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PRICE COMPETITION AND INFORMATIONAL PRODUCT DIFFERENTIATION EFFECTIVENESS: THE CASE OF EDIBLE VEGETABLE OILS IN THE U.S.

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Abstract

A time-varying parameter model was used to analyze the effectiveness of a product differentiation strategy. A negative promotional campaign focussed attention on health issues associated with tropical oils in the U.S. Permanent changes in palm oil edible use occurred, while edible use demand for soybean oil remained stable.

PRICE COMPETITION AND INFORMATIONAL PRODUCT DIFFERENTIATION EFFECTIVENESS: THE CASE OF EDIBLE VEGETABLE OILS IN THE U.S.

Price differentials generally play a significant role among commodities in competitive world markets. The potential for price differentials to persist as an important competitive factor depends on significant perceived or real quality differences. Quality can be viewed as a differentiated means of price competition; i.e., offering a higher quality at the same price as a competitor is equivalent to lowering prices (Abbott). Producers or sellers often search for market niches when positioning their products. This behavior fosters product differentiation to soften price competition (Tirole). Promotional activities contrive to influence users' preferences among goods by providing selective information about the qualities or attributes of their products. Dominant producer groups have added incentive to proclaim their product quality through advertising or promotion (or negative promotion) activities, which places the relatively weaker groups at a disadvantage. Counter-promotion activities may, however, reduce the product differentiation associated with a lack of information about selected products and therefore enhance competition. This study analyzes the effectiveness of an informational product differentiation strategy in the case of the U.S. edible vegetable oils market.

The Political Economy of the U.S. Edible Vegetable Oils Market

A host of edible vegetable oils are traded in the U.S. market -- soybean, sunflower, canola, peanut, coconut, palm, corn, and cottonseed oils. These oils have minor differences in their physical and chemical characteristics; hence, they are somewhat interchangeable. Of all the vegetable oils, palm oil has made the greatest inroads into world and domestic markets. Price differentials have been an important competitive factor for palm oil. Palm oil utilization in the U.S. is primarily in hydrogenated shortenings and, to a lesser extent, margarine and cooking and salad oils. Depending upon relative prices, palm oil can substitute for soybean oil and other fats and oils. A greater price difference favors 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 in 1973/1974 to 9.3 cents in 1974/1975, U.S. palm oil imports and consumption increased. Palm oil imports reached about 10 percent and 8 percent of U.S. domestic disappearance of soyoil and total vegetable oils, respectively, in 1974/75. In the 1960s, U.S. palm oil consumption was less than one percent of each (Williams).

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

In the U.S., 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 U.S. edible fats and oils 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. Palm oil is second in world consumption, and in the mid-1980s palm oil appeared to pose a serious challenge to soybean oil, especially in world markets for edible oils (*World Agriculture Situation and Outlook Report*, March, 1987).

Health Issues, Consumer Demand, and Market Niches

Changing attitudes about foods which are beneficial or harmful to health have become a major force in shaping consumption patterns in the U.S. The issue of saturated fats in the case of red meats

exemplifies changing consumption attitudes. Since palm oil has relatively higher saturated fats content, health issues appeared to be a natural market niche positioning strategy for U.S. domestic vegetable oils. Widespread consumer attention was drawn to tropical oils in U.S. edible oil markets in the mid-1980s, when the ASA launched a generic promotional campaign in 1986 that highlighted the health risks of using 'fatty' tropical oils (i.e., palm and coconut). The economic reasoning for such a campaign was that it provided informational product differentiation. The campaign sought to inculcate in the minds of vegetable oil users an association of palm and coconut oils with increased health risks. This, in turn, would cause consumers to shun tropical oils regardless of their price discounts. Vegetable oil users are thought to be better off with a higher perceived or actual quality, but higher-priced soybean oil would then be compared to the negative attributes of its competitors, particularly palm oil. Thus, such an activity would not only soften price competition but eventually squeeze out palm oil from the U.S. edible oil market. Following commencement of the ASA campaign, edible consumption of palm oil generally demonstrated a marked downtrend coincident with a downtrend in its real price differential relative to that of soybean oil. This outcome is contrary to price elasticity expectations and was not the case in the period prior to the campaign.

