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Negative Commodity Promotion and Changing Competitiveness: A Topological Analysis of Palm Oil in the USA

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ABSTRACT

This study utilises the Cooley-Prescott time-varying parameter model to conduct a topological analysis on the changing competitiveness of palm oil in the US market. Results show that competitiveness relationships between palm and soybean oils were more pronounced in the post 1987 period - following the commencement of the American Soybean Association (ASA) negative campaign against palm oil. Policy implications based on the findings of the study are suggested.

ABSTRAK

Kajian ini menggunakan model parameter berubah mengikut masa Cooley-Prescott untuk menganalisis secara topologi perubahan dalam daya saing minyak sawit di pasaran Amerika Syarikat. Kajian mendapati hubungan persaingan antara minyak sawit dan minyak kacang soya menjadi lebih sengit selepas pelancaran kempen negatif terhadap minyak sawit oleh Persatuan Kacang Soya Amerika Syarikat. Beberapa implikasi polisi berdasarkan penemuan kajian adalah dicadangkan.

THE POLITICAL ECONOMY OF PALM OIL IN THE USA

A host of edible vegetable oils are traded in the United States (US) market, for example, soybean, sunflowerseed, canola, peanut, coconut, palm, corn, and cottonseed oils. These oils have minor differences in the physical and chemical characteristics, hence they are somewhat interchangeable. Of all the oils, palm oil has made the greatest inroads into the world and domestic markets. Price differential has been an important competitive factor for palm oil. Depending upon relative prices, palm oil can substitute for soybean oil and other fats and oils, primarily in the production of hydrogenated shortenings, and to a lesser extent for margarine and cooking and salad oils. A greater price difference favours palm oil over substitute fats and oils. For instance, when the average price differential between soybean oil and palm oil went from 4.2 cents a pound in 1973-74 to 9.3 cents in 1974-75, US palm oil imports and consumption greatly increased. Palm oil imports reached about 8 to 10 percent of the U.S. domestic disappearance of soybean oil and total vegetable oils, respectively in 1974-75. In the decade of the 60's, US palm oil consumption was less than one percent of each (Williams 1981).

Palm oil trade in the US market is entirely imported, therefore a prolonged period of price advantage would harm domestic producers of vegetable oils, directly impacting producers' welfare. Heightened US imports of palm oil in the mid 70's led to a call for import tariffs by the US vegetable oil producer groups. The situation calmed down after US imports declined in the late 1970's. However, US palm oil imports rose again in the mid 1980's, although to much lower levels than a decade earlier. US soybean oil producer groups claimed that palm oil imports is significantly causing the domestic disappearance of soybean oil. The American Soybean Association (ASA) charged that palm oil displaced soybean oil by 171 million bushels of soybeans in 1986 (Soybean Digest 1987). The possibility for future increases in US imports for palm oil loomed ominously, especially because global production continued to expand sharply.

In the US, soybean oil dominates the vegetable oil market in terms of both production and consumption. Soybean oil accounted for 5.58 million metric tons of the US edible fats and oil products in 1991 while palm and coconut oils comprised only 538,000 metric tons in the same period (Gudmunds and Webb 1991). In the world market, soybean oil is also first in consumption, accounting for almost 30 percent of world use. While first amongst internationally-traded vegetable oils, palm oil is second in consumption, and in the mid-1980s palm oil appeared to pose a serious challenge to soybean oil, especially in world markets for edible oils.

Perceptions about foods which are healthy or harmful have become a major thrust in shaping consumption patterns in the US. Since palm oil has relatively higher saturated fats content, health issues appeared to be a natural market niche positioning strategy for the US domestic vegetable oils, particularly for soybean oil producers contesting palm oil market incursions. In 1986, the American Soybean Association (ASA) launched a generic negative promotional campaign that highlighted the health risks of using 'fatty' tropical oils (such as palm and coconut oils). The economic reasoning for such a campaign was that it provided informational product differentiation strategy. The campaign sought to develop in the minds of vegetable oil users the association of palm and coconut oils with an increased health risk. This would cause consumers to shun tropical oils regardless of their price discounts. A consumer interest group, called the National Health Savers Association, subsequently began extensively promoting the use of oils low in saturated fats through media announcements and news stories. The ASA promotion included a campaign which successfully lobbied for changes in food labelling legislation. This legislation was passed in March, 1989, requiring specification of vegetable oil types used in the processing of the food product.

