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Abstract

There is a widespread belief that consumer coffee prices are high relative to bean prices and that lower consumer prices would lead to substantial increases in bean exports from Third-World countries. This issue is evaluated by analysing how retail prices, preferences and market power influence coffee demand in Sweden. A demand function is estimated for the period 1968-2002 and used, together with information on import prices of coffee beans, to simulate an oligopoly model. This approach gives estimates of the maximum average degree of market power and shows how coffee demand would react to reductions in marginal cost to its minimum level. The maximum level of market power is found to be low, but it generates large spreads between consumer and bean prices because the price elasticity has low absolute values. Moreover, the impact of a price decrease would be small because long-run coffee demand is dominated by changes in the population structure in combination with different preferences across age groups. Hence, a change to perfect competition would only have a negligible effect on bean imports.

Keywords: Coffee exports; coffee price; market power; multinationals; Sweden

JEL Classification: F14; F23; L13; L66; L81

1. Introduction

It is a common opinion that oligopolistic market structures constitute a key problem for commodity-exporting, less-developed countries (Gibbon, 2005). This view gained ground after the collapse of coffee-bean prices in the late 1990s, when they returned to the 1960s level in nominal terms. Since a few multinational companies are active in most coffee markets, both as buyers of green coffee and suppliers of processed coffee, they are held responsible, directly or indirectly, for keeping bean prices down while maintaining high consumer prices.[1] As a consequence, Third-World bean exports and bean prices are kept below the level that would prevail in a competitive market.

The issue of market power in commodity markets is analysed in some detail by Morisset (1997, 1998). He looks at coffee markets, as well as several other markets, and finds symptoms of market power in all of them. For instance, in a sample of six industrialised countries, the average spread between consumer coffee prices and world bean prices increased on average by 186% from 1975 to 1994. This is attributed to asymmetric transmissions of world price changes to consumer prices. To evaluate the consequences of the increase in price spreads for developing countries' export revenue, Morisset (1997) simulates the impact of a reduction in consumer prices to the minimum spread observed during the 1970-1994 period. It would have increased export earnings to the order of at least 20-60% annually from 1991 to 1994.

Talbot (1997) also addresses the issue of market power in coffee markets. He uses a different approach, global value chain analysis. He finds that the collapse of the International Coffee Agreement at the end of the 1980s led to an increase in market

power and a massive shift of surplus from coffee producing countries to multinationals. According to Talbot, multinational companies exercise market power as buyers of green coffee by holding down prices and as sellers of processed coffee by inflating consumer prices. Global value chain analyses by Fitter and Kaplinsky (2001) and Daviron and Ponte (2005, Chap. 6) obtain similar results.

Although multinational companies may have market power as buyers of green coffee, as Ponte (2002) argues, the large price spreads seem to occur between import prices and prices of processed coffee, not between farm gate and world market prices (see Daviron and Ponte, 2005, Chap. 6). Moreover, Krivonos (2004) shows that the transmission of price signals from world market prices to coffee growers works quite well after the implementation of coffee sector reforms in the late 1980s and early 1990s. Although these results do not preclude the existence of oligopsony power, they indicate we should search for market power in consumer markets.

There are probably less than ten studies that directly attempt to test for market power in national consumer markets (see Gibbon, 2005). Most of these find that the degree of market power is small, although there is some evidence of oligopoly power, e.g. Bhuyan and Lopez (1997). There is, thus, conflicting evidence, and the question of why the difference between bean and consumer prices is perceived to be high is not answered.

The objective of this paper is to shed light on the presence of market power in the Swedish market for roasted and ground coffee, and evaluate potential losses for coffee growers. The Swedish market for roasted and ground coffee has a market structure

that is typical for many European markets: in 2002, the four largest companies had a market share of 87% and two multinationals (Kraft Foods and Nestlé) had 57%.[2] Moreover, roasted and ground coffee is relatively expensive in Sweden. It was 7% above the EU average in 2002 (European Commission, 2002a).

The analysis is carried out by first estimating demand for roasted and ground coffee during the time period 1968-2002. Then, the price elasticity estimates and import costs of green coffee beans are entered into a simple model of oligopolistic interaction to obtain values of the maximum average degree of market power. The cost of green coffee beans is used as the minimum value of marginal cost. This is because it is by far the most important input and there is a fixed relationship between roasted and green beans.[3] Furthermore, there exists good data on import prices, which is not the case for other marginal cost components. In the final step, information concerning how the export of coffee beans to Sweden responds to price change is obtained by simulating a shift to perfect competition. In this model, perfect competition implies that consumer prices become equal to the price of imported beans.

The analysis only gives rough estimates of average levels of market power and their impact on consumption and imports, and it would have been preferable to use detailed firm-level data that allow modelling dynamic firm interaction, but these are not available. Nonetheless, the approach is robust and transparent, compared to estimating a structural oligopoly model for a market over a 35-year period when there is a paucity of data on costs.[4]

Our main findings are that in the long run coffee consumption per adult is dominated by population dynamics in combination with differences in preferences across generations, and the absolute values of the price elasticity are small (on average 0.19). As a result, sharp reductions in price only generate small increases in demand and, consequently, in the import of coffee beans. Moreover, the measure of market power, the maximum elasticity adjusted Lerner index, was found to only be about 0.10 for the period 1985-2002. This result is less than half of what Cournot competition predicts and very far from unity, which would indicate prefect collusion. However, because of low price elasticity, the low degree of market power generates a substantial spread between consumer and bean prices. Another finding is that the average value of the elasticity adjusted Lerner index is higher during the period 1985-2002 than before. As Talbot (1997) claims, this could be due to increased market power following the breakdown of the International Coffee Agreement. In absolute terms, the increase in market power is small, from about 0.05 in the early 1970s to 0.1. Without checking for other components of marginal cost, we cannot say what caused the change.

