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Agricultural Economics Research and Its Usefulness to Private Firms: Some Unsolicited Observations

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Introduction

Agricultural economists are especially noted for conducting studies on the consumption behavior of U.S. consumers. For many decades, USDA nationwide food consumption surveys provided rich databases for agricultural economists to assess the nutritional content and quality of consumers' diets. Research results emanating from these databases were informative and insightful with respect to consumer behavior. Further, the data utilized was comprehensive and the results eagerly anticipated.

The confluence of these forces led to an enhanced likelihood of such results being published in agricultural economics journals. In addition to nationwide food consumption databases, which are cross-sectional snapshots of Americans' consumption at particular points in time, USDA has consistently collected and shared with agricultural economists' annual data on food commodities. These time-series and cross-section databases have been used extensively by agricultural economists to estimate several parameters of interest, especially own-price, cross-price, expenditure, and income elasticities (Heien and Wessells, 1988; Heien and Pompelli, 1988; Gould, et al., 1990; Yen and Chern, 1992).

Because most databases available to agricultural economists lack disaggregated information on specific food commodities, elasticity parameters traditionally have been derived for food groups or aggregated food commodities (Gao, et al., 1994; Jones, et al., 1994; Park, et al., 1996). Indeed some researchers have taken aggregation to its highest level, aggregating hundreds of food commodities into a single category called "food." (Huang, 1985). Elasticities are then derived for this broad category of food. As previously noted, these derived elasticities and other empirical results for broadly defined commodities have been published and discussed widely in professional circles of agricultural economists. Indeed it seems

reasonable to conclude that these findings and discussions have added to the professionalism of agricultural economists.

While development of intellectual capital is undoubtedly a worthy accomplishment of agricultural research, this paper raises the issue as to whether this process has had positive spillover effects on the business decisions of private firms. Clearly, many research studies have emphasized the relevancy of reported results for the decision-making of private firms. For example, private firms are predicted to use own-price and cross-price elasticities to help establish pricing and marketing policies for their products (Green and Park, 1998; Jones, et al., 1994).

Other estimated values such as advertising elasticities and income elasticities are hypothesized to help firms plan effective marketing strategies (Coulibaly and Brorsen, 1999; Ward, 1999; Jones and Ward, 1989; Ward, et al., 1985). After several months of observed behavior at a private firm, the author of this paper wishes to raise questions about the true relevancy of such results for private firms. Raising these questions, however, is not intended to plant a seed of criticism within the agricultural economics profession. Rather, questions are raised as a reflection of a sabbatical experience with a private supermarket firm and it is hoped that this discussion will help agricultural researchers re-think and perhaps refine their ideas in ways to produce studies that are even more relevant and useful to private firms.

As a matter of focus, this discussion draws from observed needs of supermarket managers, especially those at the category level. To provide some perspective, the thousand of products in a typical supermarket are segmented into categories and managed by personnel known as category managers. A few well-known categories include dairy, frozen foods, beer and wine, carbonated soft drinks and produce. From observations of category managers, it is apparent that they do not use price or income elasticities for aggregate commodities such as beer, breakfast cereals, cooking oil, ice cream, or milk. Given the environment in which supermarkets compete against

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each other for customers on a daily or weekly basis, marketing strategies are developed within and among product categories. For example, different marketing and sales strategies are often developed for classes of breakfast cereals (e.g., sugar-coated, high-fiber and all-family) as well as for breakfast cereals as part of a larger group of products (e.g., a group of breakfast foods such as eggs, sausage, cereals, and frozen waffles). Moreover, because of widely different consumption patterns among groups of consumers within narrowly defined geographic areas, marketing and sales strategies differ not only among product classes but also among stores and different consumer groups.

Differences in strategies and expected outcomes as heretofore noted can lead one to ask questions about the value of elasticities for aggregate commodities. For example, can a price elasticity for a product like milk be of value to a private firm that knows it can sell a large volume of low-fat milk in one geographic area and even a larger volume of whole milk in another area of close proximity? Additionally, can an elasticity of demand for milk be useful when a private firm knows it can sell large quantities of one-half percent milk in one area, but near zero quantities in another area of close proximity?