Tropical oil-producing countries, particularly Malaysia attributed the ASA campaign to the fear of market share loss rather then a "health issue". They vigorously called attention to the fact that tropical oils comprised very little (only about four percent at the time, 1986) of the American edible oil consumption. Following commencement of the ASA campaign, edible consumption for palm generally demonstrated a market downtrend that coincided with a downtrend of its real price differential relative to that of soybean oil (Figure 1). This outcome is contrary to price elasticity expectations and was not the case in the period prior to the campaign. Previous studies found significant structural changes in consumption and import demand for palm oil in the US occurred around September, 1987 (Othman et al. 1993).

PURPOSE OF STUDY

The purpose of this study is to conduct a topological examination of the structure of US palm oil edible use demand over a ten year period (Jan. 1980 thru Dec. 1990). In particular, this study is interested to analyse how palm oil competitiveness in the US changed over time, in the period prior to and following the commencement of the 1986/87 ASA negative campaign using the Cooley-Prescott (C-P) time-varying parameter model. This model is

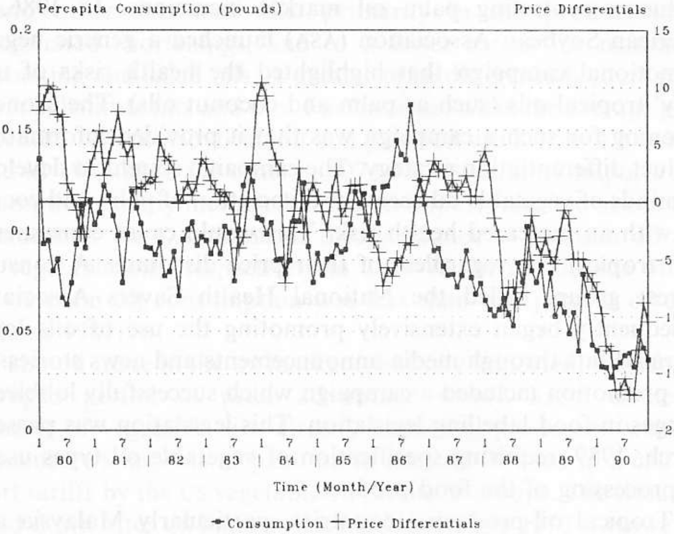

FIGURE 1. Palm Oil Edible Consumption Percapita and Price Differentials Between Palm and Soybean Oil (Price Differentials – Palm Oil Price minus Soybean Oil Price)

chosen based on its strength in examining structural "drift" as opposed to uniformly constrained shifts captured by ordinary regression models. The C-P model is generally used for supply response analysis. Ward and Myers (1979), however, have illustrated the merit of the model in analysing the dynamic effects of advertising on consumer demand. In this paper, the relative magnitudes of the permanent and temporary portions of the time-varying parameter vectors and changes in demand elasticities for palm oil in the US are examined over time. Inferences on palm oil competitiveness, and policy implications are discussed.

MODEL AND DATA

The demand for processed edible vegetable oils is derived from consumers' demand for the final products, that is from salad oils to shortening which incorporates the characteristics of taste and health choice at the final level of demand. At the processor-level, derived demand for such an intermediate product is thus a function of the price of the commodity input, prices of its substitutes and complements, income or expenditure, and tastes and preferences for the end products, especially when influenced by attributes of the input.

The US domestic derived demand for palm oil was thus specified as a fucntion of its own price, prices of other edible vegetable oils, disposable personal income, and lagged consumption. Lagged own quantities allow for a partial adjustment process related to flows of stocks, contracts, consumption habits, and other factors limiting immediate adjustment.

