the α–matrix, reported in the lower panel of Table 2, there are entries with high t-values. This is support for the presence of two stationary relations in the data. Since visual inspection of graphs of the cointegrating vectors[7] also indicates that there are two stationary relations, we proceed under the assumption that the rank of the Π-matrix is two.

The importance of including *G* for the stability of the system, and the finding of two cointegrating vectors, is indicated on the last two lines in the upper panel of Table 2. The largest root of the companion matrix process is 0.60 when *G* is included in the VAR, while the largest root is 1.02 without *G*.

To identify the stationary vectors, the significance of each individual variable was first tested; all three tests statistics were highly significant as shown by the last line in Table 2. Then we tested if *Q* and *G* form one stationary relation, while *P* is stationary by itself. The test was not significant at the10% level. Table 3 reports the test statistics for the restricted cointegrating vectors, the standardized eigenvectors, β, and the adjustment coefficients α. The first long run relation is $Q = 13.5G$ while the other one is made up of *P* only. Since α_{11} is negative and highly significant, coffee consumption adjusts to changes in *G*, as expected. Furthermore α_{12} is also negative and significant, showing that the price level affects coffee consumption. However, there is no feedback from coffee consumption on prices since α_{21} is insignificant. This implies

[7] The unrestricted cointegrating vectors are not reported, but Figure 4 shows the restricted ones.

that we can treat prices as weakly exogenous and model coffee demand using single-equation analysis.

In the second step we estimated a single-equation model. To ensure that all variables are stationary *Q* was replaced by *Q** = *Q* - 13.5*G*. Moreover, an impulse dummy for 1976 was added to capture the rise in consumption preceding the price increase. By including two impulse dummies (*Dum76* and *Dum77*) we allow the effect of the price shock to be transitory. First a general model was estimated (see Table 1a in Appendix II) and the variables with insignificant coefficients were removed, e.g. lagged *Q**. The model obtained is,

$$\underset{}{Q_t^*} = \underset{(0.24)}{2.5} - \underset{(0.005)}{0.017P_t} - \underset{(0.004)}{0.013P_{t-1}} + \underset{(0.029)}{0.074\Delta Y_t} + \underset{(0.36)}{0.98Dum76} - \underset{(0.48)}{1.5Dum77}$$

$$R^2 = 0.866 \quad \hat{\sigma} = 0.331 \quad T = 1968 - 2002 \quad F_{ar}(2,27) = 0.59\ [0.56] \tag{9}$$
$$F_{arch}(1,27) = 0.468\ [0.50] \quad F_{het}(8,20) = 0.26\ [0.97] \quad \chi^2_{norm}(2) = 3.99\ [0.14]$$
$$F_{reset}(1,28) = 0.15\ [0.70] \quad Q_t^* = Q_t - 13.5G_t$$

where coefficient standard errors are shown in parentheses, $\hat{\sigma}$ is the residual standard deviation, and T is the sample period. The diagnostic tests are against serial correlation of order 2, F_{ar}, autoregressive conditional heteroscedasticity of order 1, F_{arch}, heteroscedasticity, F_{het}, the RESET test, F_{reset}, and a chi-square test for normality, $\chi^2_{Norm}(2)$ (see Hendry and Doornik, 2001, for details).

In equation (9) both contemporaneous and lagged prices enter with negative, and clearly significant, coefficients, income growth has a positive coefficient, and the dummy variables have opposite signs.[8] Hence, the model appears to make economic sense. Since all the diagnostic tests are insignificant the model is statistically well-specified.

By estimating the model recursively its empirical constancy was assessed. The output from this exercise is summarized in graphs for the period 1980 – 2002. In the four graphs in the upper panel of Figure 5, the recursively estimated coefficients and their ±2 standard errors are depicted. Considering the small number of observations and the long time period, they are there are quite stable, in particular during the period 1985 – 2002. The one-step residuals and their ±2 standard errors are depicted in the fifth graph; since all the estimates are within the standard error region there is no indication of outliers. The last three graphs report test statistics from three Chow tests, one-step, break-point and forecast Chow tests. They are graphed such that the straight line matches the 1% significance level. Only one Chow test statistic is significant, and it is just about significant at the 1% level, while all the other are insignificant.