Similarly, can an elasticity of demand for beer be meaningful to a private firm when it knows it can sell large quantities of lite beer in one area, but much larger quantities of regular beer in another area that is less than eight miles away? Admittedly, many agricultural economists have attempted to account for differences in purchasing behavior due to factors such as education, race, and region (Frazao, 1992; Nayga and Capps, 1992). However, a more fundamental question that is raised in this paper is whether these socioeconomic factors can be meaningful when the unit of analysis for the dependent variable is an aggregated quantity. To help focus this discussion, the purchasing behavior of shoppers around six supermarket stores in the Columbus, Ohio metropolitan area is examined. Some perspective is provided on these shoppers with the following discussion of socioeconomic characteristics.

Socioeconomic Information by Store Location

Important economic and demographic information for six stores is provided in Table 1. Spectra Marketing provides these data and they include

all the households within the general shopping area of a given store, usually a 3-mile radius. These data are updated at least quarterly and Table 1 reflects updates as of November 2000. Stores 1, 2 and 3 make up a group of stores that are best characterized as being surrounded by low-income shoppers, while stores 4, 5 and 6 are best characterized as being surrounded by high-income shoppers. All of the stores are within close proximity of one another, with a maximum distance of 20 miles between any two stores (stores 3 and 6). The second greatest distance between any two stores is 17 miles (stores 4 and 6). For all other store combinations, distances among them decrease at a fairly rapid rate, reaching a minimum of six miles (stores 2 and 3). These distances are provided as background information for later reference to elasticity differences among stores.

Relative to factors that are believed to have a dominant influence on purchase decisions, education and income, it should be noted that these factors are more favorable for residents around higher-income stores. An average of 58 percent of the households surrounding higher-income stores has incomes above \$50,000, as compared to 31 percent of those surrounding lower-income stores. Also, the percent of households surrounding lower-income stores with incomes less than \$10,000 is more than double that of households surrounding higher-income stores with incomes less than \$10,000.

Additionally, college graduates represent an average of 38 percent of the prospective shoppers for higher-income stores, but just 10 percent of those for lower-income stores. Relative to race, lower-income stores are shown to have shoppers who are more heterogeneous than those for higher-income stores. These and other socioeconomic factors influence consumer purchase decisions and my experience suggests that category managers consider them when planning marketing strategies for grocery products.

Aggregate Elasticities and Their Possible Relevancy to Private Firms

As applied economists, we generate elasticities for food commodities that are supposedly relevant to shoppers, supermarket managers, public policy officials, and other decision-makers. If, for example, fairly inelastic price elasticities of demand are estimated for breakfast cereals and potatoes, then supermarket or category managers

Table 1. Household Demographic Data for Six Stores (by percentage).

Demographic Information	Lower-Income Areas				Higher-Income Areas			
	Store 1	Store 2	Store 3	Average	Store 4	Store 5	Store 6	Average
Household Income								
Under \$10,000	13.8	12.9	9.3	12.0	3.8	5.0	3.8	4.2
\$10,000-\$49,999	57.6	58.3	54.1	56.7	32.8	41.8	37.7	37.4
\$50,000-\$74,999	18.5	18.2	22.4	19.7	27.4	20.9	24.6	24.3
\$75,000-\$99,999	6.5	6.3	8.4	7.1	17.5	12.1	15.3	15.0
\$100,000 +	3.8	4.3	5.9	4.7	18.8	20.2	18.2	19.1
Race								
White	59.2	83.6	85.7	76.2	95.4	92.4	93.1	93.6
Black	38.6	14.4	12.1	21.7	2.3	3.2	5.0	3.5
Others	2.1	2.0	1.8	2.0	2.6	4.6	1.9	3.0
Education								
Grade School	7.3	10.0	11.1	9.5	4.1	2.0	2.5	2.9
Some high School	21.3	25.4	25.8	24.2	11.6	5.0	8.6	8.4
High School Graduate	33.5	36.7	37.6	35.9	28.2	16.2	27.0	23.8
Some College	24.3	19.2	17.8	20.4	26.2	26.6	28.2	27.0
College Graduate	13.8	8.8	7.5	10.0	29.9	50.6	33.5	38.0

Source: Spectra Marketing, 2000.

are expected to be able to utilize these values to increase margins for their products and therefore realize higher revenue. However, since a typical supermarket sells many brands and varieties of breakfast cereals and potatoes and may not wish to increase margins on all products, such a market would be unlikely to find broad estimates useful. Indeed Gao, et al. acknowledged that their estimate of a -0.38 price elasticity for potatoes is really for 42 different potato products: many varieties of canned, chips, dehydrated, fresh and frozen.

