

Observations on Economic Adulteration of High-Value Food Products: The Honey Case

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The paper highlights the issue of economic adulteration of high-value food products and provides a context for discussion and analysis based on experiences with the U.S. honey industry. Perspectives on economic adulteration are identified, trends relevant to the issue of economic adulteration are discussed, and industry opinions on economic adulteration of honey are summarized. The paper is based on research funded by the National Honey Board to provide a platform for industry dialogue on the need for a quality-assurance program.

Product adulteration for financial gain or competitive advantage is known as economic adulteration. The Federal Food, Drug and Cosmetic Act (Section 402) states that “a food shall be deemed to be adulterated if any valuable constituent has been in whole or in part omitted or abstracted therefrom; or if any substance has been substituted wholly or in part therefor; or if damage or inferiority has been concealed in any manner; or if any substance has been added thereto or mixed or packaged therewith so as to increase its bulk or weight, or reduce its quality or strength, or make it appear better or of greater value than it is.” Thus economic adulteration occurs when the economic value of a product has been decreased without notifying the buyer or consumer. For example, adding any other sweetening agent to a product labeled and sold as “honey” is illegal.

The problem of economic adulteration is not new, having been addressed in ancient Mosaic and Egyptian meat laws, early Greek and Roman wine laws, and in U.S. food laws dating from 1784 in Massachusetts (Crawford 1954). Economic adulteration may undermine the trust of consumers and may be a serious threat to the economic viability of firms producing high-value food products.

Logic suggests that strong incentives exist for economic adulteration in higher-value food products. In the sweetener industry, maple syrup and honey are prime targets for economic adulteration,

based on their relatively high cost when adjusted for sweetness intensity. Orange juice and olive oil are food products often targeted for economic adulteration in their respective industries.

High-value food products must develop and sustain a strong image with consumers in order to maintain sales and profit margins. A product which claims to be pure, wholesome, and natural is vulnerable to negative publicity which can change consumers' attitudes with respect to these key product attributes. Economic adulteration can strike at the core of consumer confidence. Thus quality-assurance efforts in high-value food industries are particularly important.

This paper highlights the issue of economic adulteration of high-value food products and provide a context for the discussion and analysis of economic adulteration based on the experiences of the authors with the U.S. honey industry.

The Quality-Assurance Environment

Quality assurance is by no means a simple issue. In addition to the question of economic adulteration, there are trends and issues in the area of commodity and food marketing which have implications for the industry's quality-assurance strategies.

Relationship Marketing

The umbrella of relationship marketing covers several trends which are relevant to the quality-assurance issue. First is the basic concept of win-win situations in which cooperation replaces the overt use of power in business-to-business relationships. In the food-marketing arena the possibility of cooperation for mutual benefit occurs when cooperation either produces additional benefits for consum-

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This research was supported by the Florida Agricultural Experiment Station, and approved for publication as Journal Series No. R-09646.

ers or reduces marketing costs. The existence of economically adulterated product in the marketing channel should serve as motivation for buyers at all levels of the channel to establish on-going relationships with their suppliers. Survey results from the honey industry indicate the necessity for and benefits from relationship marketing.

Companion concepts include the many dimensions of supply-chain management, which involves a recognition that firms really operate in value chains of related activities which reach from input supplies to the initial production process to the final consumer. Inherent in this concept is the idea that firms are linked together and will be evaluated as to how well activities are performed and coordinated, at a profit, to meet the wants and needs of the final consumer. Thus it is the entire value system which assures quality and purity for the consumer.

Globalization and International Cooperation

Clearly, markets for high-value food products have become international in nature, with imports and exports growing in significance. This is the case in the honey industry. Beyond the import-competition concerns of domestic honey producers, there are broader questions of product quality and quality standards. With globalization comes increased attention to harmonization, convergence, and compatibility of technical standards, product quality and safety standards, and sanitary and phytosanitary standards. Certainly, economic adulteration and quality assurance are issues with an international dimension.