[8] The increase in consumption in 1976 is likely to be due to hoarding.

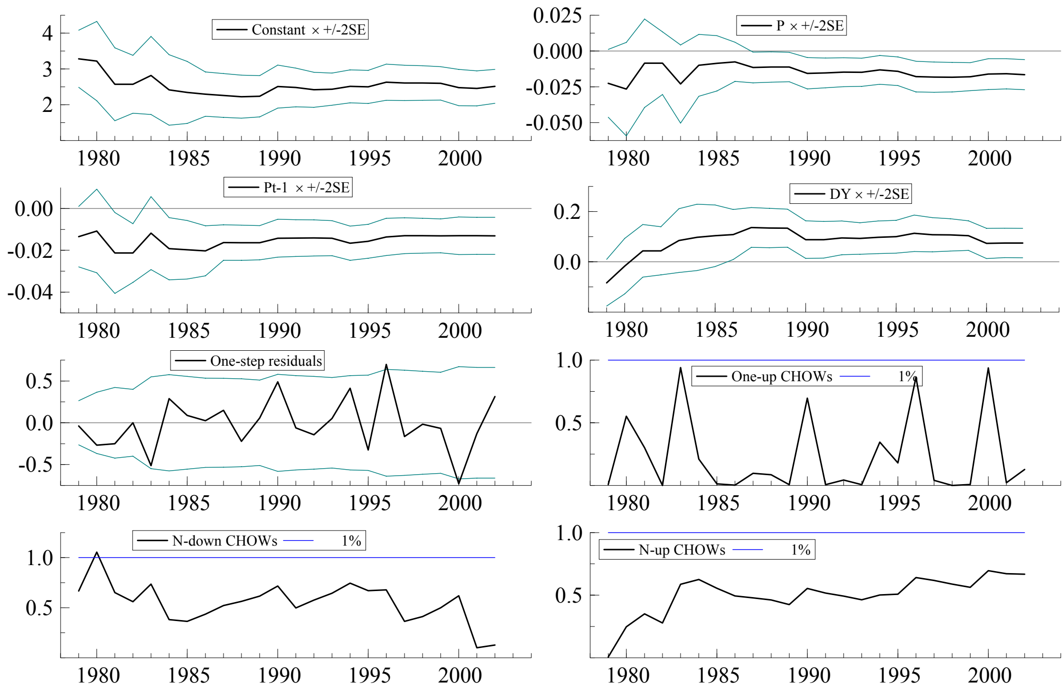

Figure 5: Recursive estimates of the coefficients with ± 2 standard error (top four graphs), one-step residuals with ± 2 estimated standard errors (left in third row), one-step (right third row), break-point (left in bottom row) and forecast (right in bottom row). Chow statistics scaled with their 1% critical values. The straight line at unity shows the 1% critical level.

To relate equation (9) to equation (7), our theoretical model, the static solution of (9) was calculated, yielding

$$\underset{}{Q} = \underset{(0.38)}{2.6} - \underset{(0.004)}{0.029P} + \underset{(0.03)}{0.072\Delta Y_t} + \underset{(0.48)}{13.28G} - \underset{(0.67)}{0.53Dum} \qquad (10)$$

where coefficient standard errors are shown in parentheses. Equation (10) shows that the price variable is negative and highly significant; its t-value is -7.9. A decline in coffee prices by one krona per kilo increases demand by 29 gram per adult, controlling for all the other variables. In 2002 this would correspond to a total increase of 2.3 ton, which should be compared to an actual consumption of 66000 ton; the impact of a change in price is thus very small. Equation (10) also shows that the sum of the two dummy variables is not statically different from zero, indicating that the price shock in 1977 did not have a lasting effect on coffee demand. Moreover, the generation variable, *G*, has the same coefficient as in the cointegration test, and growth in per capita income is significant but the *t*-value is only 2.4.

