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Competition in the Swedish Coffee Market, 1978-2002

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Abstract

Are multinationals exploiting their market power in national coffee markets by keeping consumer prices too high and thereby limiting demand for imports of coffee beans? The purpose of this study is to address this issue by testing if there is market power on the Swedish market for roasted coffee. The market structure is typical of many consumer markets for coffee, with four very large roasting companies, two of which are multinationals, plus many small ones. To analyze the degree of market power, an oligopoly model is estimated using market time series data. The econometric approach is to first test for long-run relationships between the variables with cointegration analysis and then to estimate a system of equations for demand and pricing behavior. Our key finding is that there is evidence of some market power in the short run but none in the long run.

JEL classification: L13; L66; L81

Keywords: coffee market; market power; multinationals; oligopoly; Sweden

1. Introduction

Coffee bean prices started to decline rapidly during 1998 and had fallen over 60% by 2002, when Santos coffee beans, for example, sold at a nominal price of 45 cents per pound, the lowest price since the end of the 1960s.[1] Not surprisingly, such low world prices caused widespread poverty among coffee farmers in the less-developed world. On the other hand, consumer prices were perceived to remain high, or to decrease too slowly. This spurred interest in the market power of the multinational roasting companies, since a small number are active in most, if not all, consumer markets in the industrialized world.

It seems to be a common view that multinational roasting companies have market power and that this is a concern not only to consumers but also to Third World producers, who could expect to sell more to roasters if retail prices were lower. Talbot (1997) had already argued that the market power of the multinationals enabled them to keep retail prices too high, limiting demand, while world prices for green coffee were falling in 1987 and plummeting in 1989. The former president of the WTO, Mike Moore (2003, p. 48) is equally straight forward about the presence of market power, as are Dicum and Luttinger (1999) and Gooding (2003), while Morisset (1998), Fitter and Kaplinsky (2001), Oxfam, (2002), Ponte (2002), McCorriston et al., (2004) and Daviron and Ponte (2005) though more careful in their wording seem to agree with this view.

The Swedish market for roasted and ground coffee is in many ways typical: In 2002 the four largest companies had a market share of 87%; two multinationals (Kraft Foods and Nestlé) had 57%.[2] Roasted coffee is also expensive in Sweden, 7% above the EU average and higher than all EU members except Great Britain, Ireland and Greece, which primarily consume tea and instant coffee (European Commission, 2002a).

An empirical oligopoly model is applied to quarterly Swedish data over the period 1978:1 to 2002:4 to estimate a conduct parameter that captures perfect competition, Cournot behavior and joint-profit maximization (see Porter, 1983). Bettendorf and Verboven (1998, 2000) apply a similar model to the coffee market in the Netherlands and Koerner (2002a) to Germany, while Genovese and Mullen (1998) analyze the U.S. sugar market. However, our econometric approach is more in the spirit of Steen and Salvanes (1999) who, in their study of Norwegian salmon exporters, extend the analysis to include short-run and long-run dynamics by taking stochastic trends in the variables into account. In this approach the long-run solution of the econometric model represents the equilibrium of the theoretical model.

Since aggregate market data are used, roasted coffee is treated as a homogeneous good. Although not ideal, this assumption makes it possible to model dynamics and long-run equilibria with time-series techniques. Given our interest in the overall functioning of the consumer market for coffee and whether there is market power that is detrimental for both consumers and coffee growers, the use of market-level data instead of firm-level data is probably no hindrance.

Roasted coffee is a simple product with little value added, so differences in quality are largely reflected in the cost of imported coffee beans, which we control for. Moreover, roasted coffee sold in Swedish retail outlets is generally made of high-quality beans and differences in quality are much smaller than in many other countries where low-quality beans are common.

The data do not allow a distinction between retailers and coffee roasters. However, according to industry representatives there are no long-term contracts so roasters can change prices whenever they wish. Hence, even though market concentration is high in Swedish food retailing, assuming that retailers act as neutral pass-through intermediaries might not be unrealistic for roasted coffee.

To estimate the model, the Johansen (1988) maximum likelihood procedure is first used to test for unit roots and cointegration. Then an empirically constant autoregressive distributed lag model of demand and pricing is developed, and the assumptions about its stochastic properties and empirical stability are tested.[3]

The major findings are that there is some short-run market power but it is very small, close to perfect competition, and the mark-up, measured as the Lerner index, is only about 10%. In the long run consumer prices are determined by marginal costs so there is no evidence of long-run market power. The downward trend in coffee consumption observed during the past 25 years is thus not due to high prices but more likely to differences in preferences across cohorts, those born after 1960, roughly, consuming less than those born before.

The next section describes the Swedish coffee market while Section 3 gives the theoretical background for the empirical model. Section 4 uses graphs to describe the data and highlight relationships between variables. Section 5 reports estimation results and tests of market power. Section 6 summarizes the findings and draws conclusions.

2. The Swedish market for roasted coffee

The Swedish coffee market is small compared to the world market. In 2003 total consumption in Sweden was only 97,320 tons of coffee beans, about 1.5% of world consumption, though per capita consumption is among the five highest in the world.

Most markets for roasted coffee have a few large and many small firms, as does the Swedish market (Sutton, 1991). Table 1 below shows the market shares of Swedish roasting-houses in 2002. Kraft Foods, owned by Philip Morris and selling Gevalia, Maxwell House and Blå mocca coffee, is the market leader, followed by Löfbergs Lila, Nestlé selling Zoega coffee, and Arvid Nordquist’s Classic brand. Together, these four producers had 87% of the market in 2002, while small firms each had 3% or less. The multinationals (Kraft and Nestlé) had a combined 57%, which is similar to multinationals’ market shares in many other European markets.

Table 1 here

Market structure has not changed much during the study period: there were twelve local roasters in 1978, and ten in 2002. There had been a rapid re-structuring during the first half of the 1970s, however, when seven roasters closed down (Statistics Sweden, various issues) and General Foods acquired Gevalia, the largest Swedish brand (later sold to Kraft). The most important events since 1978 are: Nestlé’s acquisition of Zoégas Kaffe AB in 1986; and Kraft Foods’ 1994 purchase of Cirkel AB and the subsequent removal of the brand Cirkelkaffe from the market. Hence, market concentration was relatively stable up to the mid-1990s with CR_4 about 70%, but increased as a result of Kraft’s purchase of Cirkel AB; in 2002 CR_4 for roasters was 87%. But the number of own-brands also grew, 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.

As noted earlier, the Swedish coffee market sells relatively high and uniform-quality coffee. Coffee quality is primarily driven by bean type, of which there are two, Arabica and Robusta. The Arabica bean, mainly used in high-quality coffee, is more expensive while Robusta is used in low quality coffee, instant coffee, and espresso due to its higher caffeine level. Robusta, which is not used in coffee roasted for Swedish retailers, constitutes only about 3% of imports.