For a lower level of aggregation, Jones, et al. derived elasticities for five classes of cereals: private label, top ten brands, instant, snack, and other brands. These classes, why not nearly as aggregated as "all-cereals" utilized in many studies, are still too broad for most category managers. Category managers recognize that there are differences in price elasticities among cereal classes such as sugarcoated cereals that appeal to kids, high-fiber cereals that appeal to adults, and all-family cereals that appeal to everyone. Further, most managers are well aware of differences in elasticities within cereal classes by brands (e.g., sugar-coated frosted flakes vs. sugar-coated cheerios).

As an indication of the limited value of aggregate elasticities for a product category like cereals, Jones, et al. found major differences in price elasticities for five classes of cereals. For the six stores listed in Table 1, shoppers of the three lower-income stores were found to be far more price sensitive than those of the three higher-income stores. Moreover, significant differences were found in the way shoppers allocate their expenditures among the five classes.

Private-label cereals represented a much larger proportion of cereal sales for lower-income shoppers than for higher-income shoppers (4.1 percent vs. 2.1 percent). The cereal class identified as other brands, mainly high-fiber and often higher-priced cereals, constitutes much larger proportions of total purchases for higher-income shoppers. These differences in purchase patterns, particularly among stores of close proximity, point to the limited value of aggregate elasticities for cereals. Even though category managers offer identical prices at stores within close proximity of one another, these pricing decisions are not guided by some naïve notion regarding common elasticities. On the contrary, recognized differences in elasticities by store and product type guide in-store promotions and the selection of products for shelf stocking.

To keep the focus on cereals, promotion efforts to boost the sales of private label and high-fiber cereals would result in private label being displayed more prominently in lower-income stores and high-fiber cereals being displayed more prominently in higher-income stores. While these different marketing strategies may lead to results that economists wish to aggregate, it is unlikely that the realized sales response for any two classes of products will approximate that which would be suggested by an aggregate elasticity. Indeed the overall price elasticity of demand for cereals for a given time period, say a year, is really a function of the type and frequency of cereal classes that are promoted through price reductions and other marketing mechanisms. That is, retailers and food manufacturers can influence price elasticities by changing the frequency of product promotions. As agricultural economists, our research on cereals and other products would be more valuable to private firms if we would attempt to segment them into meaningful product groups or classes.

As another example of the limited value of an aggregate elasticity, consider differences in milk consumption for the six stores in Table 1. For a sixty-five week period of June 1997 through July 1998, differences in the percentages of milk sales for the three lower-income and three higher-income stores ranged from a low of 7.5 percent for one percent milk to a high of 29.7 percent for whole milk. Specifically, 1-percent milk represented 16.5 percent of milk purchases for higher-income shoppers as compared to 9.0 percent for lower-income shoppers. By comparison, whole milk represented 43.1 percent of milk purchases for lower-income shoppers as compared to 13.4 percent for higher-income shoppers.

For other milk products, skim milk represented 26.9 percent of milk purchases for higher-income shoppers as compared to 7.6 percent for lower-income shoppers. Neither income group consumed large quantities of one-half percent milk, but both groups consumed near equal proportions of 2 percent milk (36.4 percent vs. 36.1 percent for lower- and higher-income groups respectively). Given these disparities in purchases by store coupled with the fact that milk is often used as a loss leader for supermarkets to generate store traffic, it is imperative that category managers gain access to disaggregated milk elasticities for store-level planning. Admittedly, few agricultural economists would have access to store-level data. However,

whenever agricultural economists do gain access to disaggregated data for products, a special effort must be made to estimate elasticities for each product class. Indeed a recent article by Green and Park (1998) is a step in this direction.