The parameters in the oil demand model were hypothesized to be subject to both permanent and transitory changes. These changes may reflect permanent underlying differences in the behavioral, technological and other factors determining input use and its availability. Factors such as taste fads or information intensity may cause temporary changes that do not persist over time. To incorporate the likelihood of inclusion of both types of changes, a time-varying parameter approach is used to estimate the model, following Cooley and Prescott (1973a, 1973b). The Cooley-Prescott (C-P) model assumes that the structure of the model follows the form:

$$y_t = X_t' \beta_t, t = 1, 2, \ldots, T \qquad (1)$$

where X is a (T x k) matrix of explanatory variables, y_t is the t^{th} observation of the dependent variable, and β_t is a k-component vector of parameters subject to both permanent and transitory changes. Transitory changes reflect temporary shocks or "fads" in consumption whose effects do not persist into the future, while permanent changes reflect changes in tastes or technological development whose effects do persist into the future (for details of the treatment, see Appendix). The process of generating the parameters in the C-P model is not stationary, and therefore specifications on the likelihood function is not possible. This study is interested in specific realizations of the paremater process. The likelihood function conditional on the value of the parameter process at some point in time is well defined. Therefore, the process can be "stopped" at a particular realization (e.g., period t+1), and estimates for the unknown parameters can be obtained (for details, see Cooley and Prescott 1976). The concentrated likelihood function is obtained:

$$L_c(Y;\gamma) = -T/2(\ln 2\pi + 1) - T/2\ \ln\sigma^2_{(\gamma)}$$
$$-1/2\ln \mid \Omega_{(\gamma)} \mid \quad (2)$$

The fraction of parameter variation due to permanent changes (γ) is restricted within the range $0 \leq \gamma \leq 1$. The range of γ is then divided into a number of observation points, in this case at incremental intervals of 0.04, to test for evidence of the relative persistence of structural changes. In this adaptive regression model, the transitory disturbances can be thought of as the usual additive error terms, while the permanent component causes changes in the parameter values over time (Cooley and Prescott, 1973a). The parameters γ and $1-\gamma$ measure the relative importance of the permanent and transitory changes, respectively. The larger the value of γ, the more important are the permanenet changes compared to transitory changes. The C-P model can also ameliorate statistical problems such as serial correlation, multicollinearity and heterroskedasticity (Ward and Myers 1979).

Equation (2) can be estimated for every γ, and an estimate of γ, say g, chosen such that:

$$L_c(Y;\ g,\ X) \geq L_c(Y;\ \gamma_i,\ X) \text{ for all i.} \quad (3)$$

Following Cooley and DeCaino (1973), the standard errors of the parameters obtained from maximum likelihood estimation under the assumption of parameter constancy were used to obtain diagonal elements of the C-P covariance matrices. The short-run demand elasticities were calculated for each period (monthly) using the respective estimated parameter β vector and the corresponding monthly price and quantity data.

Domestic derived demand for palm oil in the U.S. was specified:

$$\text{PLMU} = f(\text{PPALM, PSOYB, PCOCN, PODOM, LGPLMU, INC}), \quad (4)$$

where PLMU is palm oil consumption per capita (in pounds), PPALM and PSOYB are palm oil and soybean oils prices (US currency – cents per pound), respectively, PODOM is an index of other US cottonseed and corn oil prices, PCOCN denotes coconut oil prices, LGPLMU is palm oil consumption per capita lagged one period, and INC is real disposable per capita personal income in the US.

Indices for "other domestic vegetable oils" – PODOM were aggregated prices of cottonseed and corn oils. The Tornqvist-Theil indexing procedure, outlined by Diewert (1976), was used to calculate PODOM.

Consumption of palm oil refers to quantity used in edible end uses, because the objective was to examine the changes in the consumption structure for the oil over time. Palm oil prices were for refined oil. All prices were deflated by the producer price index for fats and oils. The data included monthly observations from January, 1980, through December 1990.

Study data on oil prices and consumption were obtained from unpublished sources at the U.S.D.A (Hoskin 1988; 1991). Producer price index data were from the U.S.D.A's Fats and Oils Situation Report, while data on population and consumer income were taken from various issues of the US Department of Commerce Survey of Current Business.

EMPIRICAL RESULTS AND DISCUSSIONS

The relative measure of permanent structural change, γ, was estimated using a single equation approach, and the results are presented in two-month moving averages in Figure 2. Short-run price elasticities were calculated from the C-P time varying parameter estimates for each month, using concurrent price, quantity, and income data. The plots of the estimated demand elasticities over time for palm oil are depicted in Figures 3-5.