The rest of the paper is organised as follows: Section 2 gives a brief description of the Swedish coffee market, while Section 3 outlines the theoretical framework. Section 4 presents the econometric approach to model coffee demand, and Section 5 describes the data. Section 6 reports the results from the econometric analysis, and Section 7 interprets the findings using the oligopoly model. Finally, section 8 summarises and draws some conclusions.

2. The Swedish Coffee market

Although the Swedish coffee market is small compared to the world market, about 1.5% in 2003, per capita consumption has been among the top five in the world for several decades. Roasted and ground coffee accounts for about 90% of all coffee consumed, while instant coffee has had a market share of about 10% since the 1980s (and somewhat less during the 1970s). The sale of beans to consumers is negligible. Quality is relatively high and uniform: the Arabica bean, mainly used in high-quality coffee, makes up close to 100% of bean imports, while Robusta, used in low-quality coffee, espresso and instant coffee, is not utilized in coffee roasted for Swedish retailers.

Roasters located in Sweden produce most of the roasted coffee consumed. Imports of roasted coffee were about 2% or less of total consumption until 1993, when it rose sharply because the roasting of one brand (Luxus) moved to Finland: in 2002, imports accounted for 9% of consumption. All instant coffee is imported (Swedish National Coffee Association, 2005b).

As in many other countries, there has been a trend towards increased market concentration and the presence of multinationals in coffee roasting. There is no available data on market shares before the 1980s, but there were about 20 roasters in the 1960s and early 1970s, all locally owned. During the first half of the 1970s, rapid re-structuring took place. Several roasters closed down or merged with others, and General Foods (later sold to Kraft) bought Gevalia, the largest Swedish brand. Since then, the market has been relatively stable. In 1978, there were twelve roasters, and by 2002 ten remained (Statistics Sweden, various issues). The most important events

since 1978 are Nestlé's acquisition of Zoégas Kaffe AB in 1986, Kraft Foods' 1994 purchase of Cirkel AB, and the subsequent removal of the brand Cirkelkaffe from the market.

In 1982, there were five large roasters that together had 84% of the market. Their market share rose to 90% by 1992, but because of Kraft's purchase of Cirkel AB the number of big players was reduced to four. In 2002, their share was 87%, and the two multinationals (Kraft and Nestlé) together had 57% of the market.

As concentration in roasting increased, retailers' own brands also grew in importance, particularly during the 1990s. In 2002, the two largest retail chains together had a market share of about 6% of retail sales of roasted coffee (Swedish National Coffee Association, 2005a). Their coffee is roasted in Finland and Denmark.

In many countries, the caffe-latte "revolution" is taking place, where consumers are switching to higher-quality beans and espresso coffee (with milk). This is occurring in Sweden as well, though only very recently; consumption of espresso was only about 0.1% in 1997, and 0.8% in 2002 of total consumption (Swedish National Coffee Association, 2005a). Hence, although there is rapid growth in this niche, which most likely will lead to changes in the coffee market, it hardly matters for this study.

The retail food sector is not considered explicitly in analysis, and arms' length pricing is assumed. Yet, there is a common opinion that retailers have market power in many European countries and that it has increased recently (Hughes, 2002). In Swedish food retailing, market concentration is high; the four-firm concentration ratio was about 75% in 2004. However, it decreased during the 1990s due to the entrance of new

actors, and there is no evidence of increasing market power (Swedish Competition Authority, 2004). In spite of the high concentration ratio, the assumption of a passive retailing sector seems reasonable for coffee in Sweden, since roasters can alter their prices whenever they wish.[5] Moreover, as in several other European markets, retailer margins for standard coffee are low since it is used as a loss leader (Tea and Coffee Trade Journal, 1992; Daviron and Ponte, 2005, p. 93).

3. Theoretical Framework

In this section, we describe the oligopoly model, and how the results from the demand analysis are used to evaluate the degree of market power. The model is static and relies on conjectural variations; that is, a firm's belief (conjecture) about its competitors' response determines its own maximizing choice of output or price. Conjectural variation models have been used widely in both theoretical and empirical analyses. However, they have also been criticized on the grounds that multi-period interpretations are implausible (Lindh, 1992; Carlton and Perloff, 2005). Nonetheless, recent research has demonstrated that conjectural variation can be interpreted as the steady state of a dynamic game under bounded rationality (Friedman and Mezzetti, 2002; Dixon and Somma, 2003). Here, the model is used to obtain a measure of the maximum elasticity-adjusted Lerner index, i.e., the price cost margin normalized by both the price level and the demand elasticity. This measure distinguishes between markets that have high margins because of inelastic demand and those that have high margins because of the presence of more market power (Corts, 1999; Wolfram, 1999).

