Honey Demand and the Impact of the National Honey Board's Generic Promotion Programs

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Preface

The following research was completed solely by the author independent of any influence from the National Honey Board except for data assistance and clarification from the National Honey Board staff. All statistical and econometric analyses including the computer programming were directly a product of the author. The scope of the report has been limited to measuring the demand for honey and the impact of the National Honey Board programs on that demand. The honey industry continues to experience considerable production issues associated with the Colony Collapse Disorder (CCD) and this report only documents the colony change but does not deal with the CCD issues in terms of the science or solutions. All demand models are based on both economic theory and scientifically accepted econometric methods. As will be shown, the demand results are both theoretically and empirically revealing. Any omissions or errors are the responsibility of the author.

Appreciation is extended to the staff of the National Honey Board for being totally responsive to data needs and for providing materials relating to specific promotion programs. Bruce Boynton's communication skills and immediate responses to my requests were most helpful.

Ronald W. Ward

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Introduction

Commodity advertising and promotions, usually referred to as *generic promotions or commodity checkoffs,* represent various commodity organization programs to enhance the demand for their specific commodity. Promotion of honey is one of those programs. Legislative authority to implement a generic program can be found at both the national and state levels. Nationally, the common element is that the programs cover geographically the nation and imports into the U.S. Producers, suppliers and/or importers are subject to an assessment with the exceptions being specifically defined in the enabling legislation for the industry.

The need for a generic program hinges on the demand situation for the industry and the common interest among those producing and supplying the product. The greater the diversity among the suppliers, the more difficult it is to design and implement a generic promotion program. Likewise, such diversity most likely would be a prohibiting condition for even receiving the legislative authority to start a program. While each industry with or considering a generic promotion program is unique, there are several common dimensions to all of the programs. Suppliers are subject to an assessment to fund the programs; there must be equity in the distribution of benefits; there must be a representative Board to design and oversee the program operations; the message(s) must be factual and consistent with the underlying goals to enhance demand; the programs must be effective; there must be means for grievances; and the programs must be subject to governmental oversight to the extent that the authority is through the legislative process. Obviously, all of these entail much to get a generic program started and running. Since national checkoff programs provide the industry authority for mandatory assessment to underwrite the programs, those subject to the assessment must be assured that the programs are effective. Hence there must be in place methods for objectively judging the impact of the programs. Measuring effectiveness of the National Honey Board's programs, one of 20 different national programs, is the focus of this report.

To measure effectiveness, there must be in place databases and the scientific methods for evaluating the demand for the commodity and, specifically, separating out the impacts of the promotions from other demand drivers. For honey, we will see that demand must be separated into its uses for manufacturing versus non-manufacturing (table honey) purposes since those are two unique dimensions to the honey industry. Almost every commodity group adopts some type of slogan to capture the essence of that commodity's attributes. "Got Milk" to "Pork, the Other White Meat" all reflect an effort to grab the consumer's attention and ultimately the decision to buy the product in its various forms. "*Honey. One ingredient. The way nature intended.*"... is similarly the National Honey Board's slogan to convey the message of the "all natural" attributes of honey.

Consumers are generally aware of honey both on the grocery shelf and use in many manufactured foods. Yet awareness does not necessarily translate into greater demand. Getting the consumer's attention when besieged by messages at every corner of the store or in the media is a challenge for every food product. Unlike some foods, honey generally does not carry attributes that could be perceived negatively. It is highly storable and has a wide range of uses as an ingredient to many foods. One would expect the purchasing frequency to be considerably less than for more perishable goods. These attributes all impact honey demand and, hence, a fundamental question for the National Honey Board (NHB) is its impact on driving the U.S. demand for honey. Have their programs had a measurable impact on demand? That question is the focus of this report.

In the following pages, considerable detail about the structural change within the honey industry is laid out. Then the specific programs of the NHB are documented. Most of the more quantitative parts of the report deal with measuring the demand for honey and the impact from the generic promotions of honey in the U.S. marketplace. This report does not deal with the underlying bee production practices and disease issues.

Structural Change in the Honey Industry

While the fundamental attributes of honey have not changed over the years, the underlying supply structure supporting the U.S. honey market has changed significantly. Colony collapse among U.S. suppliers and the growth of honey imports top the list of major structural changes. One cannot develop demand models without having an understanding of these underlying shifts in the supply chain.