The caffe-latte “revolution”, consumers switching to higher-quality beans and espresso coffee (with milk), is occurring in Sweden as elsewhere, 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, it hardly matters for the analysis.

There is no production of instant coffee in Sweden and the market share is quite small; it has hovered around 10% for many years, when measured in number of cups consumed (Swedish National Coffee Association, 2005a). Instant coffee is often consumed at workplaces or during outings.

The food retailing sector is treated as passive in the analysis since arms’ length pricing is assumed. This seems reasonable in view of the fact that roasters can change their prices whenever they wish, and that retailer margins for standard coffee are low in many markets (Daviron and Ponte, 2005, p. 93). Nevertheless, there is a common opinion that retailers' market power has increased in many European countries (Hughes, 2002), but there is no evidence that this is the case for Sweden. Market concentration in food retailing is very high; CR_4 is about 75%, but it decreased during the 1990s because of the entrance of new actors (Swedish Competition Authority, 2004). As a case in point, a comparison between consumer prices and producer prices, obtained from annual census data on value and quantity of coffee delivered by roasters, shows no trend over the period 1978-2002. For instance, the spread, measured as the log-difference, was 0.37 for 1978-1990 and 0.35 for 1991-2002, and the standard deviation was 0.07 for both periods (Statistics Sweden, selected issues).

3. Development of the theoretical framework

The model consists of demand and supply sides.[4] The supply relation is derived by assuming that firm *i* (*i*= 1,…,n) maximizes profit, π_i ,

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

where τ is value added tax; Q is total industry output; Q_i is the output of firm i; $P(Q)$ is the inverse demand function; $C_i(Q_i, w)$ is the cost function; and w is a vector of input prices. The first-order condition of 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 is the price of coffee; $P'(Q)$ is the derivative of $P(Q)$ with respect to Q; and $\theta_i = (\partial Q/\partial Q_i)(Q_i/Q)$ characterizes the firm's behavior. If $\theta_i = 0$ it sets price equal to marginal cost, which is the equilibrium outcome of Bertrand competition with standardized products; if $\theta_i = 1$ there is joint-profit maximization, i.e., a perfect cartel, and if θ_i is equal to the *i'th* firm's market share, Q_i/Q, there is Cournot competition where firms set quantities (Porter, 1983).

Since market data is used, the model has to be aggregated over all firms. Following Appelbaum (1982) and Bettendorf and Verboven (2000), the cost functions are assumed to be of Gorman polar form,

$$C_i(Q_i, w) = Q_i MC(w) + F_i(w) \tag{3}$$

where all firms face the same input prices and marginal costs, *MC* (*w*), which are constant and equal across firms. However, firms can have different fixed costs, $F_i(w)$, and be of different sizes. The market supply relation is then obtained by multiplying Eq. (2) by Q_i/Q and aggregating over all firms, giving

$$\frac{1}{1+\tau}[P + P'(Q)Q\theta] = MC(w) \tag{4}$$

where $MC(w) = \sum_i MC(Q_i / Q)$ is the marginal cost function and $\theta = \sum_i \theta_i (Q_i / Q)$ is the conduct parameter. Re-writing Eq. (4) yields the static equilibrium supply relation,

$$P = (1+\tau)MC(w) \text{-} \theta P'(Q)Q \tag{5}$$

in which the price of a good depends on three factors: marginal cost, including VAT; market power; and demand. Our parameter of interest is θ, which is the market-share-weighted average of θ_i over all *n* firms. As for θ_i, $\theta = 0$ means that price equals marginal cost and $\theta = 1$ indicates a perfect cartel. However, when there is Cournot competition, θ equals the Herfindahl index.[5] Furthermore, according to Eq. (5) θ cannot be larger than the absolute value of the price elasticity, since that would imply negative marginal cost. Hence, simply by estimating the demand function we get some information about the size of θ.

3.1. Marginal costs

Estimating Eq. (5) requires both specifying a marginal cost function, and estimating a demand function to obtain values for $P'(Q)$. Following Bettendorf and Verboven (2000), the marginal cost function is specified as,

$$MC(w) = \beta_1 IP + \beta_2 W + \beta_3 O \qquad (6)$$

where, *IP* is the real import price for coffee beans; *W* is real labor costs; *O* stands for all other costs; and β_1, β_2 and β_3 are parameters.

This specification is based on the fact, as noted earlier, that coffee roasting is a relatively simple process with one dominant input, green coffee beans. To make 1 kg of roasted coffee, approximately 1.19 kg beans is required. 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).

Other inputs, such as labor and energy, packaging, transport and physical capital, etc, usually each make up less than 5% of total variable costs, rarely more than 10%.[6] In Sweden, only wages and packaging have ever exceeded 5% of variable costs (Statistics Sweden, selected issues).

Unit labor costs in one company (Cirkel AB) were estimated to SEK0.50 per kg roasted coffee in 1989, about 1% of the consumer price.[7] Similarly, the industrial census calculated the average costs of blue collar workers at SEK0.75 per kg in 1990. During the study period, 1978-2002, average unit labor costs measured in 1995 prices only declined from SEK2.60 in 1978 to SEK2.30 in 2002, according to census data (Statistics Sweden, selected issues). Hence, productivity increases seem to have maintained unit labor costs roughly constant, almost balancing real pay rises.[8]

There is no time series data available for “all other costs” lumped into *O* which are assumed to follow general price trends and thus become the estimated intercept; Genovese and Mullen (1998) make the same assumption in their analysis of the U.S. sugar market.[9] However, packaging costs, measured in 1995 prices, decreased from SEK3.15 per kg in 1980 to SEK2.30 in 1990 and SEK1.70 in 2000 (census data combined with information from the Swedish National Coffee Association). And distribution costs have also fallen, as there certainly have been efficiency gains along the distribution chain between producers and retailers, although, transport costs might not have changed much.

Nevertheless, there is no need to include all marginal costs to estimate θ; in fact most fluctuations in *P* are accounted for by the import price of beans, *IP*. If important variables have been left out of the model, this will most likely be revealed in the form of unstable parameter estimates in the supply relation, which can be tested for.

3.2. Demand

Demand for consumer goods is usually assumed to depend on income, the price of the good and the prices of substitutes. When modeling demand over several years, changes in population and population structure should also be considered. Long-run coffee demand in Sweden is thus represented by the static linear demand function

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

where P is the relative (real) consumer price of coffee; Y is real income; G captures demographic change; and α_0, α_1, α_2 and α_3 are parameters.[10]

The relative (real) consumer price of coffee is measured as the retail price divided by the price of the basket of goods included in the consumer price index. More specific coffee substitutes, e.g. tea, could be used but tea prices do not work well empirically and, in any case, it is unlikely that they influence coffee demand in Sweden, where coffee consumption dominates heavily.[11] Within the range of price changes observed in the study period, it seems more likely that coffee-price increases primarily led to better utilization of already-purchased coffee. Market studies have shown that as much as 25% of purchased coffee is not actually drunk (Bettendorf and Verboven, 1998).