In the time varying parameter framework, the general parameters for palm oil edible utilization as reflected by γ appeared largely transitory through 1988, although there was an indication that changes became more permanent in anticipation of food labelling legislation in 1989. Relatively high degrees of permanent structural change are also shown just prior of and through 1980, the beginning of the time series, likely caused by some changes in the economic environment facing US palm oil at that time.

Several findings with respect to palm oil edible consumption relationship deserve further attention. Firstly, the own-price elasticity of palm oil was steadily becoming more inelastic toward the end of 1988 when it started to fall considerably until mid-1990, possibily in expectation of the food labelling legislation (Figure 3).

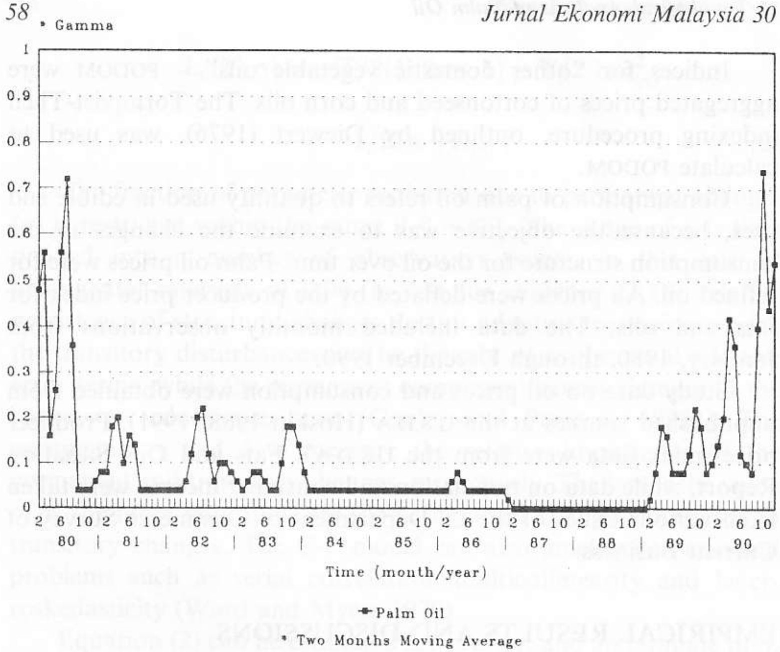

FIGURE 2. Demand Structure For Palm Oil Edible Use Over Time

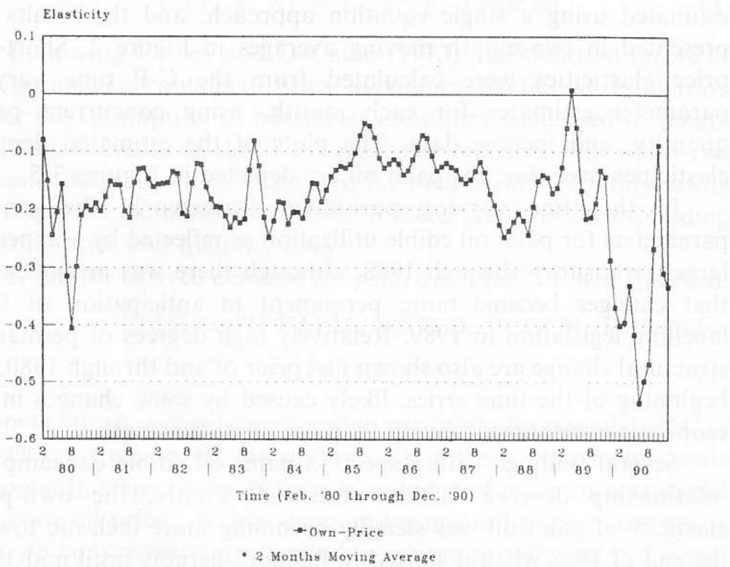

FIGURE 3. Palm Oil Own – Price Elasticity Over Time

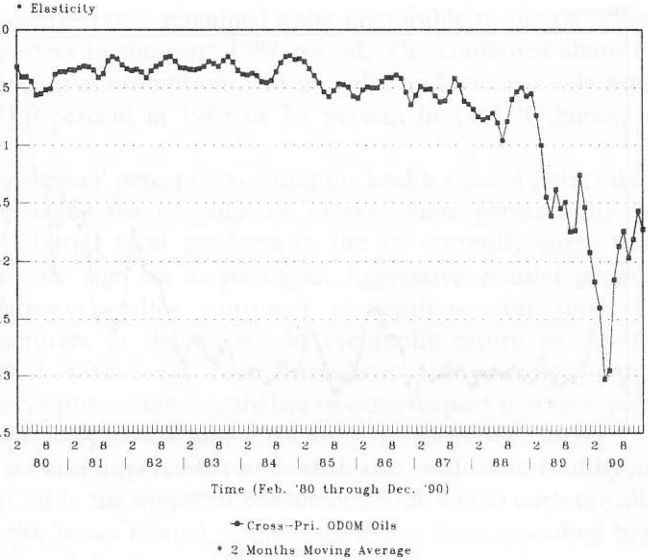

FIGURE 4. Demand Elasticity – Gross-Price Other Domestic (ODOM) Oils

This is in direct contrast to the finding of Othman et al. (1993, 1995) who found positive and significant own-price elasticity for palm oil demand and import, respectively, in the post-campaign period. The economic implications for the two findings, however, remain the same. Secondly, other domestic vegetable oils became a stronger complement to palm oil in the post 1987 period (Figure 4), probably reflecting their more limited uses in those