Production and Supply

Commercial bee colonies are moved throughout the U.S. for pollination purposes and the harvest of honey. The economic value of the pollination is almost beyond measurement since the bees are an essential link in the production process for most crops and pastures. For some commodities, the colonies are located for a fee within the production areas when the honey production is not particularly useful for consumption. Where for other crops such as oranges, clover, etc. the honey variety and flavor are tied closely with the pollen source or flower and the economic value of honey for commercial use increases substantially. In 1965, these U.S. commercial honey bee colonies totaled 4,718 million colonies with the average colony producing 51.3 pounds of useable honey. Up until the mid-80's, these colonies ranged in the numbers from 4.7 to 4.3 million. During the subsequent years, U.S. bee colonies declined due to colony collapse associated with non-economic reasons for the decline. There is a lot of literature on the reasons for the collapse and those are not discussed in this report. Interested readers are directed to the Agricultural Marketing Service (AMS) for a review of the biological issues associated with colony collapse (AMS-USDA, NASS).

Figure 1 documents the decline in U.S. bee colonies over the six decades since 1965. By 2012, total colonies declined to 2,624 million or about 53% of the 1965 levels. The lower part of Figure 1 illustrates this persistent decline especially after 1986. During the earlier years from 1965 through 1986, these colonies averaged around 49 pounds per colony. Between 1986 through 2005, colony production averaged close to 73 pounds per colony, reflecting an increase in productivity per colony. Since 2005, the colony production dropped to around 62 pounds. By 2012, production per colony was only 10% above the 1965 level. Combining the colonies times the poundage gives a direct measure of U.S. domestic honey production.

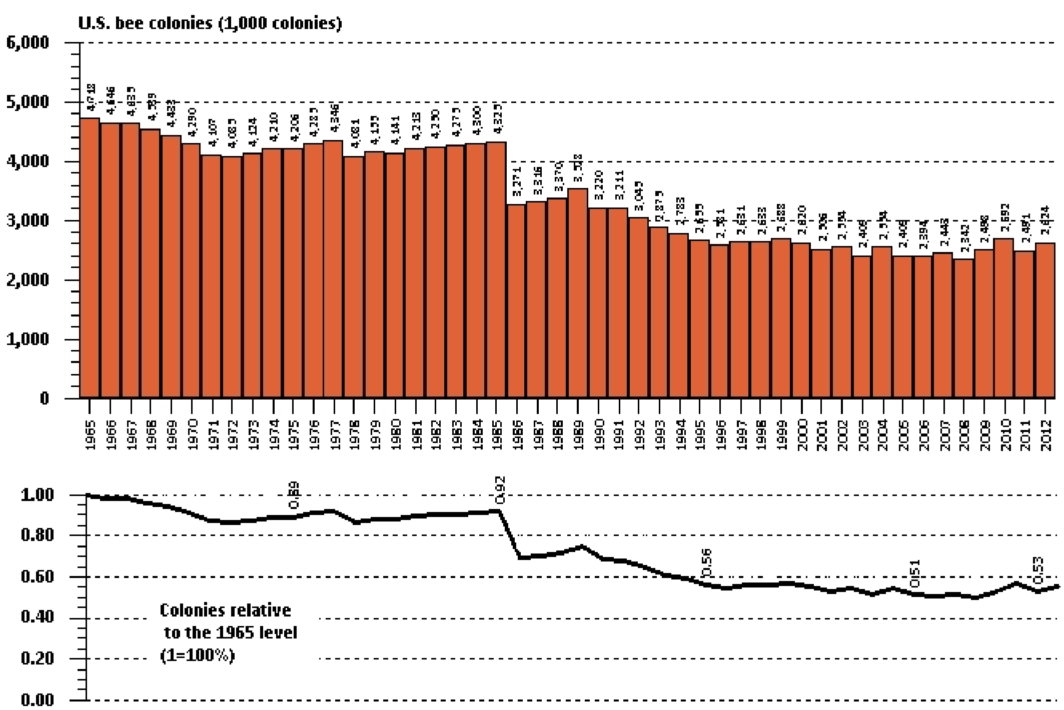

Figure 1. U.S. honey bee colonies.