The formulation of the model is based on Bettendorf and Verboven (2002), who apply it to the Dutch coffee market.[6] There is one homogenous good, and the supply

relationship is derived by assuming that firm *i* (*i*= 1…n) maximizes its profit, π_i, which is given by,

$$\pi_i = \frac{1}{1+\tau} P(Q)Q_i - C_i(Q_i, w) \tag{1}$$

where τ is value added tax, *Q* the total industry output, Q_i output of firm *i*, *P(Q)* the inverse demand function, $C_i(Q_i, w)$ the cost function and *w* a vector of input prices assumed to equal for all firms.

The first-order order condition to firm *i*'s profit-maximizing problem is

$$\frac{1}{1+\tau}[P + P'(Q)Q\theta_i] = \frac{\partial C_i}{\partial Q_i} \tag{2}$$

where $P'(Q)$ is the derivative of *P(Q)* with respect to Q, *P* is the price of coffee, and $\theta_i = (\partial Q / \partial Q_i)(Q_i / Q)$. The parameter θ_i is the conjectural variation elasticity, and it characterizes the firm's behaviour. It can take any value between zero and one in the conjectural variation approach. However, when interpreted in the light of one-shot games, $\theta_i = 0$ implies that the firm sets prices equal to marginal cost (Bertrand competition), $\theta_i = 1$ represents joint-profit maximization, i.e., a perfect cartel, and θ_i equal to the *i'th* firm's market share (Q_i / Q) means there is Cournot competition where firms set quantities (see Porter, 1983).

Since we use market data, the model has to be aggregated all the firms. Following Appelbaum (1982) and Bettendorf and Verboven (2000), two assumptions are made: the cost functions are of Gorman polar form and firms face the same input prices. This implies that the cost curves and size of the firms can vary, but marginal costs, *MC* (*w*),

are constant and equal across firms. The market supply relation is then obtained by multiplying Equation (2) by Q_i/Q and aggregating over all firms,

$$\frac{1}{1+\tau}[P + P'(Q)Q\theta] = MC(w) \tag{3}$$

where $MC(w) = \sum_i \left(\partial C_i / \partial Q_i\right)(Q_i / Q)$ and $\theta = \sum_i \theta_i (Q_i / Q)$. By re-writing Equation (3), we get an equation that describes the supply relation:

$$P = (1+\tau)MC(w) - \theta P'(Q)Q. \tag{4}$$

According to Equation (4), the price of a good depends on three factors: marginal cost, including VAT, market power, and demand. The measure of market power, θ, is the market-share weighted average of θ_i of all n firms. As for θ_i a value of zero shows that price is equal to marginal cost, and a value of unity indicates a perfect cartel. However, when there is Cournot competition, θ is equal to the Herfindahl index.[7]

By multiplying and dividing Equation (4) by P, we introduce the demand elasticity,

$$P = (1+\tau)MC(w) + \frac{\theta}{\eta}P \tag{5}$$

where $\eta = -(\partial Q / \partial P)(P/Q)$. This shows that θ cannot be larger than the absolute value of the price elasticity, since that would imply negative marginal costs. Hence, simply by estimating the demand function, we get some information about the size of θ. Moreover, rewriting Equation (5) in terms of θ;

$$\theta = \frac{P - (1+\tau)MC(w)}{P}\eta \tag{6}$$

it becomes clear that θ is price-cost gap divided by P, the Lerner index, adjusted by the absolute value of the demand elasticity.

Estimating Equation (4) requires both estimates of demand to obtain $P'(Q)$, and of marginal cost. However, since information on marginal cost is difficult to obtain for the study period, the dominant role of green coffee beans in coffee roasting is exploited. By assuming that marginal cost is equal to the import cost of beans, i.e., a measure of the minimum marginal cost, maximum levels of market power and the Lerner index can be calculated by entering estimated price elasticity into, for example, Equation 6. Such estimates provide maximum benchmarks since a higher marginal cost would reduce the measure of market power and the Learner index.

The argument for using the cost of beans as the measure of marginal cost is based on the fixed relationship between green beans and roasted coffee; to make 1 kg of roasted coffee, approximately 1.19 kg beans is required (Bettendorf and Verboven, 2000). Moreover, since coffee quality primarily is driven by bean type, which is reflected in the import price, this captures variations in quality. Other inputs usually each make up less than 5% of total variable costs, and rarely more than 10% (Koerner, 2002). In Sweden, only wages and packaging ever exceeded 5% of variable costs during the study period (Statistics Sweden, various issues). Moreover, there are few economies of scale in coffee roasting and grinding, so marginal costs are largely independent of output, and companies have similar marginal cost functions in spite of varying size (Sutton, 1991).

4. Modelling Coffee Demand

Equation (7) shows a static linear demand function designed to represent long-run equilibrium demand for coffee in Sweden:

$$Q = \beta_0 + \beta_1 P + \beta_2 Y + \beta_3 G, \tag{7}$$

where Q is the quantity of roasted coffee per adult, P is the relative price of coffee, Y is income, G is a variable capturing changes in population and β_0, β_1, β_2 and β_3 are parameters.[8] The relative price of coffee is defined as the nominal price divided by the consumer price index. Relative prices for more specific coffee substitutes, e.g. tea, could also be used, but tea prices do not work as well empirically. Moreover, it is unlikely that tea prices influence coffee demand in Sweden, where coffee consumption dominates heavily.[9] Within the price range observed in our sample, it seems more probable that coffee-price increases primarily lead to better utilization of already purchased coffee. As reported by Bettendorf and Verboven (1998), market studies have shown that as much as 25% of purchased coffee is not actually drunk.