processes requiring specific taste or texture attributes. Thirdly, substitution relationship between palm and soybean oil increasingly became stronger in the period following the ASA campaign than before the health issue was raised in the media (Figure 5). This suggests that food manufactures more-readily switched from palm to soybean oil in the post 1987 period.

CONCLUDING REMARKS

This study utilised the C-P time-varying model to conduct a topological analysis on the changing competitiveness of palm oil in

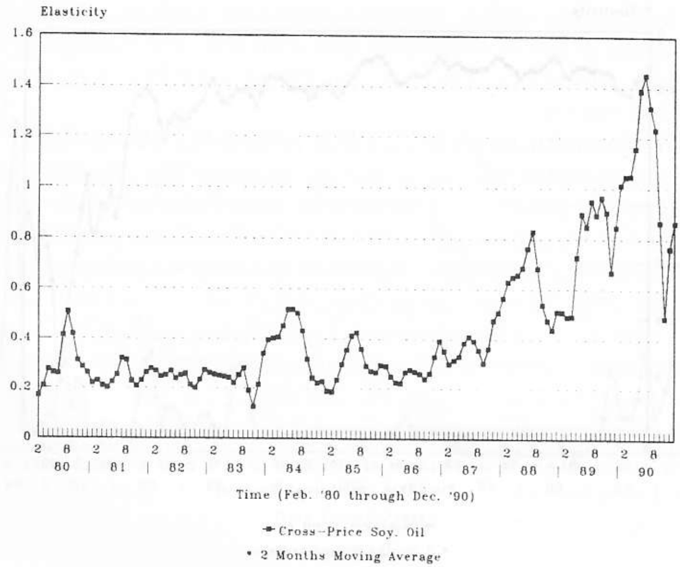

FIGURE 5. Palm Oil Demand Elasticity – Cross-Price Soybean Oil

the US market. Results show that competitive relationships between palm and soybean oils were more pronounced in the post 1987 period, following the commencement of the ASA promotional campaign which focused on negative, health-related attributes of tropical edible oils. Permanent changes in palm oil demand structure apparently occured around mid-1989, the time when food labelling legislation for the use of the tropical oils was required to be indicated on the product container.

The low estimated values of the parameter, γ, suggest that the changes on palm oil demand were largely transitory until 1989, that is, any shock including the negative promotions aimed at consumers' health concerns might not be strong or persistent enough to have a permanent impact on the edible demand for the oil. However, the food labelling legislation may have finally discouraged food processors from using the tropical oils for any necessary taste or other special property additive uses.