An increase in income would normally lead to an increase in consumption, but this is probably not the case for coffee in Sweden, a market already saturated. In fact, per-capita coffee consumption stagnated already in the 1960s, while income has continued to grow.

A common assumption is that, given average income and prices, a growing population will generate higher demand, but consumption patterns can differ substantially across age groups and birth cohorts. Actually, in Sweden there has been a slowdown in coffee consumption due to an apparent change in preferences; people born after about 1960 do not drink as much as those born before, who on average consume about six cups per day.[12] The slowdown started at the end of the 1970s as those born after 1960 reached coffee-drinking age, and continues as the population share of those born earlier declines. Hence, *G* measures the ratio of those 15 years and older born before 1960 to the total population 15 years and older. Since demographic change is slow, the exact starting year and age does not influence the results.

4. A look at the data[13]

This section uses graphs to show some characteristics of the variables and to give some preliminary intuition as to why the formal results hold. The data are quarterly because of the paucity of monthly data for labor costs and imports, and the period analyzed is 1978:1–2002:4. The analysis starts in 1978 because there was turbulence in the market in the mid-1970s; drought in Brazil led to a rise in the price of roasted coffee from SEK20 per kg in the first quarter of 1976 to over SEK40 one year later. Moreover, coffee beans were exempted from import tax in 1976. Thus, to include the mid-1970s would require extending the study period back to the 1960s but labor costs are only available from 1974.

Fig. 1 depicts total coffee consumption together with (mean and variance adjusted) income.[14] While income has grown almost continuously, consumption has declined since the end of the 1970s. It is thus obvious that income does not determine long-run coffee consumption. As noted earlier, by the end of the 1960s market was already saturated.

Fig. 1 here

Since the population of Sweden has grown since the 1970s, per adult coffee consumption has declined even more than what is indicated by Fig. 1. This decline was not due to rising retail prices, as shown by Fig. 2. The price per kilo, measured in constant 1995 prices, fluctuates much more than consumption, and from the mid-

1980s it declines considerably without generating any noticeable increase in consumption.

Fig. 2 here

Fig. 3 depicts the decline in consumption and the declining share of those born before 1960 in total population aged 15 years and older, represented by a fitted trend to highlight the relation.[15] The demographic effect seems to explain the downward trend in coffee consumption quite well. As shown in the econometric analysis, when controlling for the demographic trend, the retail coffee price is negatively correlated with consumption, as one would normally expect.

Fig. 3 here

As noted earlier, coffee beans are by far the most important input in the production of roasted coffee. Fig. 4 shows this by graphing real retail prices and bean prices, where the bean price is the per-kilo value of imported green beans adjusted for value added tax. There is no doubt that fluctuations in the import price and, to some extent, in the SEK – USD exchange rate, explain the variability in the retail price.

The two price series seem to be non-stationary due to a level shift (structural break) during the latter half of the 1980s. The direct cause of the price break was a sharp decline in world prices, which in turn was related to the collapse of the International Coffee Agreement in 1989 that had stipulated minimum prices for coffee beans (Talbot, 1997).

Fig. 4 here

Fig. 5 plots retail coffee prices and (mean adjusted) hourly labor costs for blue-collar workers in food and beverage manufacturing, adjusted for value added tax. Since labor costs rose during most of the study period, while prices declined, there is no positive long-run relation between the two. Increases in labor productivity compensated for the rise in labor costs, making real unit labor costs roughly stationary, as we noted earlier. In the econometric analysis the first difference of real labor costs is used to capture changes in real unit labor costs.

Fig. 5 here

5. Empirical analysis

Data analysis is performed in several steps. Since the mean and variance of at least some variables are not constant over time, the Johansen (1988) method is first used to test for integration and cointegration, that is, whether variables are stationary or not, and whether the non-stationary variables have stochastic trends that can be removed by taking linear combinations. Then a vector autoregressive distributed lag system for demand and pricing is estimated in which all variables are stationary or can be written as stationary. Assumptions regarding stochastic properties of the system are tested, and then it is reduced to obtain a parsimonious and empirically constant model. Finally, the stability of the model is investigated using recursive estimation.

5.1. Integration and cointegration analysis

To test for long-run relationships and ensure that the econometric model of demand and supply relations is stable, i.e., that there are no unit roots, the data are tested for integration and cointegration. In principle it is advisable to do cointegration analysis of all the variables at the same time but some do not appear to have unit roots, and results are more clear-cut when partial models are tested

The results from the Johansen maximum likelihood procedure applied to coffee consumption, *Q*, and the ratio of those born before 1960 to total population 15 and older, *G*, are summarized in Table 2.[16] The null hypothesis of no cointegration can clearly be rejected, (trace test *p*-value = 0.0001). This result is supported by the estimate of the eigenvalue of the long run matrix, 0.22, and largest root of the companion matrix, 0.498. Moreover, the likelihood ratio test for excluding *G* from the stationary vector is also rejected. The long-run equation is $Q = 10.37G$, implying that, for example, a drop in *G* from 0.6 to 0.5 leads to a 1037 ton (of roasted coffee) decline in *Q*. Table 2 also reports that there is no evidence of misspecification of the autoregressive model.

Table 2 here

Including income, *Y*, in the model does not produce another stationary relation, confirming what is obvious in Fig. 1.[17] Hence, long-run demand for roasted coffee is driven by population dynamics in combination with a change in consumer preference.

Retail price, *P*, and import price, *IP*, are analyzed with an autoregressive model consisting of five lags of *P* and *IP*; unrestricted constant; centered seasonal dummies; impulse dummies for 1986:1 and 1994:3; and the first difference of $1+VAT$.[18] The two impulse dummies capture excessive, but temporary, retail price increases in response to exceptionally large import price increases: The price of Brazilian Milds, a common type of bean used in Swedish coffee, rose by 134% from 1985:3 to 1986:1 and by 161% from 1994:1 to 1994:3 (IMF, 2004). Misspecification tests, reported in Table 3, indicate that some non-normality is left in the residuals, which is accepted since many more impulse dummies would be required to remove all the outliers. The basic results are not affected by the inclusion or non-inclusion of impulse dummies, however.

Both variables appear stationary based on the trace test that rejects a rank of one. However, the largest root is 0.94, which is fairly high, and *P* and *IP* do not look stationary, as we saw in Fig. 4. Visual inspection of the two "cointegrating" vectors (not reported) and Fig. 4 reveals that both series are non-stationary due to a level shift at the end of the 1980s, which is not detected by the trace test. Furthermore, *P* and *IP* seem to co-break, i.e., have the same structural breaks, so a linear combination of the two variables would create a stationary series.

Table 3 here

5.2. The empirical model and results

There are many reasons why adjustment might not be instantaneous in a coffee-market model with quarterly data. There is probably habit formation because coffee is addictive, and, many consumers buy coffee irregularly, so the response to a price change may not be completed within one quarter. Since little is known about these adjustment processes, a general semi-reduced dynamic model is first estimated to allow the data to determine the lag structure, while testing to make sure that its stochastic assumptions are fulfilled; then equilibrium conditions are obtained by solving for the static state of the model.