Real income is the second variable in the demand function. Usually an increase in income is expected to increase consumption. Nevertheless, this might not be the case in a market that is mature and where practically all consumers can afford to buy the product. In fact, as shown below, only the change in income affects coffee consumption in Sweden.

Finally, we have G, which captures population dynamics. Intuitively, a growing population generates higher demand, given prices. However, consumption patterns can differ significantly across 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.[10] This process seems to have started at the end of the 1970s, and continues as the number of those born before 1960 declines. This change in preferences is measured by defining the variable G as

the share of the population at the age of 18 and older born before 1960 in the total population at 18 and older.

An important aspect of Equation (7) is that it describes the static state of a dynamic process. Hence, like 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:

$$Q_t = \pi_0 + \sum_{i=1}^{k} \pi_{1i} Q_{t-i} + \sum_{i=0}^{k} \pi_{2i} P_{t-i} + \sum_{i=0}^{k} \pi_{3i} Y_{t-i} + \pi_4 G_t + \varepsilon_t \qquad (8)$$

where π_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. The long-run solution of Equation (8) gives the static state shown by Equation (7).

Since some or all of the variables in Equation (8) might be non-stationary, Johansen's (1988, 1995) procedure is first used to test whether some individual variables are stationary and whether some of them are cointegrated.[11] 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. The hypothesis of cointegration is about the rank of Π:. It is tested with the trace test, a likelihood ratio procedure, and it amounts to finding the number of linearly independent columns in Π.. When Π is of reduced rank, we can write $\Pi = \alpha\beta'$, which has $r \leq (n-1)$ cointegrating vectors, where r = rank. By testing for the significance of the components in β', the coefficients of the cointegrating vector, we can then evaluate

what variables enter the cointegrating vector. Further, by testing the components of α, the adjustment coefficients, we can determine whether there is feedback between Q and P, that is, whether P is weakly exogenous. If it is weakly exogenous, we only need to estimate a single-equation model.

5. A Look at the Data

In this section, the data is described using plots. The purpose is to provide intuition to the empirical results. The data are yearly, and the period analyzed is 1968–2002.[12]

The two core variables usually assumed to explain demand are price and income. In Figure 1, consumption of roasted and ground coffee, measured in kilos per person aged 18 or older, is depicted together with per capita income, measured by total consumer expenditure. Note that the mean and variance of the income variable have been adjusted to highlight the relationship between the two variables. Coffee consumption was stable until the 1975, when it declined due to a sharp, but temporary, increase in prices. From the end of the 1970s, 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 about here

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, set to unity in 1995). Although the negative relationship is visible during the end of the 1970s and around 1995, the two variables generally move in the same direction. It is thus apparent that price and income cannot explain coffee consumption by themselves.

Figure 2 about here

Since the slowdown in coffee consumption has been attributed to differences in preferences between those born around the 1960s and later and older generations, Figure 3 shows the proxy for changes in preferences, *G*, and per-capita consumption. The preference effect started at the end of the 1970s and continued as the share of those born before 1960 declined. Hence, its evolution coincides with coffee consumption.

Figure 3 about here

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

Figure 4 about here

6. Empirical Analysis

The data analysis is performed in two steps. First, we use the Johansen approach to test for integration and cointegration. Then, we estimate a general single-equation autoregressive model, which is tested to make sure that the assumptions regarding its stochastic properties are fulfilled. After that, 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 is carried out for the period 1968-2002 with Q and P as endogenous variables and G as a deterministic variable. Income enters 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 include an impulse dummy for the sharp increase in coffee-bean prices in 1977.[13] Estimating the model with two lags over the period 1969-2002 and then testing for misspecification determined the number of lags. None of the tests for autocorrelation, non-normality, and heteroscedasticity were significant at the 5% level. A likelihood ratio test for reducing the model to one lag was then 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 too was 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 the maximum likelihood procedure. The first line lists the estimated eigenvalues of the Π–matrix. The smallest one is 0.35, so both of them are all clearly larger than zero, indicating the rank is two. The trace test for the rank of the Π–matrix and critical values are reported on the following lines. The critical values are based on the asymptotic distributions for restricted trend and unrestricted constant since *G* behaves as a deterministic variable, Moreover, since the trace test has low power in small samples, the 90% critical values were used.. 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 constitutes support for the presence of two stationary relationships in the data. Since visual inspection of graphs of the cointegrating vectors[14] also indicates that there are two stationary relationships, 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 rows 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 without *G* is 1.02.

To identify the stationary vectors, the significance of each individual variable was first tested; all three test statistics were highly significant, as shown by the last line in

Table 2. Then we tested if Q and G form one stationary relationship, while P is stationary by itself. The test was not significant at the 10% 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 that we can treat prices as weakly exogenous and model coffee demand using single-equation analysis.