A strong correlation between the events in the campaign period and the consumption behaviour for palm oil in the period following the campaign was found as other factors that could negatively affect the importation of palm oil into the US, such as production, prices, and exchange rates, remained quite favourable to the US vegetable oil importers in the post 1987 period. The combined share of US vegetable oil consumption held by palm and coconut oils declined from 11.9 percent in 1985 to 7.1 percent in 1991 (Othman, et al. 1993).

Consumers' perceptions about the health risks of palm oil might have damaged the US palm oil market share permanently. Most national brand food products in the US currently carry the 'no tropical oils' sign on its packages. Aggressive counter promotion may, however, alter consumer perceptions over time. Food manufacturers in the US would eventually return to input mix consistent with least cost formulation, favouring palm oil. Aggressive promotional activities in other export markets, particularly in developed, affluent consuming countries such as the EC and Japan are also imperative to establish and reinforce a healthy image of palm oil in the minds of consumers. This would curb the alleged health risk issues related to the commodity from spreading beyond the shores of the US.

In addition to these promotional activities, the Malaysian government should also request the US to urge its food industry to stop carrying the 'no tropical oils' sign on their product packages. This sign is misleading and serves only as a means to perpetually reinforce the negative perception about palm oil in the US.

Economically, it is equivalent to a non-tariff barrier imposed by the US, quite inconsistent with the pursuance of trade liberalizations, that US is trying to portray to the world.

APPENDIX: THE COOLEY-PRESCOTT TIME-VARYING PARAMETER MODEL

The parameters in the oil demand model were hypothesized to be subject to both permanent and transitory changes. Thus, a time-varying parameter approach is used to estimate the model, following Cooley and Prescott (1973a, 1973b). The Cooley-Prescott model assumes that the structure of the model follows:

$$y_t = X_t' \beta_t, t = 1, 2, \ldots, T \qquad (A-1)$$

where X is a (T x k) matrix of explanatory variables, y_t is the t^{th} observation on the dependent variable, and β_t is a k-component vector of parameters subject to both permanent and transitory changes. Transitory changes are temporary shocks whose effects do not persist into the future, while permanent changes reflect changes in tastes or technological developments whose effects persist into the future. In this adaptive regression model, the transitory disturbances can be thought of as the usual additive error terms, while the permanent component causes changes in the parameter values over time (Cooley and Prescott 1973a). An important feature of this model is that it accounts for structural "drifts" as opposed to uniformly constrained shifts. This model can sometimes remedy statistical problems such as serial correlation, multicollinearity and heteroskedasticity (Ward and Myers 1979).

The hypothesized variations of β are:

$$\beta_t = \beta_t^p + u_t \qquad (A-2)$$

$$\beta_t^p = \beta_{t-1}^p + v_t,$$

where the p supercript denotes the permanent component of the parameters. The u_t and v_t are identically and independently distributed normal vector variables with zero mean and covariances:

$$\mathrm{Cov}\,(u_t) = (1-\gamma)\,\sigma^2\,\Sigma_u \qquad (A-3)$$

$$\mathrm{Cov}(v_t) = \gamma\sigma^2\Sigma_v, \text{ where } 0 \le \gamma \le 1$$

and where Σ_u Σ_v provide information on relative variability of the parameters and are assumed known up to scale factors. The parameters γ and 1-γ measure the relative importance of the permanent and transitory changes, respectively. The larger the value of γ, the more important are the permanent change compared to transitory changes. The objective of the estimation is to obtain estimates for the unknown parameters of σ^2, γ and the permanent components of β_t.

The process generating the parameters is not stationary, and therefore specification of the likelihood function is not possible. This study is interested in specific realizations of the parameter process. The likelihood function conditional on the value of the parameter process at some point in time is well defined; therefore, the process can be "stopped" at a particular realization (e.g. period $t+1$), and estimates for the unknown parameters can be obtained.