As another illustration of the limited value of aggregate elasticities, consider beer purchases among the six stores in Table 1. For marketing purposes, beer is often segmented into six classes: premium, super premium, imports, popular/budget, specialty and microbrews. For these product classes, major differences exist in the purchasing patterns of higher- and lower-income shoppers. Import purchases represent an average of 13.6 percent of beer purchases for shoppers of the three higher-income stores, but just 4.5 percent of purchases for shoppers of the three lower-income stores. At another extreme, popular/budget beer represents an average of 26 percent of beer purchases for the three lower-income stores, but just 10 percent of purchases for the three higher-income stores. Similar disparities exist between the purchases of microbrews in higher- and lower-income stores. While the aforementioned differences in beer purchasing patterns can perhaps be explained by income and education differences among shoppers, it should also be noted that differences in purchasing patterns for beer can be observed even when income and education are quite comparable. Indeed internal analyses conducted for the supermarket chain during my sabbatical suggest that ethnicity and race influence beer purchases just as much as education and income.

As shown in Table 1, household incomes and education are quite comparable across the residents who patronize stores 1 and 2. Significant differences, however, do exist in the racial mix of the populations. Blacks represent 39 percent of the shoppers surrounding store 1, but just 14 percent of those shoppers surrounding store 2. Undoubtedly, these differences lead to sharp differences in the purchasing patterns for beer. Among the premium class of beer, the top two brands, budweiser and bud light, represent 29 percent of total beer sales for both stores. Yet Budweiser represents 19.9 percent of beer sales in store 2, but just 10.5 percent in store 1.

By contrast, bud light represents 19.8 percent of beer sales in store 1, but just 9.7 percent in store 2. These differences become even sharper when regular and light beer sales are compared for the top four brands of premium beers (the top four

includes the addition of coors light and miller light). In addition to purchase differences emanating from race, purchase patterns for beer also differ significantly by ethnicity. That is, when income, race and education levels are practically identical, ethnicity differences can lead to widely different purchasing patterns. Simply stated, variations in beer purchases are determined by factors that are far too localized to render meaning to an aggregate elasticity. Given this reality, supermarket managers can maximize beer sales only if disaggregated elasticities are provided them for each class of beer within a narrowly defined geographic area.

Marketing Methods of Category Managers

Based on the preceding discussion, one might be inclined to argue that elasticity differences for a few products in a few stores in Columbus, Ohio are insufficient to invalidate the usefulness of elasticities in signaling the sales response that can be expected for a given price change. For example, if retailers know that milk faces a price elasticity of demand of a negative 1.4, they would also know that a 10 percent price reduction would lead to a 14 percent increase in quantity sold.

Now assuming the existence of an aggregate elasticity of the stated magnitude, retailers would still need to know which type of milk to stock in each store. For example, does this elasticity imply sales of 800,000 gallons of skim milk, 900,000 gallons of 1 percent, 1 million gallons of 2 percent, etc.? Does an aggregate elasticity for milk imply that each type of milk will realize a 14 percent increase in sales over its base level? If so, it requires category managers simply to make promotion stocks a function of baseline stocks. In reality, each type of milk faces a different elasticity of demand and if retailers adequately stocked all classes of milk across all stores and then added resulting sales, it would be a true miracle if total sales approximated a 14 percent response. Indeed a recent study by Akbay (2000) shows that lower-income consumers are more sensitive to changes in milk prices than higher-income consumers. This suggests that milk promotion requires retailers to have some knowledge of elasticity measures by product type as well as by store type. Indeed as retailers plan milk and other promotions within areas of close proximity, they implement uniform price reductions across all stores as a matter of

policy, and not as a matter of belief in a common elasticity. Evaluations of sales responses are done with respect to specific product classes and specific store locations. Simply stated, variability in milk sales by store and milk type would render an aggregate elasticity as virtually meaningless.

Although it has been argued that supermarket managers find limited, if any, value in aggregate elasticities, they do pay attention to sales responses that result from promotion efforts. These efforts, as heretofore stated, are for specific products and specific package sizes and the lingo used is "lift" as opposed to "elasticity." Consider a retail supermarket that wishes to increase sales and revenue by promoting breakfast cereals. Clearly the hundreds of brands and package sizes will make it impossible to promote all cereals. Further, promotion is generally done in cooperation with manufacturers and few manufacturers wish to promote their products concurrently with those of their competitors. This forces category managers to select an advertising and promotion strategy.