The Role of Government

Governments continue to respond to concern for the health, safety, and welfare of consumers. Increasing attention is being given to labeling laws and accurate and available information for consumer choice and decision making (Kim, Nayga, and Capps 2001). These concerns focus on a diverse range of topics from pesticide and drug residues to nutritional labeling and allergenicity. Government concern, then, has direct application to economic adulteration. For example, some people are allergic to common adulterants found in honey, such as beet sugar or gluten. In terms of food intol-

erance, if the ingredients in the product are not pure the label is wrong and labeling laws have been violated. Serious chain-of-responsibility issues are involved; governments often provide the basis for independent or third-party regulation of food products.

Industry Self-Policing

Industries are increasingly taking more responsibility for themselves regarding standards and behavior. At the same time, the importance of government inspectors is being diminished. Industries are developing self-policing control systems. Firms are testing their competitors' products, knowing that the actions of one firm can affect the welfare of an entire industry. Industries may develop lists of questionable firms, and firms may report their unscrupulous competitors to the proper government authorities.

To be effective, quality assurance should be a front-end issue, not an after-the-fact find/test/prosecute issue. Quality assurance is becoming a way of life for many food-manufacturing companies. There are just too many reasons why it is good business to buy only high-quality, pure ingredients. Examples include government labeling laws; consumer-health issues; competitive advantages associated with consumer demand for 100% pure, high-quality products; and increasingly stringent technical standards for imported food products in many countries.

In the food-ingredient market, honey, for example, is a positive, value-adding ingredient. Food manufacturers need to have confidence that the product purchased is pure honey. It is expected that increasing attention will be given to quality assurance in the food-ingredient market.

Traceability and Other Monitoring Systems

Increasingly, consumers want to know more about the history of their food. Information they desire includes genetic material, chemical inputs, handling and storage, manufacturing processes, additives, and environmental impacts. Traceability and accountability are becoming important issues. For example, more consumers will want to know "where their honey was last night." This is an issue which high-value food industries need to address.

Product Image: More Important Than Ever

High-value food products with pure, natural, wholesome images are vulnerable to erosion from negative publicity which undermines consumer confidence in the underlying product attributes. For example, because many consumers purchase honey and products containing honey on the basis of product quality and image rather than price, image maintenance demands the highest priority.

Perspectives on Economic Adulteration

A number of potential impacts are associated with economic adulteration, including the cost of consumer deception, the cost to firms which compete with firms selling adulterated products, the cost associated with a negative shift in consumer demand resulting from changes in product images and consumer attitudes, illicit profit associated with violations of grades and standards and labeling laws, the cost associated with a positive shift in supply due to the addition of adulterants, and the cost of negative externalities. Some of these perspectives may provide a basis for measuring economic impact.

Consumer Deception

As a result of economic adulteration, consumers are overspending for the adulterated product which they perceive to be a 100% pure product. While some defense attorneys may attempt to argue that consumer fraud regarding the purchase of adulterated products should only include the difference in ingredient costs—e.g. corn syrup vs. honey or pulp-washed orange solids vs. pure orange juice—it seems more appropriate to argue that the complete cost of adulteration to consumers can only be captured by estimating total consumer expenditures on adulterated product purchases. This would involve calculating the volume and price of adulterated product purchases over a specific period of time.

Food scientists and chemists have developed a number of tests to detect the presence of illegal ingredients in honey, helping to establish the degree of adulteration. Similar tests have been developed to detect adulteration in orange juice. However, tests for non-labeled ingredients often are not able to accurately detect very small amounts of such in-

gredients due to the similarities in profiles of the higher-value product and the lower-value adulterating ingredient. For example, tests such as the Stable Isotope Ratio Analysis cannot accurately detect the presence of corn syrup in honey below seven percent. Thus, unlike tests for the presence of pesticide concentrations on produce, it is the similarity of adulterating-ingredient characteristics to the pure product that makes detection so difficult. In this context, one can see why consumers may not notice moderate levels of economic adulteration.