To obtain more information on the role of the prices we calculated the price elasticity. Its mean is -0.19 and the standard deviation is 0.058. Figure 6 shows how the elasticity has varied over time; the minimum value is -0.38. It is thus evident that competition in the coffee market keeps the elasticity well above -1, which is the maximum we would expect if there was perfect collusion among the roasters. Our finding of an elasticity well above -1 is consistent with other studies on coffee demand such as Bettendorf and Verboven, (2000), Durevall (2003), Feuerstein (2002), Koerner (2002b) and Olekalns and Bardsley (1996). The exception is Koerner (2002a) who obtains an elasticity of about -1.2 for Germany.

Figure 6: The price elasticity, 1968 – 2002.

An interesting question is how demand would respond to a reduction in the spread between coffee bean prices and consumer prices. This issue was analyzed by Morisset (1997) who found that a reduction in the spread of some primary commodities, including coffee, due to a drop in consumer prices in U.S. and some European countries, would have a strong impact on export revenue in developing countries.

However, in our case, the trend in coffee demand makes the impact of a permanent decrease in coffee prices short run. This is illustrated by the recent decline in real coffee prices; they went from 76 SEK in 1998 to 51 SEK in 2002 while consumption dropped from 9.6 kg per adult to 9.4 kg.

To further highlight the role of prices, we simulated the response of coffee consumption to a permanent decline in consumer prices from 51 SEK in 2002 to 35 SEK in 2003. Such a drop in consumer prices could result from a reduction in import prices, since they are tightly linked to each other (see Durevall, 2004). We assumed that G continued to decline at the rate it had during the period 1993 - 2002, that is at 2.13 percent, and that ΔY was constant at the average value it had over the same period, 2.13. Furthermore, we used the fitted value for the base year 2002. The result of the decline in prices would be an increase in coffee consumption by 3.6 percent in 2003 and a small increase in 2004. However, consumption would decline in 2005, and in 2006 it would be below the 2002 level. Our analysis thus shows that the preference effect is the dominant factor in determining demand, since it explains the trend. It is possible that Morisset (1997) obtained a strong effect on export revenue because he disregarded the dynamics of demand.

6. Conclusion

The objective of this paper was to evaluate the role of prices in determining demand in the Swedish market for roasted coffee. This is an important issue because it can shed light on the functioning of coffee markets, and how exports from coffee-bean producers in the developing world is likely to respond to changes in consumer prices. An empirical analysis of the stochastic properties of consumption and relative prices can provide information about market power; when there is a trend in consumption but not in relative prices firms do not control quantities with prices, or vice versa, in the long run.

First we showed that a trend in the quantity demanded should be present in prices according to the Cournot and Bertrand oligopoly models, unless the trend appears in marginal costs. When this not the case the, models do not describe market behavior well, and prices reflect marginal costs in the long run. Then demand for roasted coffee was then estimated using data from Sweden over the period 1968 -2002. The major determinant of demand is differences in preferences across generations in combination with population dynamics; those born before the 1960s consume more coffee than younger generations. This result is in accordance with industry wisdom. Relative consumer prices of coffee only explain deviations from the trend in consumption. Consequently a reduction in coffee prices can only have a short-run impact on consumption.

Our results indicate that there is a high degree of competition in the Swedish market for roasted coffee, since the long-run evolution of consumption was independent of prices, and it is unlikely that marginal costs contain the same trend as consumption (see Durevall, 2004). This finding contrasts with what one would expect from looking at the market structure for roasted coffee; in 2002 the market share of the multinationals was 57 percent, and the share of the four largest roasters was 87 percent (see Durevall, 2004). Moreover, it implies that a permanent reduction in the spread between world prices and consumer prices, due to lower consumer prices, would not lead to a permanent improvement of the export revenue from Sweden for coffee-bean producing countries.

Although our results are obtained from the Swedish market, they are likely to apply to many other markets for roasted coffee as well. Most industrialised countries have a market structure that is very similar to the one in Sweden; there are some large multinationals present and the concentration of the four largest firms is very high (see Clarke, et al., 2002; Durevall, 2003; Sutton, 1992). Moreover, trends are often needed in demand functions for coffee, see Koerner (2002a) and Olekalns and Bardsley (1996) for the U.S. and Koerner (2002b) for Germany; Feuerstein, (2002) prefers to remove the trend and estimate a model in first differences in her study on West Germany. And the technology used in coffee roasting is fairly simple and similar in most markets.