The general semi-reduced dynamic model is specified as

$$Q_t^* = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} Q_{t-i}^* + \sum_{i=1}^{k} \alpha_{2i} P_{t-i} + \sum_{i=1}^{k} \alpha_{3i} DP_{t-i} + \sum_{i=0}^{k} \alpha_{4i} \Delta Y_{t-i} + \varepsilon_{Qt} \tag{8}$$

$$P_t = \beta_0 + \sum_{i=1}^{k} \beta_{1i} P_{t-i} + \sum_{i=1}^{k} \beta_{2i} Q_{t-i}^* + \sum_{i=0}^{k} \beta_{3i} IP_{t-i} + \sum_{i=0}^{k} \beta_{4i} \Delta W_{t-i} + D_t + \varepsilon_{Pt} \tag{9}$$

where $Q^* = Q - 10.37G$ is coffee consumption net of the age effect, which ensures that consumption is a stationary; *DP* is an interaction dummy for *P*, the real price of coffee, that is zero from 1978:1 to 1988:4 and the same as *P* from 1989:1 to 2002:4, included to capture the structural break in the mean value of *P* at the end of the 1980s since there was no concomitant increase in consumption;[19] ΔY is the change in income; *IP* is the import price of coffee multiplied by *1+VAT;* ΔW is the change in hourly labor costs for blue-collar workers multiplied by *1+VAT;* and *D* represents two impulse dummies, unity in 1986:1 and 1994:3, zero elsewhere. Both equations contain intercepts and seasonal dummies, included in α_0 and β_0. The error terms, ε_Q and ε_P, are assumed to be random with zero mean and constant variance.[20]

This model is estimated by maximum likelihood with five lags on each variable. Results are reported in Table A1 in Appendix II.[21] In the demand equation two parameters are significant, the first lag of price and change in income, both with expected signs. Many more parameters are significant in the pricing equation, the contemporaneous import price has a t-value over 9, and both labor costs and lagged prices have several significant parameters. Quantity also seems to affect pricing; the fifth lag is positive and highly significant. The correlation between the residuals is negative but close to zero, -.08, indicating little simultaneity between *Q** and *P*, probably because of the construction of the consumption series.[22]

Reduction to a parsimonious model is carried out in steps, removing the longest lag of each variable with low t-value, then using likelihood-ratio tests and various information criteria to ascertain that no relevant information is lost (Table A2 in Appendix II).[23] To enhance interpretability, three transformations are made in the price equation: The second and third lags of *P* are replaced by the first difference of the second lag; lagged import prices are aggregated (as a simple Almon polynomial) with 2-to-1 relative weights; and the labor cost variables are aggregated with weights 0.15, 0.05, 0.25, 0.25, 0.15, and 0.15, based on the estimated coefficients.

Table 4 reports the final model and diagnostic tests on the residuals for autocorrelation, normality and heteroscedasticity. None of the tests is statistically significant, nor is the likelihood ratio test for reducing the number of parameters by 34 significant. Empirical model constancy was assessed using recursive estimation and dynamic forecasts (not reported).[24] All tests indicate that the stability of the model is satisfactory.

In the demand equation changes in income have a contemporaneous impact on consumption, and price increases reduce demand as expected, with a statistically significant decline in the price coefficient from about 1989.

The price-response estimates imply an average price elasticity of -0.38 with standard deviation 0.14, which in absolute terms is somewhat higher than what other coffee markets studies have found.[25] The interaction dummy keeps the price elasticity fairly constant across the structural break; -0.41 for 1978:1-1988:4 and -0.37 for 1989:1-2002:4.

The pricing equation is more complicated and dynamic than the demand equation. There is some inertia in pricing, since lagged consumer prices remain in the model. The coefficient on the first lag, 0.62, affects the interpretation of the other coefficients because we have to solve for P_{t-1} to find the long-run effect of any other variable.

Lagged changes in consumer prices, on the other hand, only affect the short-run dynamics.

Import prices have a strong contemporaneous impact on retail price, but it is moderated by a negative coefficient on lagged import prices. In the long run, a rise in the import price by SEK1 leads to an increase in the retail price by SEK1.14, which is close to the technical ratio, 1.19, between beans and roasted coffee.

The two impulse dummies indicate some non-linearity in the price equation; on those two occasions, sharp rises in import prices led to even larger increases in retail prices. But no permanent changes in the spread between *P* and *IP* seem to have been generated, so, with only two unusual observations, there is no need to estimate a non-linear model.

Table 4 here

The impact of labor costs is harder to interpret since we have no direct measure of labor productivity. However, using labor costs in first differences removes a component that hopefully captures it, leaving unit labor costs. Changes in real labor costs raise the consumer price over five quarters; if labor costs per hour increases by SEK1, consumer price eventually rise by SEK1.6.

In evaluating market power, the parameter of Q^* is of primary interest. It is clearly significant (t-value = 3.2), and it is positive as would be expected when there is market power.[26] To calculate $\hat{\theta}$ the price equation is first solved for the lag to obtain the static (long run) solution, which gives a coefficient of 0.66 for Q^*. The conduct parameter is thus 0.042 x 0.66 = 0.028 for 1978:1-1988:4, and 0.061 x 0.66 = 0.040 for 1989:1-2002:4.

Likelihood ratio tests for the non-linear cross-equation restrictions that $\hat{\theta}$ is equal to zero and one are significant in both cases, though only at the 5% level for $\hat{\theta} = 0$ (see Table 4). The standard deviation of $\hat{\theta}$ was calculated with the delta method (Green, 2003, Ch. 9): For 1989:1-2002:4, the 95% confidence interval is 0.017-0.063, indicating $\hat{\theta}$ is larger than zero but very far from unity. Since the interval includes the 0.028 value for 1978:1-1988:4, the conduct parameter may not have increased in 1989. The estimates of θ are much lower than what they would be if there was Cournot competition (approximately 0.36 in 1982, and 0.26 in 2002) even when considering the confidence intervals.[27]

The Lerner index calculated from the price elasticity and the conduct parameter indicates an average 10% mark-up over marginal costs for 1989:1-2002:4, clearly less than what would be expected with Cournot competition, that is, 70% based on market shares in 2002, and close to 50% with market shares as in the 1980s.[28]

Short-run market power in the Swedish roasted coffee market is thus almost as small as in perfect competition. And there is no evidence of long-run market power, since the long-run level of coffee consumption is independent of prices. This implies that firms do not permanently influence prices with quantities or vice versa, and subsequently long-run retail prices are determined by marginal costs.

6. Summary and conclusions

The objective of this study was to estimate the degree of market power in the Swedish roasted coffee market during 1978:1-2002:4. A dynamic model of coffee demand and pricing was developed and its long-run solution interpreted in the light of a static model with three alternative equilibria; Bertrand (perfect) competition, Cournot competition and perfect collusion. The resulting model is parsimonious and empirically stable, and has parameters that make economic sense. However, stability was achieved by including two impulse dummies capturing unusually large increases in the consumer price in response to unusually large increases in the import price of coffee beans.