In the second step, we estimate a single-equation model. To ensure that all variables are stationary, Q is replaced by $Q^* = Q - 13.5G$. Moreover, an impulse dummy for 1976 is added to capture the rise in consumption preceding the price increase.[15] By including two impulse dummies (*Dum76* and *Dum77*), we allow the effects of the price shock to cancel out. First a general model is estimated and the variables with insignificant coefficients are removed, e.g. lagged Q^* (not reported). The model obtained is thus:

$$\begin{aligned} Q_t^* = \; & \underset{(0.24)}{2.5} - \underset{(0.005)}{0.017P_t} - \underset{(0.004)}{0.013P_{t-1}} + \underset{(0.029)}{0.074\Delta Y_t} + \underset{(0.36)}{0.98Dum76} - \underset{(0.48)}{1.5Dum77} \\ & R^2 = 0.866 \quad \hat{\sigma} = 0.331 \quad T = 1968 - 2002 \quad F_{ar}(2,27) = 0.59\ [0.56] \\ & F_{arch}(1,27) = 0.468\ [0.50] \quad F_{het}(8,20) = 0.26\ [0.97] \quad \chi^2_{norm}(2) = 3.99\ [0.14] \\ & F_{reset}(1,28) = 0.15\ [0.70] \quad Q_t^* = Q_t - 13.5G_t \end{aligned} \tag{9}$$

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 for serial correlation of order 2, F_{ar}, autoregressive conditional heteroscedasticity of order 1, F_{arch}, heteroscedasticity, F_{het}, nonlinearity, 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. 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.[16] The output from this exercise is summarized in graphs for the period 1980-2002. The four graphs in the upper panel of Figure 5 depict the recursively estimated coefficients and their ±2 standard errors. Considering the small number of observations and the long time period, they are quite stable, particularly between 1985 and 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 only significant at the 1% level, while all the others are insignificant.

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

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

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 Swedish 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 tonnes, which should be compared to an actual consumption of 66,000 tonnes; 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 statistically 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.

7. Market Power and Coffee Exports: Interpreting the Results

Figure 6 reports the absolute values of the price elasticity based on Equation (10). It shows how the elasticity has varied over time, and that the highest value is 0.38. The average over the study period is 0.19, and the standard deviation is 0.06. Evidently, competition in the coffee market keeps the elasticity well below 1, which is the minimum we would expect with perfect collusion among the roasters. The finding of low price elasticity is consistent with studies on coffee demand in other countries,

such as Bettendorf and Verboven, (2000) for the Netherlands, Feuerstein (2002) for West Germany, and Koerner (2002) and Olekalns and Bardsley (1996) for the US.

Another useful piece of information is obtained by using the fact that θ is equal to the Herfindahl index in Cournot competition with firms of different sizes.[17] Dividing the measures of the Herfindahl index by the absolute value of the price elasticity indicates whether Cournot competition is a possibility, since the ratio cannot be larger than one; it would imply negative marginal costs, as evident from Equation (5). Data on market shares, available for certain years from the early 1980s and onwards, indicate that the Herfindahl index was 0.18 in 1982, rose during the following years, and reached 0.27 in 1997, where it remained until 2002. Meanwhile, the average price elasticity was 0.19 over this period. Hence, the market probably is more competitive than Cournot, or in other words, the (average) mark-up for roasted coffee is not larger than predicted with Cournot competition, though it can of course be much smaller.

A more exact estimate of the maximum value of θ can be obtained by using Equation (6). Marginal cost for producing one kilo of roasted coffee is set equal to the price of imported green coffee beans, adjusted for weight loss during roasting, and import and value added tax. The evolution of θ is reported in Figure 7. The overall pattern is an increase from about 0.05 before the price shock in the mid-1970s to 0.12 in the mid-1980s. During the period 1985- 2002, θ fluctuates around an average of 0.1 with maximum and minimum levels of 0.12 and 0.6, respectively. Hence, for this period, θ is too low for Cournot competition, which would require it to be in the range of 0.20 to 0.27. However, it is clearly larger than zero. We can thus conclude that the market

is fairly competitive, since 0.1 is an overestimate of the actual degree of market power.

These results also shed light on the conflicting results from global value chain analyses, such as Talbot (1997) and Daviron and Ponte (2005), who find large spreads between consumer prices and bean import prices, and from econometric analyses, which fail to detect substantial deviations from perfect competition (see Gibbon, 2005). The spread is large because the low price elasticity, in combination with a small amount of market power, generates a large difference between price and marginal cost, as implied by Equation (6).

Figure 7 indicates that there was a permanent increase in θ from the mid-1980s. This could be due to the breakdown of the International Coffee Agreement that regulated the supply of coffee beans and minimum prices, which shifted market power from coffee growers to multinationals (Talbot, 1997; Ponte, 2002). The increase in market power is small though, and could be due to rising marginal cost not captured in the analysis. Nevertheless, if taken at face value, the change in market power from 0.05 to 0.1, which appears negligible, raises the spread from 25% to 50% when the price elasticity is 0.20.

The final issue is how demand would respond to a decrease in the spread between green coffee bean prices and consumer prices. Morisset (1997) simulates 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. He finds a strong impact on export revenue in developing countries. However, in our case, the trend in coffee

demand makes the impact of decreases in coffee prices quite small. This is illustrated by the recent decrease in real coffee prices: they went from 76 Swedish kronor in 1998 to 51 kronor in 2002, while annual consumption dropped from 9.6 kg per adult to 9.4 kg.

To further highlight the role of prices, the response of coffee consumption to a reduction in the consumer price to the price of imports of green coffee beans (including import and value added tax) from 1990 to 2002 is calculated. The assumption is that there is a shift to perfect competition in 1990 and that prices then are determined by marginal cost. This implies a price decline of over 50%, where, for instance, the consumer price is reduced from 56 to 25 kronor in 1990 and from 51 to 19 kronor in 2002. This generates an increase in consumption of about 8%, a very small increase for a large, and unrealistic, reduction in prices. The reasons for the weak response are the downward trend in coffee demand due to differences in preferences across age groups and low price elasticity. It is likely that Morisset obtained a strong effect on export revenue because he disregarded the dynamics of demand.