Impacts on Competition

One motivation behind economic adulteration is the opportunity to reduce costs and increase profits per unit sold at prices comparable to pure products, or to reduce input costs and lower selling price to increase sales volume and/or market share. Cost differences can be significant enough that firms selling adulterated product can cause economic injury to competing firms, sometimes selling below product cost for pure products and sometimes driving producers and packers out of business. Without direct evidence of adulteration, these impacts on competition are difficult to measure, and thus the results of economic adulteration may be attributed to other competitive factors.

Consumer Demand

Publicity regarding economic adulteration can result in a decrease in consumer demand for that product category. As a result, individual producers, processors/packers, and distributors can suffer financial losses. Consumer images of a product in terms of such attributes as purity and health benefits can be negatively impacted, resulting in significant changes in purchasing patterns. It is far easier—and less expensive—to maintain a positive product image with consumers than to rebuild an image which has been damaged. The importance of image to consumer demand, and thus consumer prices, should not be underestimated.

Illegal Profits

The impact of economic adulteration also includes profits associated with violation of government and

industry grades and standards and government labeling laws. While there is an analytical perspective associated with competition, there is also a legal perspective to be considered. Sales and profits can be measures of the degree of violation. Such estimates are well-received by the legal community, regulatory agencies, and the court system. This methodology was utilized in testimony in an orange juice adulteration case in the Federal District Court of Western Michigan and used by the court to determine the extent of fraud associated with the felony charges and subsequent conviction (Fairchild 1993).

Supply Expansion

The addition of an adulterant to a product can have the effect of expanding the available supply of the product in a given time period. Such a positive shift in supply has the potential to decrease the market-clearing price. Own-price flexibilities can be utilized to measure the price response to a given change in quantity supplied. This may be the most direct approach to the measurement of impacts.

Externalities

Negative externalities are costs which accrue to other individuals, groups, or society as a result of actions by those engaging in a particular activity. For example, firms engaging in economic adulteration of honey could create negative externalities (decreases in welfare) for fruit growers and consumers. If lower honey prices and revenues, resulting from economic adulteration of honey, cause fewer bee colonies to be available for pollination services, then negative externalities would accrue to fruit growers and perhaps to consumers.

An Industry Example

In an effort to determine industry opinions on economic adulteration, a mail survey of fourteen U.S. honey packers was conducted at the request of the National Honey Board in 1999 (Fairchild 1999). The response rate was 86%. The total volume of honey purchased by survey respondents represented approximately one-half of estimated total U.S. honey sales in 1996–98. The survey was not a statistically representative (random) sample and thus the information generated only represents the ex-

perience and opinions of the responding firms.

Fifty-eight percent of respondents, representing 88 percent of respondent volume, reported testing for economic adulteration, while 42 percent did not test for economic adulteration. The honey sales of those testing for economic adulteration were distributed among product-utilization channels as follows: retail sales, 50.2 percent; food-service sales, including hotel, restaurant, and institutional pack, 13.4 percent; and bulk sales to the food-ingredient market, 36.4 percent. All of the responding firms which test for economic adulteration reported using commercial labs, with one firm using both commercial and in-house labs. All firms testing for economic adulteration reported using the Stable Isotope Ratio Analysis (SIRA), and 43 percent of firms testing reported using a protein test.

Estimates of Economic Adulteration

Firms were asked if they had found economically adulterated product in the past three years. Seventy-one percent reported finding adulterated honey, while 29 percent reported no such findings. Firms which reported finding economically-adulterated product were asked what percentage of the total volume of honey purchased was determined to be adulterated by the addition of foreign ingredients. Among those reporting adulterants, adulterated product as a percentage of total volume purchased averaged 0.8 percent in 1998; 1.3 percent in 1997; and 2.6 percent in 1996. The only adulterant found was corn syrup.