Few cases of widespread, negative promotional activities have been documented in the U.S. One notable example was the "Alar" media offensive on fresh apples in the late 1980s. Paralleling the "Alar" affair, the ASA's "health issues" campaign was often amplified by local and national media using support from closely, at least temporarily, allied groups. In the case of edible oils and the "health issue" campaign, the ASA redirected generic promotion funds from producer check-offs to focus attention on the negative health aspects attributed to palm and coconut oils. 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, rather than through traditional advertising/co-advertising outlets. The promotion included a campaign which

successfully lobbied for changes in food labelling legislation. Legislation passed in March, 1989, requiring specification of vegetable oil types used in the processing of the food product.

A number of studies which associate the direct impacts of advertising with per capita consumption of a particular commodity are found in the agricultural demand literature (e.g., Ward and Myers, 1978; Thompson and Eiler, 1977; Kinnucan and Forker, 1986; Liu and Forker, 1988; Goddard and Amuah, 1989; Ward and Dixon, 1989). Relatively little or none, however, appertains to the impact of advertising or promotions on competition, such as suggested for product selection and quality by Spence (1975, 1976) and Tirole (1988, pp. 100-115). Lambin (1976) regressed the estimated absolute value of the own-price elasticity for various branded products alternatively on advertising expenditures (per capita) and advertising shares of the individual brands. In both cases, the estimated regression coefficients suggested that increased advertising intensity leads to less elastic consumer demand (i.e., differentiates the product from potential or actual substitutes).

This study utilizes the Cooley-Prescott (C-P) time-varying parameter model to permit analysis of transitory and permanent changes in soybean and palm oils markets in the U.S. and the resulting competitive effects. In their 1979 paper, Ward and Myers illustrate the potential of the C-P model to analyze the dynamic effects of advertizing 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 U.S. soybean and palm oils are examined for periods prior to and following commencement of the ASA "health issue" promotion. Inferences and implications based on the empirical findings on the competitiveness of soybean and palm oils are then discussed.

Model and Data

The demand structure for processed edible vegetable oils is derived from consumers' demand for the final products, from salad oils to shortening, and incorporates the characteristics of taste and health choice at the final level of demand. Processor-level, derived demand for such an intermediate

product commodity is thus a function of the price of the commodity input and its substitutes and complements, income or expenditure, and tastes and preferences for the end products, especially as influenced by attributes of the input. Both the level and the mix of edible vegetable oil consumptive use are influenced by technology, tastes and preferences, and government programs and policies.

U.S. domestic derived demands for soybean and palm oils were each specified functions of 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. ASA promotion expenditures were related to producer check-off funds, shifting only in focus and methods (media promotion and news stories) and thus not explicitly entered in the model.

The parameters in the oil demand model were hypothesized to be subject to both permanent and transitory changes. That is, changes may reflect permanent underlying differences in the behavioral, technological, or other factors determining input use or availability, or 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:

$$y_t = X_t'\beta_t \qquad t = 1,2,\ldots,T \tag{1}$$

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 reflect temporary shocks or "fads" in consumption whose effects do not persist into the future, while permanent changes reflect changes in tastes or technological developments whose effects do persist into the future.

The likelihood function for the C-P model, conditional on the value of the parameter process at some point in time, is well defined at a particular realization (for details, see Cooley and Prescott, 1976). The concentrated likelihood function is obtained:

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

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 permanent changes compared to transitory changes. An important feature of this C-P model is that it accounts for structural "drifts" as opposed to uniformly constrained shifts. The C-P model can also ameliorate statistical problems such as serial correlation, multicollinearity and heteroskedasticity (Ward and Myers, 1979).