8. Conclusion

The objective of this paper was to evaluate the role of market power and prices in determining the demand for roasted coffee in Sweden. This is of interest because it can shed light on the functioning of consumer coffee markets and the determinants of the demand for coffee beans supplied by Third-World countries.

Demand for roasted coffee was estimated using market data from Sweden for the period 1968-2002. In the long run, demand is mainly determined by population dynamics in combination with differences in preferences across generations; those born before the 1960s consume more coffee than younger generations. This result is in accordance with industry wisdom. Consumer prices also influence demand, but they only explain deviations from the long-run trend. Moreover, price elasticity is low, on average 0.19 in absolute terms. As a result, even large price reductions generate small increases in demand for roasted coffee and, consequently, for imports of coffee beans.

To illustrate the response of coffee consumption to a consumer price decline, the impact of a price reduction to the level of the import price of green beans, including import and value added tax, was calculated for the period 1990-2002. Bean imports would have been about 8% higher, even though the price declined by over 50%. This finding differs from those of Morisset (1997), which indicate a substantial increase in export earnings, albeit in a very different model. The reason is probably that Morisset's model does not include the dynamics of coffee demand adequately.

The maximum elasticity adjusted Lerner index was found to only be about 0.10 for the period 1985-2002, where zero is perfect competition and one is monopoly or a perfect cartel. This points to the presence of some market power, but it is small and well below what is predicted by Cournot competition. The analysis does not show where this market power comes from, since market data is used and coffee is treated as a homogenous good. However, roasters are likely to have some market power because of branding and advertising and some roasters might be able to exercise

regional market power. Moreover, it is possible that retailers also have some market power, although margins for coffee are considered to be low in general. Detailed micro data are needed in order to analyse these issues. Unfortunately, they are not available.

Although there is a low degree of market power, a substantial spread between consumer and bean prices is generated when it interacts with the low price elasticity. This is evident when comparing periods before and after 1985. The measure of market power increased from approximately 0.05 to 0.1. Although this was a small increase in absolute terms, it nevertheless led to a substantial rise in the spread between consumer and import prices (roughly from 25% to 50%). We cannot say whether this change was due to increases in other costs without controlling for all components of marginal cost. Nonetheless, it was in line with Talbot (1997) and others who claim that there was an increase in market power following the breakdown of the International Coffee Agreement.

The results of this study were obtained from one national coffee market, and they might not be relevant for other markets. Nevertheless, most industrialised countries have a market structure similar to the Swedish one: some of the largest multinationals are present in almost all consumer markets and the concentration of the four largest firms is usually very high (see Clarke, et al., 2002; Sutton, 1992). Moreover, price elasticity is generally low, and, at least in North European markets, per-capita consumption is stagnant or declining (Durevall, 2003).

Finally, it is possible that large roasters and traders have market power as buyers in the market for green coffee, as argued by Oxfam (2002) and Ponte (2002). We have not analyzed this issue. However, if they influence bean prices, increased competition is likely to have a beneficial effect on export revenue of coffee producing countries, particularly since consumer price elasticity is low.

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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]		

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 dummy that takes a value of unity in 1977.

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	0.005	
	(0.18)	(0.004)	
α_2	1.20	-0.48	
	(5.39)	(0.12)	

Test of significance a given variable

	Q	*P*	*G*
$\chi^2(3)$	31.83**	26.54**	33.23**

Note: Critical values for the trace tests are from Johansen (1995). They are based on the asymptotic distributions for restricted trend and unrestricted constant. Standard errors are reported in parentheses, and '**' indicate significance 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	-0.03	
	(0.18)	(0.007)	
α_2	-3.19	-0.46	
	(5.56)	(0.21)	
Test for restricted cointegrating vectors $\chi^2(1) = 2.30$ [0.13]			

Standard errors are reported in parentheses and *p*-values in brackets.

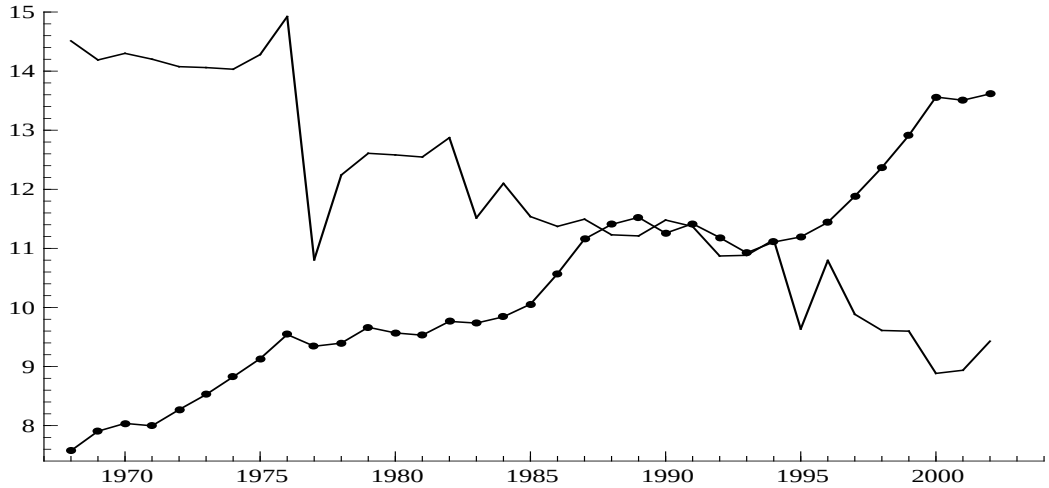

Figure 1: Coffee consumption, kilo per adult ——, and mean and variance adjusted real income •—•—•.