Honey packers were asked the average detected level of adulterant for the honey found to be economically adulterated. Respondents reported adulterant levels ranging from 5.7 to 25 percent in 1998, from 7.3 to 43 percent in 1997, and from 7 to 23 percent in 1996. Establishing lower and upper bounds for each year was determined to be more meaningful than calculating a weighted average, given the relatively wide range of responses and small sample size.

In an effort to determine the sources of adulterated product, firms were asked the percentage of economically adulterated product purchased from various sources. Respondents indicated that, on average, most adulterated honey originated in Argentina and China, with little coming from domestic sources.

Packer Opinions

Honey packers were asked a number of open-ended opinion questions. All survey respondents were asked to answer these questions regardless of whether or not they tested for economic adulteration or whether or not they had found adulterated product.

Survey participants were asked if they were satisfied with their ability to detect adulterated product. One-fourth of respondents indicated that they were satisfied, while three-fourths indicated that they were not currently satisfied with their ability to detect adulterants. Of those who test for adulterants, 85 percent are not satisfied. The surveyed firms who test seem to be concerned about being able to test for a range of adulterants, levels of adulteration below the detection threshold, and the cost and accuracy of tests. Those who do not test are concerned about the cost of testing large numbers of small lots and desire easier tests and more information.

Honey packers were asked whether or not they believe economic adulteration is affecting their operation or creating unfair competition. Nearly sixty percent of respondents indicated that; one-third did not believe economic adulteration was affecting their operation or creating unfair competition, and eight percent who did not know. Respondents indicating an effect were asked to identify its source. Collectively, respondents believe that there are unscrupulous participants at all levels of the honey supply chain, including producers, packers, and importers.

Survey participants were asked how important an issue economic adulteration is for the U.S. honey industry. Seventy-five percent of respondents believe economic adulteration to be a very important issue and an additional 17 percent believe it is a somewhat important issue. While 8 percent answered that they did not know how important an issue it is, no one thought it to be somewhat unimportant or not very important. Thus 92 percent of survey respondents believe economic adulteration to be a very important or somewhat important issue for the industry.

Additional comments by respondents included observations that while their own firm had a reputation for demanding quality product from their suppliers, some other firms did not seem as con-

cerned about product quality. Several respondents noted the importance of developing and maintaining trusting relationships between buyers and sellers in order to minimize product-quality problems. Other comments included concerns that economic adulteration hurts competitiveness and cheats consumers, and that ultimately the honey industry gets hurt when product quality is compromised through adulteration.

Survey participants were asked an open-ended question about what, if anything, they believe can be done to reduce or eliminate economic adulteration. Individual responses can be grouped into six categories and are listed in order of frequency of response. First, there is a belief that more or better or simpler testing methods would help reduce or eliminate adulteration. Second, it was suggested that there should be standardized testing requirements and protocols. Third, it was indicated that the industry should support random product testing in both the retail and institutional markets. Fourth, participants felt that a program should be developed to educate both honey-buying firms and the general consuming public about the importance of product quality and to provide assurance of product quality. Fifth, it was suggested that analysis of all imports from firms with a history of economic adulteration problems should be conducted on a regular basis. Sixth, an acceptable protocol should be developed for testing global supplies which take into account "variations" among production regions.

When asked to explain their opinions about the importance of the economic-adulteration issue, the collective responses in order of frequency were as follows: honey's image is vulnerable to damage; product adulteration expands supply and decreases price; "our" firm is not affected by economically adulterated product but we believe there are problems elsewhere; there is a need for better tests to reduce confusion and strife; the easiest and safest place to send adulterated product is the food service/ingredient market; and we need to be checked for adulterated product more often.