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

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

Following Cooley and DeCanio (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 derived demand for edible soybean oil was thus specified:

(4) $SOYU = f(PSOYB, PODOM, PTROP, LGSOYU, INC)$,

where *SOYU* is soybean oil consumption per capita (pounds), *PSOYB* is soybean oil price (cents per pound), *PODOM* is an index of other domestic cottonseed and corn oil prices, *PTROP* is an index

of tropical (palm and coconut) oil prices, *LGSOYU* is soybean oil consumption per capita lagged one period, and *INC* is real disposable per capita personal income. Indices for "other domestic" and "tropical oil" prices were aggregated prices of cottonseed and corn oils, and coconut and palm oils, respectively, using the Tornqvist-Theil indexing procedure outlined by Diewert (1976). Domestic derived demand for palm oil was similarly specified:

(5) $PLMU = f(PPALM, PSOYB, PCOCN, PODOM, LGPLMU, INC)$,

where *PLMU* is palm oil consumption per capita (in pounds), *PPALM* and PCOCN are the prices of palm and coconut oils, respectively, and *LGPLMU* is palm oil consumption per capita lagged one period. All other variables are the same as in the soybean oil specification (4). Consumption refers to quantity in edible end uses, the objective being to examine the effects of structural change in the industry, especially as might be influenced by the "tropical oils" promotional campaign. Structural changes are revealed by parameter changes for the respective edible vegetable oils.

Except for palm oil, which was imported refined, prices were for crude 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. A previous study found September, 1987, represented the time frame during which structural changes in the consumption of several edible vegetable oils appeared statistically evident (Othman et al.). 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*. Data on population and consumer income were taken from various issues of the *U.S. Department of Commerce Survey of Current Business*.

Empirical Results and Interpretation

The C-P coefficients were estimated using a single-equation approach, and the results are presented in two-month moving averages in Figures 1a and 2a. The parameters for soybean oil edible