Firms with long-run market power would have set quantities as to affect long-run demand, but there is only a short-run relation between quantity and price. In the long run, changes in preferences across cohorts in combination with population dynamics determine demand. Thus, the results provide support for the presence of Bertrand competition where prices are set according to marginal costs.

Even in the short run, only slight evidence of market power was found. The maximum estimate of the conduct parameter, i.e., the point estimate for 1989-2002 plus twice the standard deviation, was 0.063. This is very far below unity, which would correspond to perfect collusion, and even far below 0.26, which would be the value if there were Cournot competition in 2002. The Lerner index, measuring the mark-up over marginal costs, was estimated to only about 10%, whereas it would have been 70% in 2002 with Cournot competition. Hence, even the short-run behavior of firms in the Swedish roasted coffee market seems to be closer to perfect than Cournot competition.

The analysis has some limitations that probably can explain the finding of market power inconsistent with either perfect or Cournot competition. There should be some short-run market power reflecting branding and advertising in the roasted coffee markets, which might not be captured adequately in this analysis that treats coffee as a homogenous good. And some roasters might also be able to exercise regional market power, not revealed with aggregate data. Moreover, no distinction is made between producers and retailers.

The analysis was also based on a theoretical model that might not describe the characteristics of the coffee market adequately, which could create a bias in our measure of market power (Corts, 1999), though it is unlikely to invalidate the major findings: The bias does not seem to be important for small estimates of the conduct parameter and it is irrelevant for estimation of demand.

Yet, the analysis indicates that, contrary to common belief, overall market power for roasted coffee in Sweden was low during the period studied. High consumer prices had only temporary effects on the demand for imports of coffee beans, and the harm made to Third World producers by domestic market power in Sweden was probably small.

Acknowledgements

I would like to thank the editor Igal Hendel, two anonymous referees and Rick Wicks for their extremely useful comments. All the remaining errors and omissions are my own. Financial support from the Swedish Competition Authority is gratefully acknowledged.

Appendix I: Data description

The following variables were used in the empirical analysis:

Consumer price index from the IMF's International Financial Statistics.

*Incom*e, measured as household expenditure from the IMF's International Financial Statistics.

Import price, *imports and exports of green and roasted coffee*, in volume and value, from the data base of the International Coffee Organization and Statistics Sweden.

Labor costs, per hour for manual worker in the food and beverage industry, from Statistics Sweden

Population from the U.S. Census Bureau's International Data Base (IDB), yearly data interpolated to obtain quarterly observations.

Retail price per kilo of roasted coffee, based on 500-gram packets, from Statistics Sweden.

VAT from the European Commission (2002b)

Consumption of roasted coffee, quarterly series, was obtained with the Denton technique (Bloem et al., 2001) by combining yearly data on consumption from the Swedish Board of Agriculture with quarterly observations on net imports of coffee beans and weight-adjusted imported roasted coffee. There are two potential problems related to stocks when doing this conversion; there could be stocks of beans held by the roasters, and stocks of roasted coffee held by roasters or retailers, and either of these could cut the link between the short-run fluctuations of imports and consumption (the level of consumption is measured by the annual consumption data). However, the process of roasting, grinding and packing takes less than a day, and roasters do not usually keep more coffee beans than required for a month's production, often much less (Lodder, 1998; Swedish National Coffee Association, 2005b), so imported coffee beans are generally processed and delivered to retailers within three months. Retailers also usually sell all their coffee within three months because there are regular deliveries and all coffee is stamped with a best-before date (Swedish National Coffee Association, 2005b). For these reasons the measure of consumption, *Q*, can be taken as reflecting deliveries to retailers at time t and sales at t+1.

During 1977:2-1988:4 the International Coffee Association published quarterly observations on household purchases for Sweden, obtained from surveys carried out by the company Europanel. To check whether the seasonal fluctuations of this series are similar to those of the series used here, *Q* was regressed on household purchases, plus a deterministic trend and seasonal dummies (the results can be obtained from the author). The trend was included because of the interest in quarterly fluctuations. The regression coefficient for household purchases turned out to be 1.0 with t-value 4.3, and no seasonal dummy significant. Diagnostic tests also indicated that the residual was white noise. Since there is no useful information left in the residual, there series used here seems to capture the short-run fluctuations during 1977:2-1988:4.

Appendix II: Regression results

Table A1 here

Table A2 here

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[1] The prices are from IMF (2004) and refer to the New York market.

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

[3] Although a dynamic model is estimated, it is based on a static framework. According to Corts (1999), the use of a static model is likely to induce downward bias in the conduct-parameter estimates since it measures marginal and not average collusiveness of conduct. While there is no disagreement about the validity of Corts' critique, the bias seems small for low levels of market power (Genovese and Mullen, 1998; Clay and Troesken, 2003).

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

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

[6] In the U.S. and Germany during the 1990s no individual input apart from coffee beans accounted for more than 5% of total production value (Koerner, 2002b).

[7] The information was provided by Calle Åkerstedt, former president of the company and now at the Swedish National Coffee Association.

[8] Industrial census information is not very useful for time series analysis because of changes in the classification of companies and the reporting of costs.

[9] Data on energy and fuel indexes are available and there are proxies for capital costs, but they turned out to be insignificant in empirical analysis.

[10] The functional form of the demand function estimated in other studies on market power varies but linear and log-linear models seem to be the most common ones. The linear form is preferred here for simplicity; when estimating demand models with different functional forms, the average price elasticities turned out to be quite similar and the linear and log-linear models did equally well empirically.

[11] Coffee demand was estimated with tea prices included instead of the CPI but the t-value was 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 find that there is no influence of tea prices on coffee demand in the Netherlands and in Germany.

[12] The change in the age-specific consumption pattern is well-known in the Swedish coffee industry according to Calle Åkerstedt at Swedish National Coffee Association. Durevall (2005) analyzes coffee demand and the generation effect for the period 1968 – 2002.

[13] Data description and sources are given in Appendix I.

[14] The Denton method was used to obtain quarterly data on consumption of roasted coffee by combining annual data with quarterly import data (see Appendix I for details).

[15] Since the generation effect starts at the end of the 1970s and evolves slowly, it is simply a negative deterministic trend over the period 1978 to 2002.

[16] See Johansen (1995) for details about cointegration analysis and the tests reported in this section. The cointegration tests and all other numerical results were obtained with PcGive. For the misspecification and diagnostic tests, see Doornik and Hendry (1994).

[17] Re-estimating the model with *Q*, *G* and *Y* and testing for two stationary relations gave a trace test statistic of 5.95 with *p*-value = 0.477.

[18] The level of *1+VAT* was not included since it was found to be insignificant. Reporting on the model with *1+VAT* would require another table with different critical values, so the results are omitted here.