It is possible that large roasters have market power as buyers in the market for green coffee, as argued by, among others, Ponte (2002). We have not analyzed this issue but if it is the case, increased competition would lead to higher prices for coffee beans, and that would have a beneficial effect on export revenue of coffee producing countries.

Table 1: Determination of Lags and Diagnostic Tests, 1969 -2002

Multivariate tests		
AR 1-2 test	$F(8,46) = 0.846$ [0.567]	
Normality test	$\chi^2(4) = 7.280$ [0.122]	
Hetero test	$F(18,54) = 0.945$ [0.531]	
Hetero-X test	$F(27,47) = 0.881$ [0.631]	
Schwartz Criteria	Two lags	One lag
	10.07	9.53
Tests of model reduction,		
2 to 1 lag: $F(4,48) = 0.394$ [0.812]		
1 to 0 lag of ΔY: $F(2,26) = 0.731$ [0.491]		

Table 2: Cointegration Analysis, 1968 - 2002

Eigenvalue of Π-matrix		0.62	0.35
Null hypothesis		r = 0	r = 1
Trace test		48.75	14.79
90% critical value		22.76	10.49
Roots of process		0.60	0.16
Roots without *G*		1.02	0.61
Variable	*Q*	*P*	*G*
β'_1	1.000	0.028	-13.42
β'_2	4.80	1.00	-113.06
α_1	-1.47 (0.18)	0.005 (0.004)	
α_2	1.20 (5.39)	-0.48 (0.12)	
Test of significance a given variable			
	Q	*P*	*G*
$\chi^2(3)$	31.83**	26.54**	33.23**

Note: The estimation period is 1968 - 2002. The vector autoregression includes one lag on *Q* and *P*, and G_t, ΔY_t , a constant and an impulse dummies that takes a value of unity in 1977. Critical values are for the trace tests are from Johansen (1995). They are based on the asymptotic distributions for restricted trend and unrestricted constant. *t*-values are reported in parentheses, and '*' indicate significance at the 5% and '**' at the 1% level.

Table 3: Restricted cointegrated vectors and adjustment coefficients

Variable	*Q*	*P*	*G*
β'_1	1.00	0.00	-13.49
β'_2	0.00	1.00	0.00
α_1	-1.09 (0.18)	-0.03 (0.007)	
α_2	-3.19 (5.56)	-0.46 (0.21)	

Test for restricted cointegrating vectors $\chi^2(1) = 2.30$ [0.13]

Appendix I: Description of Data

The following variables have been used in the empirical analysis:

Consumer price of coffee
Price per kilo of roasted coffee. The price is based on 500-gram packets. Source: Statistics Sweden.

Consumer price index (CPI)
CPI is from the International Financial Statistics database of the IMF.

Consumption of Roasted Coffee
The quantity of yearly consumption is published by the Swedish Board of Agriculture

Income
Income is measured as household expenditures. Source: International Financial Statistics database of the IMF.

Population
The demographic data are from The International Data Base (IDB), U.S. Bureau of the Census and Statistics Sweden.

Appendix II: Regression Results

Table 1a: General model for coffee demand, 1968 - 2002

Equation for *Q**	Coefficient	Std. Error	t-value
Q^*_{t-1}	-0.092	0.162	-0.568
P_t	-0.017	0.005	-3.160
P_{t-1}	-0.016	0.007	-2.350
ΔY_t	0.085	0.034	2.450
$Dum76_t$	0.979	0.369	2.650
$Dum77_t$	-1.330	0.602	-2.210
Constant	2.768	0.506	5.470

$R^2 = 0.867$ $\hat{\sigma} = 0.335$ $T = 1968 - 2002$ $F_{ar}(2,26) = 0.20$ [0.82]

$F_{arch}(1,26) = 1.01$ [0.32] $F_{het}(10,17) = 0.29$ [0.97] $\chi^2_{norm}(2) = 3.46$ [0.17]

$F_{reset}(1,27) = 0.49$ [0.48] $DW = 2.12$ $Q^*_t = Q_t - 13.5G_t$

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