Figure 1a: Demand Structure For Soybean Oil Edible Use Over Time

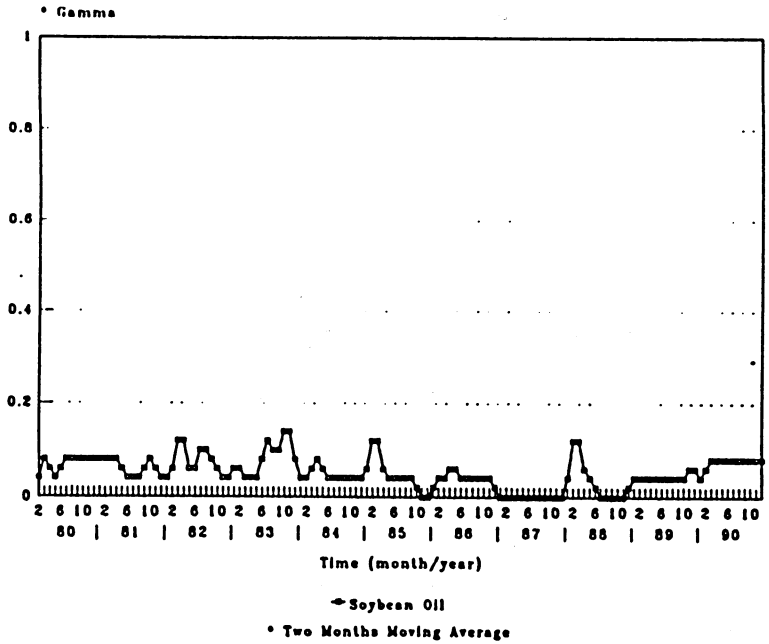


Figure 2a: Demand Structure For Palm Oil Edible Use Over Time

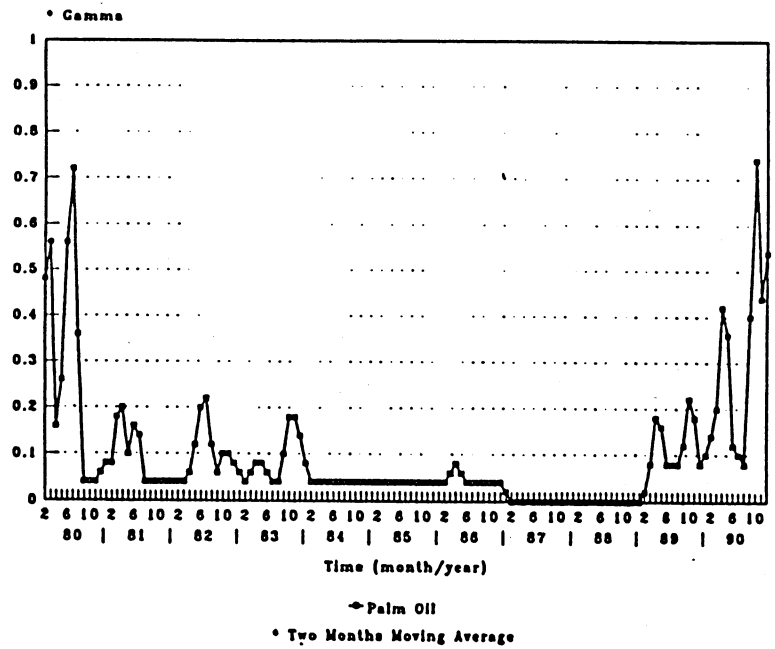


Figure 1b: Soybean Oil Demand Elasticity
• [Own-Price Elasticity]

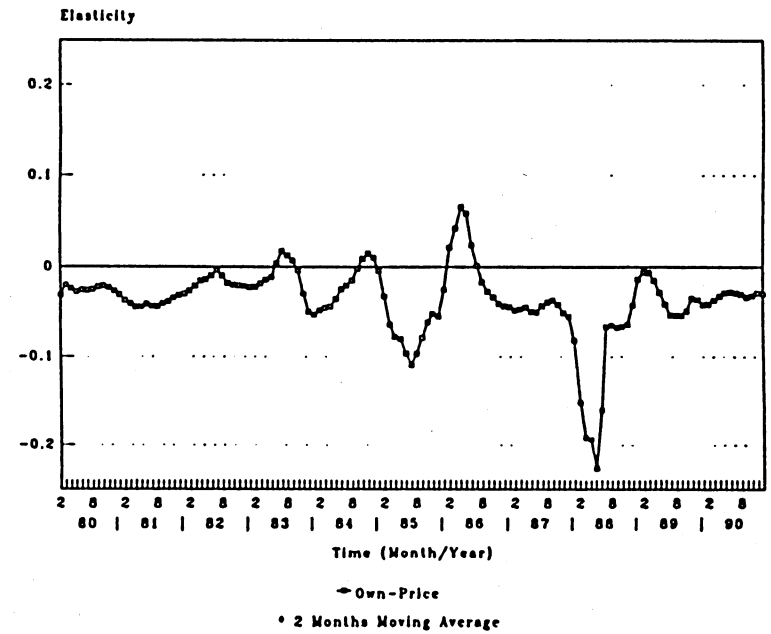
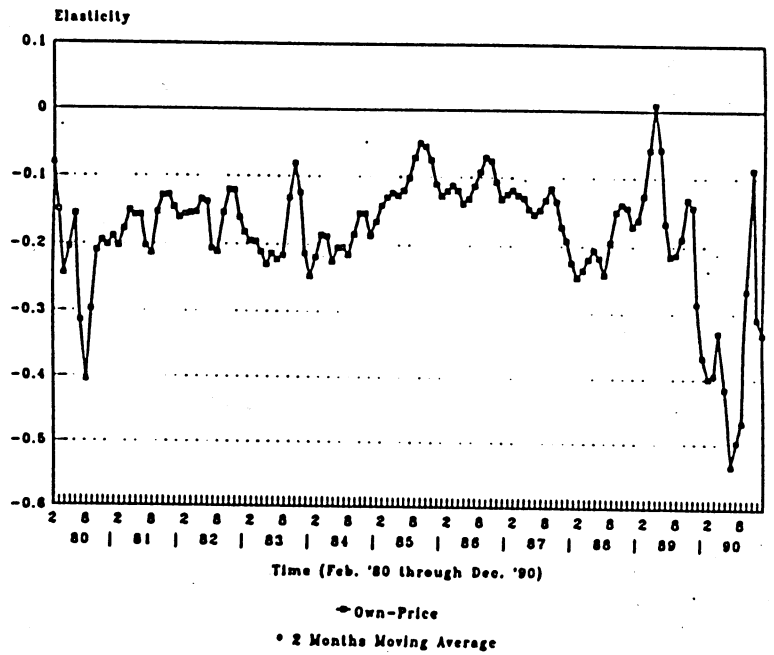


