ESTIMATING MARKETING MARGIN COST COMPONENTS: AN APPLICATION OF SIMULATION TO PRODUCTS OF THE VEGETABLE OIL INDUSTRY*

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While many methods have been proposed for evaluating agricultural processing market efficiency, estimation of product marketing margins has received the most attention and direct research effort. Despite this fact, there are many technical and statistical problems associated with both the performance of marketing analyses and utilization of margin reports [2, 7, 9, 12]. Most early marketing margin studies either ignored or circumvented these problems, concentrating on estimating absolute magnitudes of marketing margins over time [1, 3, 5, 10]. Marketing margin studies performed in the last few years have continued, in varying degrees, to ignore these and other problems implicit in the analysis. Relative levels of marketing margins over time may provide some insight into marketing efficiency, but those of various cost components of the marketing margin over time appear to give even more suitable indications of changing market performance.

The object of this study was to develop a method for estimating cost components of the marketing margin when no firm accounting data were available. It is demonstrated that utilization of a simulation model allows for an explicit determination of cost components. Advantages and disadvantages of this approach are discussed briefly in the first section of this paper. The formulation of the simulation model is described in the second section. In the third section, selected results of estimating (marketing) cost components of the marketing margin for margarine and cooking oil are presented and evaluated in light of the existing state of cost component methodology. Implications of the results are considered in the final section.

PROBLEMS WITH COST COMPONENT STUDIES

Most statistical and accounting cost component studies performed in the past have concentrated on products whose production processes are relatively simple. Three constraining factors have been primarily responsible for this. First, the number of calculations required by a cost components study is an increasing function of the complexity of the process. The more complex the process, the greater the burden of numerical manipulation. Second, the difficulty of repeating analyses at later time periods is complicated by maintaining consistency in variable definitions, since some products change form over time. Errors in defining variables for subsequent repetitions can lead to considerable misstatement of production costs. Third, obtaining necessary data for cost component analyses of products with complex production processes is difficult. This is because products with complex production processes are more likely to be traded in markets where there are few producing firms and the availability of market information is limited [11].

Restraints on the performance of cost component studies for products with more complex production processes can be overcome, to a considerable extent, by developing and using an event simulation model of the production process being considered. This approach requires direct measurement of production parameters for typical producing plants in

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*This paper is based on research performed under contract for the Economic Research Service, USDA. The views presented here do not necessarily reflect those of the Economic Research Service. The author is indebted to William T. Boehm, J. Paxton Marshall, and two anonymous referees who made useful comments on drafts of this paper.

the industry, along with construction of a representative plant model based on these measurements. If measured production and cost functions of the constructed plant model are truly representative of a typical plant in the industry, then reported cost components for the model plant should approximate the true cost components for the industry. This approach is essentially an extension of the Marshallian concept of the representative firm.

Several problems are associated with the application of this procedure to the measurement of cost components. First, data requirements are substantial, both in quality and quantity. Data required to construct a production simulation model are usually not available from secondary sources and must be collected from primary sources. Second, the researcher must have a comprehensive technical knowledge of the industry. Finally, the model must be updated regularly, to reflect technology changes in the industry. The sum value of these disadvantages must be considered in light of available alternatives [11].

The only obvious alternative available for estimating industry cost components is the use of firm accounting data. However, such use to determine cost components in the case of products with complex production processes involves a substantial project. Not only must costs from different accounting systems be made comparable, but even if this is achieved, there is no way of determining whether the accounting costs are equivalent to actual economic costs. For the vegetable oil industry, accounting data are not readily available. There is no question of whether this source should be used.[1] For this reason, use of a production simulation model offers the only viable method of approximating production cost components of the marketing margin for vegetable oil products.

THE MODEL

The method used here to generate the production cost components of the marketing margin for cooking oil, and margarine, is basically an extension of conventional economic engineering cost analysis [8]. Rather than modeling a single representative plant in its entirety, the procedure required modeling representative production stages of plants in the industry. Data were compiled initially on fifteen plants in the industry. Production stage technologies exhibiting essential characteristics of the group were then incorporated in the model plant. Since included stage technologies are representative of the sample, then, by implication, a model composed of these representative stage technologies is also representative if all interrelationships are correctly included.

A typical plant in the vegetable oil industry jointly produces refined vegetable oil (cottonseed and soybean), margarine and cooking oil at a single production facility. Thirteen autonomous production stages are included in this process. It is not required that each product pass through all thirteen production stages, although there are constraints on the order through which the stages must be passed. The production process begins with arrival of crude vegetable oil at the plant and ends at the thirteenth production stage, when margarine and cooking oil are released from storage for transportation to distribution centers. All these features are incorporated directly into the model by specifying technical coefficients to represent the actual production process as accurately as possible.[2]

Technical coefficients of the model were determined using one of two alternative approaches. First, if the technical coefficients were measurable directly at the plant, then a measure of each was obtained from all plants processing the representative technology. For example, the technical coefficient giving the rate at which cooking oil bottles were filled by a filling machine was taken as the mean of rates reported by different plants possessing the representative type of filling machine. Second, if the technical coefficients were not measurable directly at the plant, then a measure of the required coefficients was obtained from alternative sources, usually equipment manufacturers. For example, most companies had no information on the energy requirements of their cooking oil filling machine, although they knew their total plant energy requirements. Consequently it was necessary to obtain pertinent information from equipment manufacturers.