Importer Opinions

Several firms which import honey into the United States were interviewed by telephone in order to get their perspective on the economic-adulteration

issue. There was a striking similarity across importer interviews, resulting in a locus of opinion points. The first point is that it is important to know your foreign supplier in order to assure a pure product, as the U.S. government does not routinely test for economically adulterated product. Thus relationships are more important now than ever before. This point was stressed repeatedly.

Second, the problem has diminished in recent years. Opinions vary as to how much adulteration exists currently. Most agree that adulteration is positively correlated with price, noting that honey prices have decreased in recent years. General agreement also exists as to the need to be permanently vigilant for adulteration. Third, improved and less-expensive testing methods are needed. Fourth, there is a need for international cooperation and communication on the subject of economic adulteration among firms, industries, and governments. Lastly, problems are centered in the food-ingredient market. There is a need to work with and educate buyers about the importance and advantages of assuring pure product ingredients, particularly honey. It is very hard to compete with adulterators on price.

An Example of Potential Economic Impact

Several potential types of economic impacts can result from economic adulteration. One approach to estimating the impacts of economic adulteration involves knowing how price might be expected to behave in response to an increase in quantity supplied, as adulterated product has the effect of expanding the "supply" of product available in the market. One approach would be to begin with an estimation of the retail demand for a given product, then develop estimates for own-price elasticity of demand at the retail and producer levels of the market channel, and finally develop estimates for the upper bounds of own-price flexibility at the producer and retail levels. It is reasonable to assume that high-value-product prices are relatively sensitive to quantity changes.

Estimates of own-price elasticities or flexibilities for honey at either the retail or producer level of the marketing are not abundant in the extant literature. Willett and French (1991) estimated a simultaneous-equation model of the U. S. beekeeping industry using calendar-year data from 1952 to 1984. Using monthly A. C. Nielsen price

and consumption data as well as other supporting data from January 1994 to April 1998, Capps (1999) developed estimates of demand elasticities at the retail level and the farm level, $-.2577$ and $-.1972$, respectively. The upper bound for the own-price flexibility, conditional on these estimates, is -3.88 at the retail level and -5.07 at the farm level. We adopt these estimates from Capps (1999) to describe potential economic impacts from adulteration of honey merely to provide an example for illustrative purposes.

When the own-price flexibilities are combined with product-adulteration estimates and production and price data, potential economic impacts of adulteration can be calculated in terms of price changes and revenue changes measured at both the producer and retailer levels of the marketing channel. The degree of economic impact resulting from the supply-expanding dimension of product adulteration would be affected by the percentage of adulterant contained in the adulterated product. For any given amount of product determined to be adulterated, higher percentages of adulterant would be associated with greater supply expansion and therefore with larger price impacts.

Price Impacts

Examples of the potential price changes associated with various levels of adulterant in the percentage of total product estimated by honey packers to have been adulterated during the three-year period 1996–1998 are represented in Table 1. The estimates are a function of the level of adulterant (100, 50, 25, or 7 percent) in the estimated percentage of total product adulterated for each year: 0.79 percent in 1998, 1.3 percent in 1997, and 2.6 percent in 1996. The various combinations of these two factors yield the array of percentage-price changes and the cents-per-pound changes at the producer and retail levels contained in Table 1.

For example, in 1996—a year in which honey packers estimated that 2.6 percent of honey was economically adulterated—if the average level of adulterant was 25 percent, then the expected price decrease would have been 3.31 ($2.6 \times .25 \times -5.0698$) percent, or -2.94 cents, at the producer level and 2.53 ($2.6 \times .25 \times -3.8804$) percent, or -4.78 cents, at the retail level. It should be noted that while the farm-level own-price flexibility coefficient ($-$

Table 1. Potential Economic Impacts of Adulteration Based on the Honey Packer Survey.