Figure 2b: Palm Oil Own-Price Elasticity Over Time



utilization appear relatively stable, with only transitory $(1 - \gamma)$ changes throughout the 1980 to 1990 period, as shown in Figure 1a. This contrasts greatly with the depiction of γ for palm oil over this same period (Figure 2a). Relatively high degrees of permanent structural change are shown just prior to and through 1980, the beginning of the time series, and for the end of the decade, 1989/90, following changes in legislation requiring labelling of oils on processed food products. Any changes in the palm oil utilization occurring during the 1980s appeared mostly transitory through 1988.

Short-run demand elasticities were calculated for each period (monthly) using the respective estimated parameter ß vector and the corresponding monthly price, quantity, and income data. Means and standard deviations (demonstrating variability of monthly, short-run responses) of own-price, cross-price, and income elasticities of soybean and palm oils over two time periods -- January, 1980 through August, 1987, and September, 1987, through December, 1990 -- were then calculated and are presented in tables 1 and 2, respectively.

Soybean Oil Consumption

Estimated own-price elasticity for soybean oil, although highly inelastic in both periods, doubled in the period following the ASA promotion (Table 1). On average, the short-run elasticity was also more variable in the latter period. Monthly own-price elasticity estimates settled to longer-term levels again in 1989/90 (Figure 1b). Little difference was observed in the estimated cross-price elasticities of soybean oil with respect to other domestic oils, although cross-price elasticities were higher and varied more in the post-promotion period. The soybean cross-price elasticity with respect to other domestic oils remained very low, averaging 0.086 to 0.115, respectively, in each period. The tropical oils demonstrated a very weak complementary relationship with soybean oil, and the relationship between soybean oil and tropical oils in the latter period weakened further. These findings suggest that U.S. soybean oil edible utilization was not very sensitive to changes in the prices of other edible vegetable oils. The results generally agree with those of Reed et al. (1985) and

Table 1. Estimated γ and Elasticities for Soybean Oil Edible Use in the Pre- and Post-Campaign Periods.

Parameter	*Pre-Campaign*		*Post-Campaign*	
	Mean	Standard Deviation	Mean	Standard Deviation
γ	0.056	0.036	0.046	0.036
Elasticities:				
Own-Price	-0.027	0.030	-0.058	0.054
Cross-Price Other Domestic	0.086	0.035	0.115	0.066
Cross-Price Tropical	-0.044	0.027	-0.034	0.030
Income	0.542	0.175	0.609	0.179

Note: Mean elasticities for the pre- and post-campaign periods are calculated from the estimated monthly (time-varying) coefficients and the actual quantity and price data in the commensurate time periods. Calculated standard deviations further describe the variability of elasticities pre- and post-campaign and are not the standard errors of the estimated parameters.

Table 2. Estimated γ and Elasticities for Palm Oil Edible Use in the Pre- and Post-Campaign Periods.