As a first step, these managers must ascertain the range of products offered by the manufactures as well as the level of funds being made available for promotion. From this range of products and available funds, category managers must select a promotion strategy that fits within the retailer's overall revenue and sales objectives. This is accomplished by examining the historical lifts for the available range of products. The magnitude of these lifts will depend upon a number of factors, but key among them are in-store promotions, package size, and advertisement size, especially that in newspapers and free standing inserts. Final product selections for any promotion will be dictated by historical lifts, promotion funds, store-level socioeconomic characteristics, and the sales/profit objectives of the retailer. Critical to an assessment of historical lifts is recognition of the influence of package size. For example, there is not a single lift for Kellogg Frosted Flakes, but there are separate lifts for 25-ounce, 20-ounce and 15-ounce boxes of Frosted Flakes.

Marketing managers clearly understand the role socioeconomic factors play in the success or failure of product promotion. For example, managers know the promotion of sugarcoated cereals has its highest probability of success in stores that are surrounded by households with high percentages of school-aged children. Similarly, promotion of high-

fiber cereals has its highest probability of success in stores surrounded by high-income households and an age distribution that is skewed toward middle age and older. However, there are also factors that marketing managers do not clearly understand and therefore cannot implement optimal plans to execute their marketing programs. For example, what are the factors that explain widely different consumption and purchasing patterns for consumers in reasonably close proximity of one another? Why, for example, does one-half percent milk barely sell in Ohio, but sells extremely well in Pennsylvania? Why are Ohio and West Virginia consumers more prone to purchase light than regular beer? Why is Pepsi the leading soft drink in Ohio and West Virginia when coke is the largest seller in practically every other state? Should retailers with establishments in Ohio and West Virginia promote light beer more heavily in other states in which they operate on the premise that consumers in other states simply lag behind Ohioans and West Virginians? Or, are consumers in these two states atypical and consumers in other states more representative of the norm? Answers to these types of questions would undoubtedly prove more valuable to category managers than measures of aggregate elasticities.

As a final observation, category managers have come to understand that promotion is often more successful for complementary groups of products than for a single or limited number of products. This means that a promotion effort for a complementary set of outdoor barbecue products—franks, hamburger patties, ketchup, mustard, buns, relish—is likely to be more successful for each product than a promotion effort for any one or two of these products. Observations suggest that consumers are simply more responsive when they are provided a wider range of products from which to make their selections. Perhaps no individual consumer response is any greater, but a greater number of consumers respond. With reference to an earlier example of breakfast cereals being promoted as part of a group of breakfast foods, it can be concluded that higher sales of cereals are realized because they are advertised within a complementary group. Further, these complementarities among breakfast cereals and other breakfast foods will vary widely among product classes of cereals. In essence, an aggregate elasticity for cereals will provide little guidance to category managers.

Summary and Conclusions

Agricultural economists are known for conducting applied and practical research. Readily available data sets have been utilized to estimate elasticity parameters for commodities such as bread, milk, pasta, potatoes, breakfast cereals and even "food." Estimated own-price parameters for these commodities suggest changes in sales or purchases that will result for given changes in price. For large geographic areas, such as the United States, these elasticities may indeed approximate quantity-price relationship. However, most private firms make business decisions for more narrowly defined geographic areas such as a city, county, or state, even though they often operate within larger geographic areas. Thus, for all practical purposes, aggregate elasticities do not serve to inform the business decisions of private firms.

With recognizable constraints placed on the ability of agricultural economists to acquire disaggregate data, it is certainly understandable why aggregate elasticities have become the norm. These estimates, however, must not be over generalized as having significant value for the decision making of private firms, but must be interpreted, at best, as approximate measures of price-quantity relationships for large geographic areas. As scanner data and other firm-level data become available, agricultural economists must make a special effort to provide elasticity estimates at the product and market area — however narrowly defined. Further, agricultural economists must attempt to address some of the apparent anomalies of observed consumer behavior. Retailers are struggling to understand and stay ahead of consumer trends and they are receptive to research studies that shed insights on these issues. As applied and practical scientists, we can gain credibility with private firms by producing studies that are indeed relevant to their business decisions. From the perspective of supermarket retailers, we will know we are producing relevant results when research dollars are redirected from marketing research firms such as IRI and Nielsen to departments of agricultural economics.

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