It should be noted that all costs of marketing the products considered in this study were not determined directly by the simulation model, which estimates production costs only. Specifically, interest, advertising, and transportation expenditures are not directly related to physical production of the product and were calculated separately, by using aggregate data available from published sources. All other costs

[1] The major corporations in the vegetable oil industry generally permitted plant visitations and the collection of production data for this study. However, no company would release firm cost data, even when anonymity was assured.

[2] Over fifteen hundred equations were included in the specification of the model, to allow for all feasible variations and substitutions in factors and products. Nonlinear relationships were approximated using linear segments.

were obtained directly from the simulation model. The computer program representing the simulation was structured so that given an initial price vector, necessary operational parameters, and a time period of operation, production costs for manufacturing margarine and cooking oil were completely determinant. Within the program, price vector could be generated randomly for multiperiod simulation experiments, or actual prices could be used to represent real-world situations for a one-period simulation [4]. To generate the production cost components of the marketing margin for vegetable oil products in 1974, this latter procedure was used. Relevant production and price data were collected, and the simulation carried out for a single event—a one year's operation of the model plant.

RESULTS

Eleven cost components for margarine, cooking oil and the refined oil used in these products were estimated using the method outlined above (based on 1974 industry prices and utilization ratios). These results are reproduced in Table 1. Each component cost is reported per final product unit, four-stick pound packages for margarine and twenty-four ounce bottles for cooking oil. The total of all components represents the value added by refining and manufacturing respectively. Cost components for both margarine and cooking oil represent components for name brand products only, private label products being excluded from the analysis because of their relatively small shares of the total market. Definitions of each component are consistent with specifications used by the Economic Research Service. An exception is profit, which is taken in this study as the residual between calculated cost of production per unit, and factory price per unit of product.[3]

Examination of Table 1 reveals that relative profit on margarine for both refining and manufacturing was 13.1 percent of value added per unit of product in 1974, while the corresponding figure for cooking oil totaled 22.5 percent. The estimated 1974 level of profit on margarine is not out of line with the reported profit levels of food processors in general,

TABLE 1. ESTIMATED COST COMPONENTS FOR MARGARINE AND COOKING OIL, 1974 (IN DOLLARS)

Cost Component	Margarine		Cooking Oil	
	Refining	Manufacturing	Refining	Manufacturing
	Per pound package		Per 24-ounce bottle	
Labor	.0013	.0110	.0029	.0058
Packaging	.0000	.0333	.0000	.0987
Transportation	.0097	.0186	.0172	.0198
Business taxes	.0160	.0117	.0333	.0771
Depreciation	.0077	.0153	.0136	.0092
Repairs	.0003	.0005	.0005	.0025
Advertising	.0001	.0217	.0001	.0302
Interest	.0008	.0022	.0014	.0030
Energy	.0008	.0003	.0013	.0001
Other[a]	.0172	.0150	.0202	.0117
Profit	.0147	.0113	.0307	.0710
Total	.0686	.1409	.1214	.3291

[a]Includes processing chemicals, unallocated fixed costs, food ingredients (except base oil), and materials not elsewhere listed.

[3]The factory prices of margarine and cooking oil for 1974 were determined by averaging published prices of the principal producers weighted by market share. This information for branded label products is not currently available from any published source.

but the estimated profit level for cooking oil is substantially greater than the reported profit levels of most food processing companies. This result is not surprising when prior information on each of these markets is considered. The bottled cooking oil market is dominated by three firms which control approximately seventy-six percent of the total market. On the other hand, the packaged margarine market is less concentrated, the leading eight producers controlling seventy-one percent of the market. For this reason, one might expect a greater relative profit in the more concentrated cooking oil market. This expectation is supported by the evidence presented here.

There are limitations which must be considered before evaluating information generated by the simulation model. Before results of any simulation can be regarded as accurate, they must be verified empirically [6]. The only way which the results presented in Table 1 can be validated is to obtain industry cost data on the components. Not only is this information unavailable from companies in the industry, it is not likely forthcoming. For this reason, an explicit validation of the cost components presented in Table 1 has not been made. On the other hand, an approximate validation of the simulation model itself was possible from census reports on input utilization and output in the vegetable oil industry. This partial validation is the best that can be accomplished, given constraints under which the analysis was performed.

CONCLUSION

Cost component studies performed in the past have used firm accounting data as a basis for analysis. These studies have been limited to products with relatively simple production processes because of complications in obtaining firm cost data. The method proposed here offers a viable alternative for estimating cost components for products with complex production processes. Principal constraints which have hindered the performance of cost component analyses up to this time are not those on the simulation approach. If the representative plant model is specified accurately, then production and cost functions of the model will approximate those of a typical industry plant, giving an approximation of industry production cost components. Although validation of the model is difficult, many problems are overcome by the approach outlined here, particularly the calculations problem, and that of maintaining consistency in variable definitions over time.

Implications of this study are important for policy decisions with respect to the vegetable oil industry. For example, there has been much debate in recent years over the question of responsibility for the increase in food prices. Although much of the increase is directly attributable to governmental inflation of the money supply, it is quite possible that food processors have been able to increase their relative returns through the exercise of market power. A cost component analysis of the marketing margin allows for a straightforward evaluation of this question. This study of the vegetable oil industry indicated that profits on margarine were not out of line with profit levels of other food products. However, the profit level on bottled cooking oil was found to be substantially greater than relative profits on other food products. Whether this result is a short run phenomena, evidence of returns to advertising, or the identification of market inefficiency, is a question which remains to be answered. The point worth noting is that the simulation approach outlined here provides a means for approximating processing cost components, and identifying possible sources of market inefficiencies, where no other method is available.

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