Year (%)*	% Adulterant in honey	Producer level		Retail level	
		Maximum % price change	Maximum cents/pound change	Maximum % price change	Maximum cents/pound change
1998 (0.79)	100	-4.02	-2.63	-3.08	-7.34
	50	-2.01	-1.32	-1.53	-3.65
	25	-1.00	-0.66	-0.77	-1.84
	7	-0.28	-0.18	-0.22	-0.52
1997 (1.3)	100	-6.60	-4.96	-5.05	-11.74
	50	-3.30	-2.49	-2.53	-5.88
	25	-1.65	-1.24	-1.26	-2.93
	7	-0.46	-0.35	-0.35	-0.81
1996 (2.6)	100	-13.25	-11.77	-10.14	-19.11
	50	-6.62	-5.88	-5.07	-9.56
	25	-3.31	-2.94	-2.53	-4.78
	7	-0.93	-0.83	-0.71	-1.43

*Percentage of honey supply estimated to be economically adulterated.

5.0698) is larger than the retail-level own-price flexibility coefficient (-3.8804), the larger price changes measured in cents per pound at retail are due to the higher retail prices relative to producer prices.

Whatever the level of economic adulteration, the resulting supply-expansion impacts are notable, as prices at all levels of the honey marketing channel are extremely sensitive to quantity changes, as previously hypothesized. It is also instructive to examine potential producer-level price and revenue loss resulting from supply expansion due to adulterated honey.

Revenue Impacts

Over the three-year period covered in the honey-packer survey (1996–1998) the USDA three-year average for U.S. honey production was reported to be 205,014,660 pounds. The USDA three-year average producer price for 1996–1998 was 76.5 cents per pound. Over the same three-year period, honey packers reported an average of 1.56% of honey purchased to have been adulterated at some level. Based on these numbers, and assuming that the adulterant level was 25%, the estimated producer-level price decrease could have been as much as 1.98% or 1.51 cents per pound in the 1996–1998

period. This adulteration scenario would translate to an estimated producer-level revenue loss of \$3.1 million.

Demand and Income Elasticity Considerations

The previously described loss estimates are just the supply-expansion induced impacts. Likely, there also would be concomitant leftward shifts of the retail-level demand and farm-level demand functions because of changes in product image. The fall-out of this simultaneous shift in demand is not only a further reduction in farm prices but also a further decline in farm revenues.

The concept of income elasticity of demand measures the percentage change in quantity of a product demanded which results from some percentage change in consumer income. If high-value products are extremely sensitive to changes in consumers' incomes, they may be classified as luxury goods, with sales exhibiting a strong positive correlation with income.

Capps (1999) estimated the income elasticity of demand for honey in the neighborhood of 2.5. Given that honey is a relatively high-priced product in the sweetener market, it may be concluded that the image of honey is both extremely valuable

and vulnerable—valuable in that honey enjoys an image as a pure, natural, nutritious product, and vulnerable in that such an image could be damaged by negative publicity. Thus one may conclude that quality assurance is particularly important for high-value products, especially those with relatively high income elasticities of demand.

Concluding Remarks

The economic adulteration of food products means illicit profits, unfair competition, consumer fraud, and a potential source of industry-wide economic damage. Given the existence of financial incentives for the adulteration of high-value products such as honey, economic adulteration will continue to be a threat. Therefore, given that the image of high-value products tends to be vulnerable to damage, there are compelling reasons for industry participants to consider the development of quality-assurance programs.

A number of potential weapons exist for combating economic adulteration. Among these are clear, enforceable grades and standards of identity; accurate, scientifically accepted tests for detecting product adulteration; an approved monitoring and enforcement program; and an educational program to encourage responsibility at the firm level throughout the production-marketing channel. It is important to enlist the support and cooperation of both industry and government in order to successfully develop and support such a program.

This paper has attempted to increase awareness of the issues surrounding the economic adulteration of high-value food products, using the honey industry as an example. The authors hope the pa-

per will foster discussion among academics, government agencies, and food-industry leaders, resulting in improved regulations, monitoring, and analysis of economic adulteration.

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