Define:

$$\beta_{t+1}^p = \beta_t^p + v_t \qquad (A-4)$$

$$= \beta_t^p + \sum_{s=t+1}^{T+1} v_s$$

from which it follows:

$$\beta_t = \beta^p_{T+1} - \sum_{s=T+1}^{T+1} v_s + u_t \qquad (A-5)$$

Equation (A-1) can be rewritten as:

$$y_t = X'_t \beta + u_t \qquad (A-6)$$

where $\beta = \beta^p_{T+1}$, and

$$\mu_t = x'_t u_t - x'_t \sum_{s=t+1}^{T+1} v_s \qquad (A-7)$$

The vector of disturbances (μ) is distributed normally with mean zero and covariance matrix (Cooley and Prescott 1973a):

$$\mathrm{cov}(\mu) = \sigma^2[(1-\gamma)R + \gamma Q] \equiv \sigma^2 \Omega_{(\gamma)} \qquad (A-8)$$

where R is a diagonal matrix with

$$r_{ii} = (x'_i \Sigma_u x_i), \qquad (A-9)$$

and Q is a T x T matrix such that

$$q_{ij} = \min(|t-i|, |t-j| x'_i \Sigma_v x_i) \qquad (A-10)$$

for all i,j = t, otherwise q = 0.

From (A-6), it follows that Y, the T-component vector of the y_t is distributed:

$$Y[X\beta, \sigma^2 \Omega_{(\gamma)}] \qquad (A-11)$$

Using equation (A-8), the log likelihood function of the observations can be written:

$$L(Y; \beta, \sigma^2, \gamma, X) = -\frac{T}{2}(1n2\pi + 1n\sigma^2 + \frac{1}{T}1n\ |\Omega_{(\gamma)}|) \qquad (A-12)$$

$$-\frac{1}{2\sigma_2}(Y - X\beta_{(\gamma)})' \Omega^{-1}_{(\gamma)} (Y - X\beta_{(\gamma)})$$

Conditional maximum likelihood estimators of β and σ^2 in (A-12), given γ, are respectively:

$$\beta_{(\gamma)} = [X' \Omega^{-1}_{(\gamma)} X]^{-1} X' \Omega^{-1}_{(\gamma)} Y \qquad (A-13)$$

and

$$s^2_{(\gamma)} = \frac{1}{T}(Y - X\beta)' \Omega^{-1}_{(\gamma)} (Y - X\beta) \qquad (A-14)$$

Substituting $\beta(\gamma)$ and $s^2(\gamma)$ for β and σ^2, respectively, in (A-12), the concentrated likelihood function is obtained:

$$L_c(Y;\gamma) = -\frac{T}{2}(1n2\pi + 1) - \frac{T}{2}\,1n\sigma^2{}_{(\gamma)} - \frac{1}{2}\,1n\,|\Omega_{(\gamma)}| \qquad (A-15)$$

Globally maximizing equation (A-15) over the range of is equivalent to maximizing equation (A-12). The fraction of parameter variation due to permenent changes (γ) is restricted within the range $0 < \gamma < 1$. The range of γ is then divided into a number of points, at intervals of 0.04. Equation (A-15) can be estimated for every, and an estimate of, say g, chosen such that:

$$L_c(Y;g,X) \geq L_c(Y;\gamma_i,X) \quad \text{for all i} \qquad (A-16)$$

It is assumed $\Sigma_u = \Sigma_v$, unless there is a priori basis to assume otherwise. Similarly, without an a priori basis to believe the random changes in parameters are correlated, the standard errors of the parameters obtained from maximum likelihood estimation under the assumption of parameter constancy were used as the diagonal elements of Σ_u and Σ_v such that:

$$\Sigma_u = \Sigma_v = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \sigma_{22}^n & 0 & 0 \\ 0 & 0 & \sigma_{33}^n & 0 \\ 0 & 0 & 0 & \sigma_{kk}^n \end{bmatrix} \qquad (A-17)$$

after the diagonal is normalized. The procedures discussed above obtain asympotically efficient estimates of β and σ^2 (Cooley and Prescott 1976).

The parameters in the models were assumed to be subject to both permanent and transitory changes, with $\Sigma_u = \Sigma_v$. Following Cooley and DeCaino (1973), the standard errors of the parameters obtained from maximum likelihood estimation under the assumption of parameter constancy were used to obtain diagonal elements of Σ_u and Σ_v. The short-run demand elasticities were calculated for each period using the respective β vector along with price and quantity data.

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