[19] The most obvious explanation for why there was no increase in demand is the economic crisis which Sweden experienced in the early 1990s. Unemployment rose from 1.5% to 8% from 1989 to 1994 while house prices collapsed, consumer credit was squeezed, etc. However, as pointed out by a referee, this explanation is not consistent with the fact that the market was saturated. Moreover, it was tested whether economic recovery during the latter half of the 1990s required another interaction dummy, but this was not the case.

[20] In Eq. (5) *1+VAT* also enters as a separate variable but no explanatory power in levels or first differences was found for VAT. Changes in *1+VAT* probably affected the CPI and the nominal price of coffee about the same.

[21] The model appears well specified statistically, with no evidence of vector serial correlation or vector heteroscedasticity, and the residuals normally distributed. The largest eigenvalue (modulus) of the companion matrix is 0.7, which shows that the model is dynamically stable (Table A1 in Appendix II).

[22] As described in Appendix I, short-run fluctuations reflect producers' deliveries to retailers at time t, and sales at t+1, which creates a lagged demand response to price changes in the model.

[23] The number of parameters was reduced from 53 to 26, while the Schwartz criterion went from 10.23 to 9.20; the likelihood ratio test statistic for the reduction was $\chi^2(27)=26.33$, which has a *p*-value of 0.50 (see Table A2 in Appendix II). Hence, the simplification seems to be statistically valid.

[24] The results from the recursive estimation and dynamic forecasts can be obtained from the author.

[25] Using Swedish yearly data for 1968-2002 Durevall (2005) finds an average price elasticity of -0.19. Bettendorf and Verboven (2000) report price elasticity of -0.20 for the Netherlands, and Feuerstein (2002) reports -0.18 for Germany.

[26] Step dummies and interaction dummies were used to test whether the entrance of Nestlé to the market in 1986, the increase in CR_4 in 1994, i.e., Kraft's acquisition of Cirkelkaffe, or the break-down of the International Coffee Agreement in 1989 affected the supply function, but no test was significant. This is reflected in the overall stability of the model. The stability tests can be obtained from the author.

[27] In Cournot competition with firms of different sizes the conduct parameter is equal to the Herfindahl index, the values of which 026 and 0.36 are underestimates since information on some small firms is missing.

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

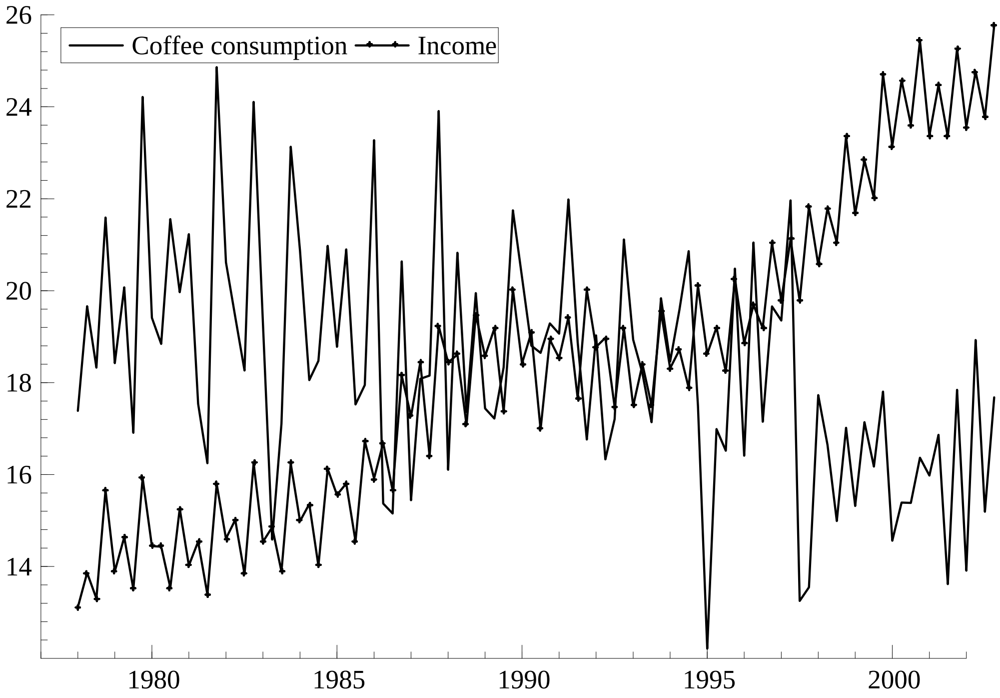

Fig. 1. Coffee consumption, 1000 ton per quarter, and mean and variance adjusted income. The Y-axis shows quarterly coffee consumption.

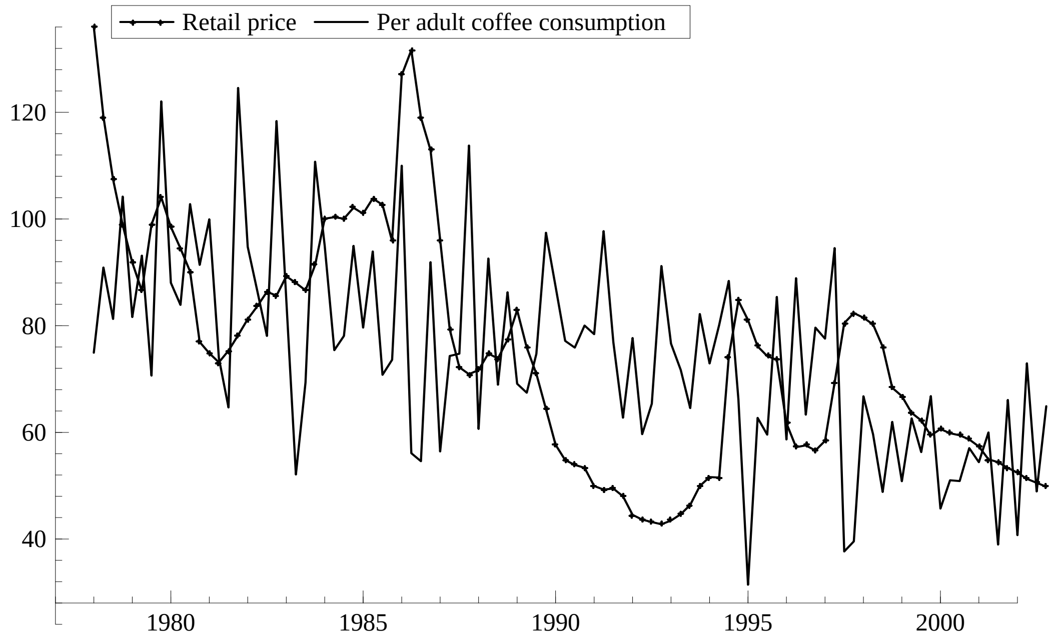

Fig. 2. Retail coffee price in 1995 prices and mean and variance adjusted per adult coffee consumption. The Y-axis shows the retail price.