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

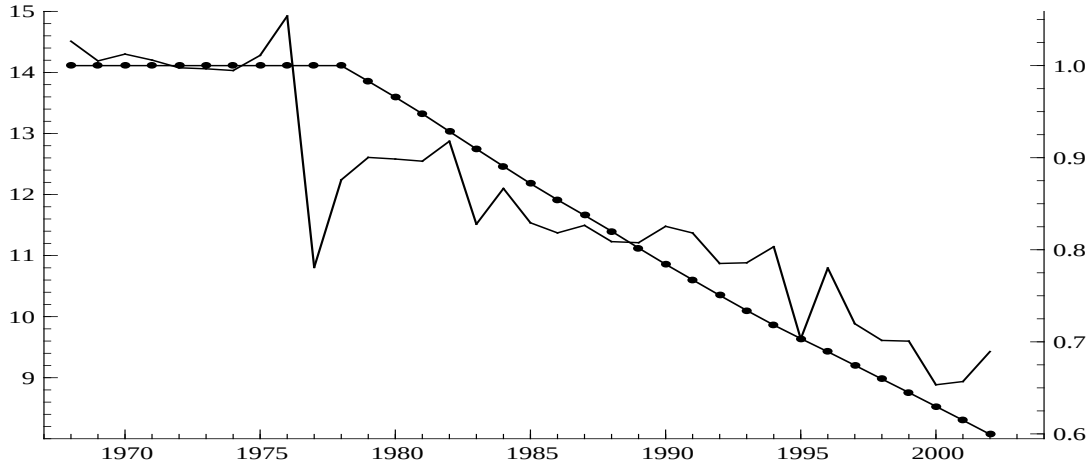

Figure 3: Coffee consumption per adult (left scale), ——, and the share of adults born before 1960 in total adult population (right scale), •—•—•.

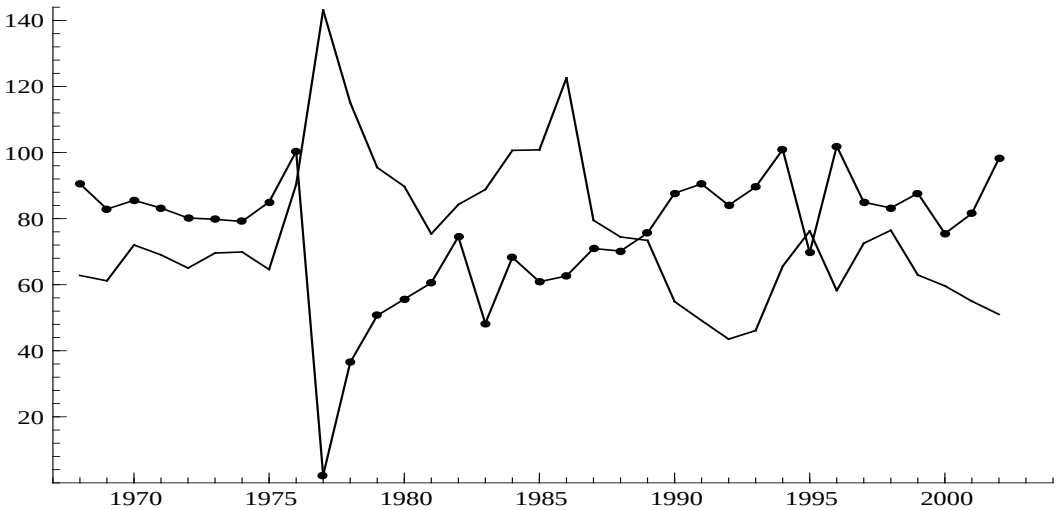

Figure 4: Price of roasted coffee in constant 1995 Swedish kronor , —— , and coffee consumption net of the effect of *G*, the share of adults born before 1960 in total adult population, mean and variance adjusted, •—•—•.