Parameter	*Pre-Campaign*		*Post-Campaign*	
	Mean	Standard Deviation	Mean	Standard Deviation
γ	0.092	0.148	0.132	0.226
Elasticities:				
Own-Price	-0.161	0.064	-0.225	0.138
Cross-Price Other Domestic	-0.392	0.115	-1.276	0.715
Cross-Price Soybean	0.293	0.085	0.761	0.302
Cross-Price Coconut	-0.019	0.054	0.058	0.086
Income	0.361	0.347	0.957	0.926

Othman et al. (1993), who found very low cross-price elasticities of soybean oil demand with respect to palm and coconut oils using models based on quarterly and monthly data, respectively.

The higher own-price elasticity for soybean oil in the post-campaign period may be due to higher substitution of other domestic oils by food manufacturers, particularly those vegetable oils which have superior characteristics. Consumers might be led to perceive, as suggested by the ASA promotional campaign, that soybean oil provides a better bundle of characteristics than do tropical oils. However, soybean oil at 15% saturated fats does not compare favorably to other domestic vegetable oils, such as corn (13%), sunflower (10%), or canola (6%) oils. Canola, an oil especially low in saturated fatty acid, received a "generally-regarded-as-safe for use as fats and oils and food status by the U.S. Food and Drug Administration (FDA) in early 1985" (Emery, 1985).

Palm Oil Consumption

The own-price elasticity of palm oil was 40% higher (in absolute value) in the post-campaign period (shown graphically in Figure 2b). Cross-price elasticities of palm oil with respect to soybean and to other domestic oils were, on average, much higher and more variable in the post-campaign period than before the health issue question in the media (also see Figures 2c and 2d). Changes in the consumption relationships between palm oil and domestic vegetable oils appeared largely transitory through 1988, although there was an indication that changes became somewhat more permanent in anticipation of food labelling legislation. Changes in cross-price elasticities were much greater for palm oil than for soybean oil, indicating that the "health issue" campaign and subsequent food labelling legislation generated greater repercussions on the imported palm oil. Palm oil also became much more responsive to changes in income in the latter period, likely reflecting their more limited uses in those processes requiring specific taste or texture attributes.

Concluding Remarks

An informational product differentiation strategy through a promotional campaign which focused on negative attributes of tropical oils changed competitive relationships between U.S. soybean oil and palm oil edible demand. Permanent changes in palm oil edible use occurred around the time of food labelling legislation requiring that all oils used in the manufacture of a product be indicated on the container. The combined share of U.S. vegetable oil consumption held by palm and coconut oils declined from 11.9% in 1985 to 7.1% in 1991. Although the own-price elasticity for soybean oil was higher in the post-campaign period, the overall consumption of soybean oil remained more stable than consumption of palm oil. Domestic soybean oil demand exhibited insensitivity to changes in prices of tropical oils over the entire period. Low estimated values of the persistence parameter suggest that the negative impacts on palm oil were largely transitory until 1989. That is, promotions aimed at consumers' concerns might not be strong or persistent enough to have a permanent impact on edible demand for oils. However, the campaign induced legislation which may have finally discouraged food processors from using the tropical oils for any but special property additive uses.

Strong correlation between the events in the campaign period and the utilization behavior for the soybean and palm oils in the period following the campaign exists. Other factors that could have negatively affected the importation of tropical oils into the U.S., such as exchange rates, remained quite favorable to U.S. vegetable oil producers in the post-campaign period. Effects of generic promotions directly influence subsequent industry conduct, and, in the end, import/export relationships. Negative publicity about one or more competitive products can raise questions about relative health and safety factors for all products which are closely related. This strategy may, over time, boost another competitor's products more than one's own. Trends in the late 1980s suggest that the ASA campaign against tropical oils reduced palm and coconut oil edible use shares and benefitted other edible vegetable oils, while leaving the soybean oil domestic market share unchanged.

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