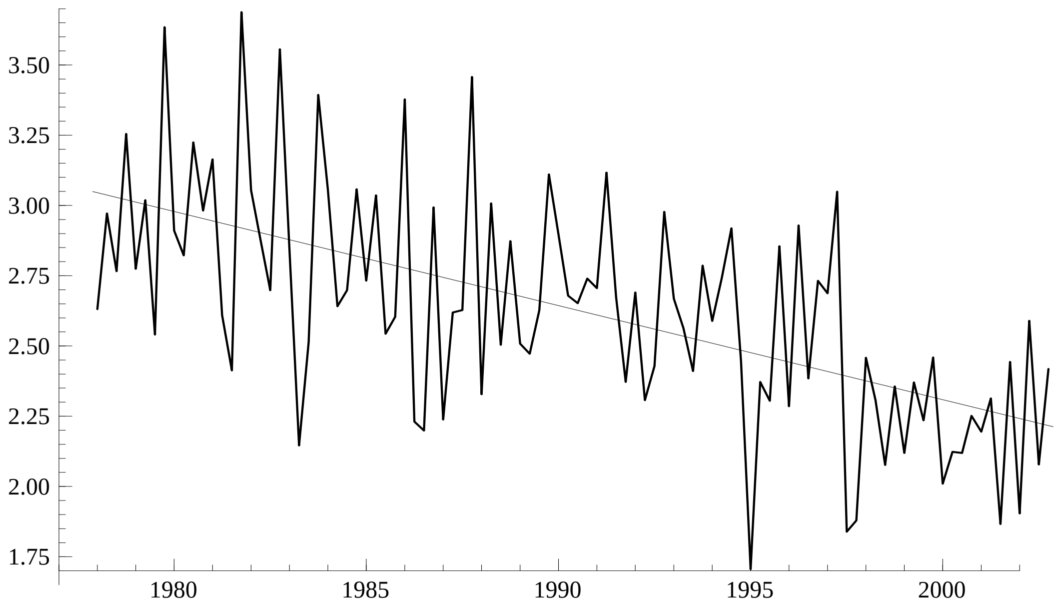

Fig. 3. Coffee consumption in kg per adult per quarter and a fitted trend representing the share of those born before 1960 in total population 15 and older.

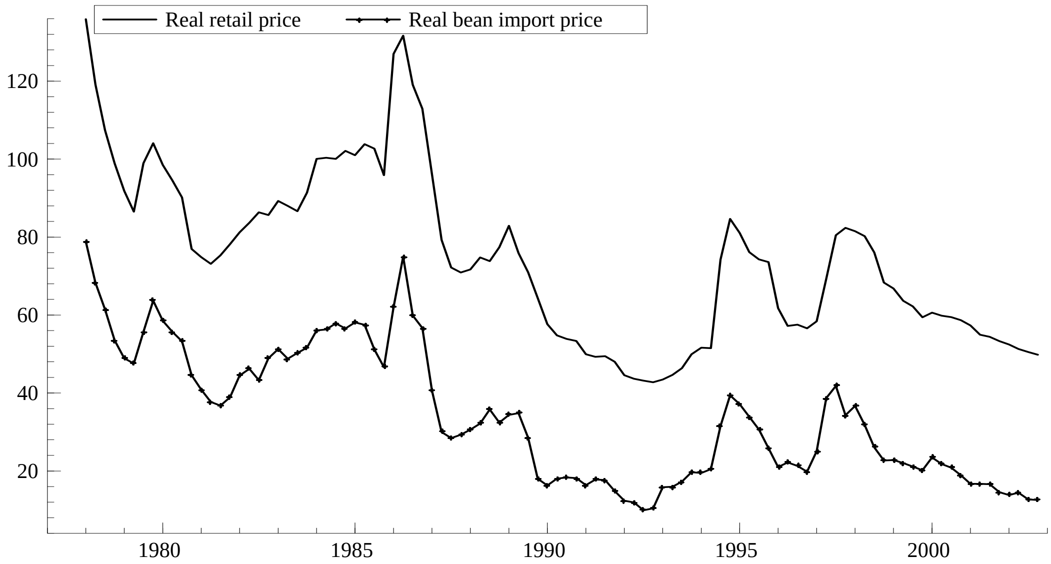

Fig. 4. Retail coffee price per kg and VAT-adjusted import price of coffee beans per kg in constant 1995 prices.

Fig. 5. Retail coffee price per kg and VAT-adjusted labor costs. Labor costs are mean and variance adjusted. The Y-axis shows the coffee price in constant 1995 prices.

Table 1

Market shares for roasted coffee by roasting-house 2002 (%)

Roasting-house	Brand	Market share %
Kraft Foods	Gevalia, Maxwell House, Blå mocca	44.0
Löfbergs Lila		18.0
Nestlé	Zoega	13.0
Arvid Nordquist	Classic	12.0
Lindvalls Kaffe		3.0
K W Karlberg		1.7
Kahls Kaffe		1.5
Bergstrands		1.0
Guldrutan		0.7
Others		5.1
Total		100

Source: ACNielsen, published in Företagaren Direkt (2002).

Table 2

Cointegration test of Q and G and misspecification tests

		Vector misspecification tests		p-value
Eigenvalue of Π-matrix	0.220			
Trace test, $r \geq 0$	24.980	AR 1-5 test	$F(5,85) = 0.733$	0.600
p-value	0.000	Normality	$\chi^2(2) = 0.328$	0.848
Largest root of process	0.498	ARCH	$F(4,82) = 1.464$	0.220
LR test for excluding G, $\chi^2(1)$	16.040	Hetero	$F(12,77) = 0.913$	0.537
p-value	0.000	Hetero-X	$F(27,62) = 1.092$	0.377

Standardized eigenvector $\hat{\beta}'$

	Q	G
$\hat{\beta}_1'$	1	-10.37

Note: Five lags and centred seasonal dummies were used. The critical values for the trace test statistic are based on the distribution for a model with unrestricted constant and restricted trend.

Table 3

Cointegration test of *P* and *IP* and misspecification tests

Eigenvalues of Π-matrix		Vector misspecification tests		*p*-value
Rank = 1	0.219	AR 1-5 test	$F(5,150) = 1.438$	0.113
Rank = 2	0.092	Normality	$\chi^2(4) = 22.500$	0.000
Trace test	*p*-value	Hetero	$F(60,188) = 0.655$	0.971
$r \geq 0$	0.000	Hetero-X	$F(195,54) = 0.776$	0.891
$r \geq 1$	0.002			
Largest roots of process	0.94, 0.77			

Note: The model includes five lags of *P* and *IP*, centred seasonal dummies, unrestricted constant, the first difference of *1+VAT*, and impulse dummies for 1986:1 and 1994:3.