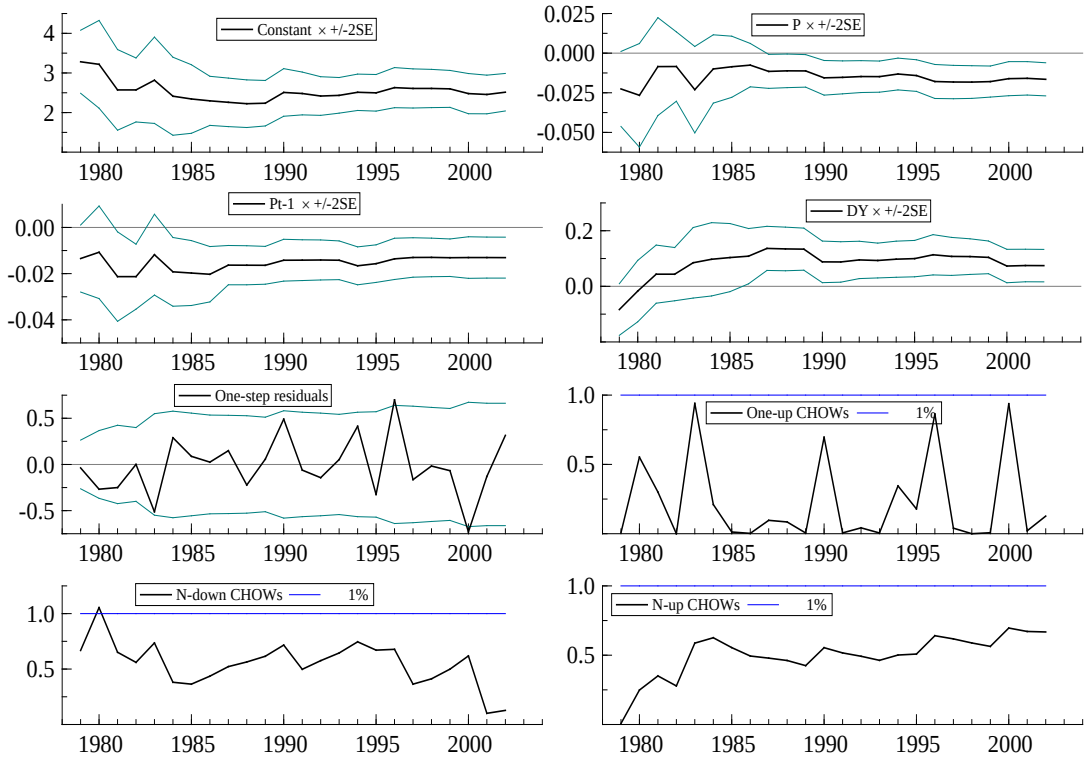

Figure 5: Recursive estimates of the coefficients with ± 2 standard error (top four graphs), one-step residuals with ± 2 estimated standard errors (left in third row), one-step (right in third row), break-point (left in bottom row) and forecast (right in bottom row). Chow statistics scaled with their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

Figure 6: Absolute values of the price elasticity, 1968-2002.

Figure 7: The elasticity adjusted Lerner index, θ, derived from Equation (6?) using cost of imports as marginal cost.

[1] See, for example, Dicum and Luttinger (1999), Fitter and Kaplinsky (2001), Ponte (2002), Oxfam (2002), Gooding (2003), Moore, (2003), McCorriston et al. (2004), Daviron and Ponte (2005), Gibbon (2005), and Green (2005).

[2] Sutton (1991), Clarke et al. (2002) and Durevall (2003) provide information on market shares in various other countries.

[3] See Sutton (1991) on the coffee roasting production process. Inputs, such as labour, energy, packaging, transport, physical capital, etc, usually each make up much less than 5% of total variable costs, rarely more than 10% in Germany and the US (Koerner 2002). In Sweden, only wages and packaging have ever exceeded 5% of variable costs (Statistics Sweden, various issues).

[4] Corts (1999) examines other difficulties of estimating structural oligopoly models.

[5] According to C. Åkerstedt (the Swedish National Coffee Association), there are no contracts that prevent roasters from adjusting prices.

[6] See Bresnahan (1989) for a description of different approaches of measuring market power.

[7] In Cournot equilibrium $\partial Q_t / \partial Q_{it} = 1$ so $\theta = \sum_i \theta_i (Q_i / Q) = \sum_i (Q_i / Q)^2$, which is the Herfindahl Index.

[8] The functional form used in studies of coffee demand varies, but linear and log-linear models are the most common ones, although Bettendorf and Verboven (2000) also estimate a non-linear model and Olekalns and Bardsley (1996) estimate a model with forward looking expectations. All four specifications were tried; the linear and log-linear versions did equally well and basically provide the same information, while there was little empirical support for the other two. This is probably due to the limited number of observations.

[9] Estimation of coffee demand with tea prices instead of CPI produced *t*-values below 2 in absolute value. In fact, tea prices fluctuate too little over time to explain changes in coffee demand. Bettendorf and Verboven (2000) and Feuerstein (2002) also fail to find that the tea prices influence coffee demand in the Netherlands and Germany, respectively.

[10] Information provided by the Swedish National Coffee Association (2005b)

[11] See Juselius (2001) for a very clear and instructive illustration of the use of the Johansen approach with annual data.

[12] The following variables are used in the empirical analysis: Consumer price per kilo roasted coffee, based on 500-gram packets, from Statistics Sweden; consumer price index from IMF's International Financial Statistics,; consumption of roasted coffee, from the Swedish Board of Agriculture; income, measured as household expenditures, from International Financial Statistics; population, from the U.S. Census Bureau's International Data Base (IDB); import price of green coffee beans, calculated from data on quantity and value of imports from Statistics Sweden; and VAT, from European Commission, (2002b).

[13] Since the sample is small, the cointegration analysis was also carried out with partial models. However, the results do not depend on the exact specification of the model: repeating the analysis with only *Q* and *G* in one model, and *Q* and *P* in another, gives the same results, as does excluding the dummy and the income variable. However, the normality test is significant when the dummy is not included.

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

[15] The increase in consumption in 1976 is likely to be due to hoarding related to the frost in Brazil.

[16] See Hendry and Doornik (2001) on recursive estimation.

[17] The Lerner index for Cournot competition is H/ε, where *H* is the Herfindahl index and ε is the absolute value of the price elasticity of demand (see Martin, 2002, p. 338).