Table 4

Final Model, 1978:1-2002:4

$$Q^*_t = -\,0.042P_{t-1} - 0.019DP_{t-1} + 0.9\Delta Y_t + 14 + 2.2S_{1t} + 0.27S_{2t} + 1.1S_{3t}$$

[0.011] [0.008] [0.38] [1] [1.8] [0.92] [1.8]

$$P_t = 0.25Q^*_{t-5} + 0.62P_{t-1} - 0.25\Delta P_{t-2} + 0.71IP_t - 0.17\left(\frac{2}{3}IP_{t-3} + \frac{1}{3}IP_{t-4}\right) + 1.6\Delta Ww + 24Dum86$$

[0.077] [0.037] [0.045] [0.032] [0.022] [0.23] [2]

$$+\ 11Dum94 + 9.5 - 0.26S_{1t} - 1.1S_{2t} + 1.1S_{3t}$$

[2.1] [1.5] [0.61] [0.56] [0.59]

Note: $\Delta Ww = 0.15\Delta W_t + 0.05\Delta W_{t-1} + 0.25\Delta W_{t-2} + 0.25\Delta W_{t-3} + 0.15\Delta W_{t-4} + 0.15\Delta W_{t-5}$

Estimation method: FIML, Estimation sample: 1978:1 – 2002:4

Vector AR 1-5 test: $F(20,160)= 0.686$ [0.836]
Vector normality test: $\chi^2(4) = 0.806$ [0.937]
Vector hetero test: $F(144,120)= 0.899$ [0.729]

Tests of reduction: General to Final model: $\chi^2(34)=29.76$ [0.676]

Likelihood ratio test for $\hat{\theta} = 0$: $\chi^2(1) = 5.67$ [0.017]
Likelihood ratio test for $\hat{\theta} = 1$: $\chi^2(1) = 3190$ [0.000]

Table A1

General model, 1978:1-2002:4

Eq. for Q^*	Coeff.	Std. Err	t-value	Eq. for P	Coeff	Std. Err	t-value
Q^*_{t-1}	0.024	0.121	0.201	Q^*_{t-1}	-0.070	0.135	-0.519
Q^*_{t-2}	-0.068	0.116	-0.585	Q^*_{t-2}	0.037	0.127	0.289
Q^*_{t-3}	-0.001	0.116	-0.006	Q^*_{t-3}	-0.119	0.122	-0.978
Q^*_{t-4}	0.046	0.097	0.474	Q^*_{t-4}	0.023	0.111	0.209
Q^*_{t-5}	0.016	0.094	0.170	Q^*_{t-5}	0.262	0.103	2.540
P_{t-1}	-0.093	0.043	-2.180	P_{t-1}	0.726	0.080	9.080
P_{t-2}	0.040	0.074	0.542	P_{t-2}	-0.294	0.093	-3.150
P_{t-3}	0.050	0.076	0.652	P_{t-3}	0.307	0.092	3.330
P_{t-4}	-0.089	0.071	-1.260	P_{t-4}	-0.227	0.104	-2.180
P_{t-5}	0.051	0.041	1.230	P_{t-5}	0.093	0.071	1.310
ΔY_t	1.075	0.483	2.230	IP_t	0.686	0.069	9.960
ΔY_{t-1}	-0.086	0.482	-0.178	IP_{t-1}	-0.074	0.108	-0.690
ΔY_{t-2}	0.007	0.478	0.015	IP_{t-2}	-0.062	0.110	-0.565
ΔY_{t-3}	-0.560	0.454	-1.240	IP_{t-3}	-0.088	0.104	-0.851
ΔY_{t-4}	-0.085	0.450	-0.190	IP_{t-4}	-0.010	0.088	-0.116
ΔY_{t-5}	-0.288	0.463	-0.622	IP_{t-5}	0.006	0.073	0.077
DP_{t-1}	-0.028	0.024	-1.150	ΔW_t	0.301	0.076	3.960
DP_{t-2}	0.022	0.033	0.668	ΔW_{t-1}	0.121	0.082	1.470
DP_{t-3}	-0.002	0.033	-0.057	ΔW_{t-2}	0.377	0.084	4.490
DP_{t-4}	0.028	0.034	0.827	ΔW_{t-3}	0.323	0.087	3.710
DP_{t-5}	-0.038	0.024	-1.560	ΔW_{t-4}	0.308	0.080	3.840
Constant	13.982	3.748	3.730	ΔW_{t-5}	0.223	0.078	2.850
S_1	5.491	4.251	1.290	*Dum86*	23.220	2.500	9.290
S_2	0.569	1.215	0.468	*Dum94*	11.046	2.318	4.770
S_3	5.085	4.048	1.260	*Constant*	11.453	3.835	2.990
$\hat{\sigma}$ = 1.957				S_1	0.228	1.209	0.189
				S_2	-2.104	0.915	-2.300
				S_3	2.558	1.239	2.060
				$\hat{\sigma}$ = 1.988			

Method of estimation: FIML, Estimation sample: 1978:1- 2002:4

Correlation of structural residuals (standard deviations on diagonal)

	Q*	P
Q*	1.957	-0.080
P	-0.080	1.988

Vector autocorrelation test: F(20,126) = 1.057 [0.403]
Vector normality test: χ^2 (4) = 2.575 [0.631]
Vector hetero test: F(210,3) = 0.050 [1.000]
Largest four eigenvalues (modulus) of companion matrix: 0.70, 0.70, 0.69, 0.69

Table A2

Parsimonious model, 1978:1-2002:4

Eq. for: Q^*	Coeff	Std.Err	t-value	Eq. for P	Coeff	Std.Err	t-value
P_{t-1}	-0.042	0.011	-3.860	Q^*_{t-5}	0.220	0.085	2.600
ΔY_t	0.903	0.390	2.320	P_{t-1}	0.627	0.062	10.100
DP_{t-1}	-0.018	0.008	-2.350	P_{t-2}	-0.258	0.066	-3.940
Constant	14.252	1.023	13.900	P_{t-3}	0.217	0.056	3.890
S_1	2.186	1.883	1.160	IP_t	0.698	0.043	16.100
S_2	0.274	0.944	0.291	IP_{t-3}	-0.132	0.056	-2.330
S_3	1.163	1.811	0.642	*IPt-4*	-0.083	0.035	-2.370
$\hat{\sigma}$ = 1.954				ΔW_t	0.298	0.070	4.260
				ΔW_{t-1}	0.128	0.078	1.630
				ΔW_{t-2}	0.409	0.078	5.270
				ΔW_{t-3}	0.397	0.078	5.080
				ΔW_{t-4}	0.322	0.076	4.220
				ΔW_{t-5}	0.276	0.072	3.810
				Dum861	23.848	2.174	11.000
				Dum943	10.559	2.173	4.860
				Constant	11.000	2.031	5.420
				S_1	-0.463	0.996	-0.465
				S_2	-1.646	0.806	-2.040
				S_3	1.533	1.023	1.500
				$\hat{\sigma}$ = 1.925			

Tests of reduction General to Parsimonious model: $\chi^2(27) = 26.335$ [0.500]