Figure 2 shows the total U.S. honey production expressed in millions of pounds of honey. Clearly the total depends on both the colony numbers and the productivity per colony. As most apparent in Figure 2, changes in productivity could have but did not offset the loss in colonies. U.S. production peaked in 1969 with 267.5 million pounds of honey. While there is considerable natural year-to-year changes in total production, a negative trend since the early 90's is most evident. By 2012, total U.S. production equaled 147.1 million pounds or approximately 60% of the 1965 level.

The lower chart in Figure 2 expresses the annual production relative to 1965 and the negative trend is clear during the last two decades. This decline in U.S. honey production in Figure 2 depicts the single most important structural change in the domestic honey industry, a 40% decline in domestic honey production.

The second and parallel structural change is seen with the growing imports of honey

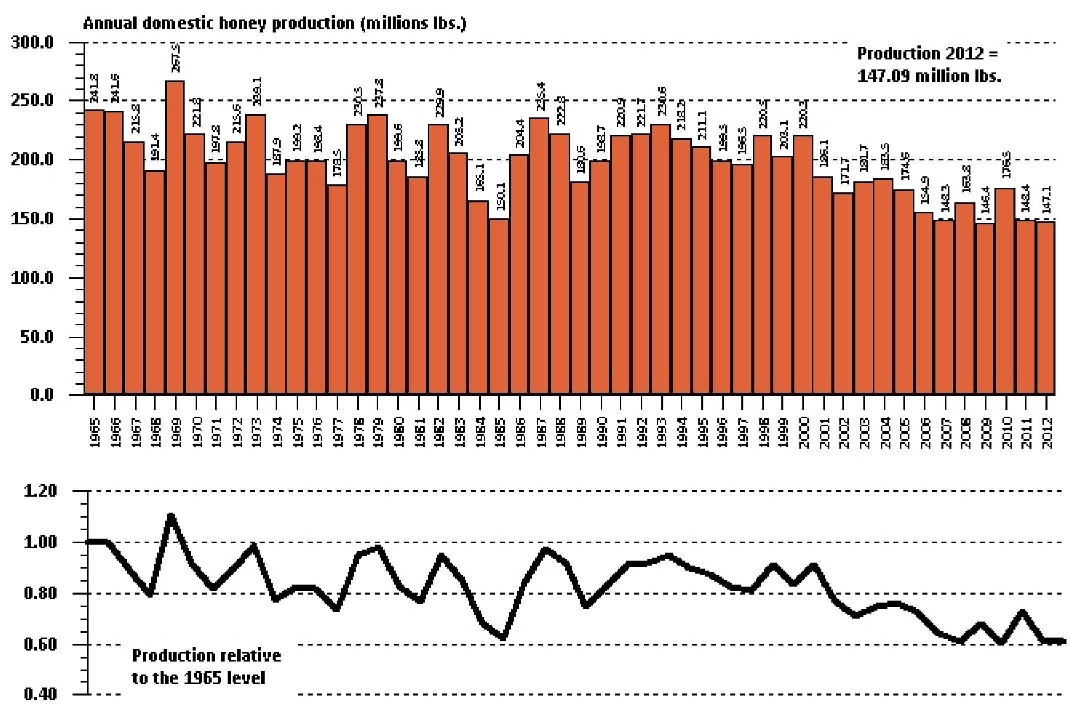

Figure 2. Annual domestic honey production in millions of pounds.

as well as a shift with greater volumes coming from the Asian production areas. In 1965, total imports was 13.3 million pounds and by 2012 this number rose to 310.9 million pounds. That is a factor of 23 times the 1965 level as illustrated in Figure 3. As with domestic production, there are year-to-year changes but the fairly consistent upward trend in imports is clear with both the total pounds and the relative values in Figure 3. For the entire period in Figures 1 and 2, domestic production is still less volatile than imports based on the Coefficients-of-Variations (CV) defined as the standard deviation divided by the mean pounds. CV_{US}=.14 and the $CV_{Imports}$= .72 while from 2000 forward the relative variation in supplies were CV_{US}=.12 and the $CV_{Imports}$= .20. Volatility in imports have decreased in the last decade and likely reflect the growing dependence on a steady supply of imported honey into the U.S. Note in Figure 3 that U.S. exports are relatively small and of less consequence when viewing the total supplies of honey.

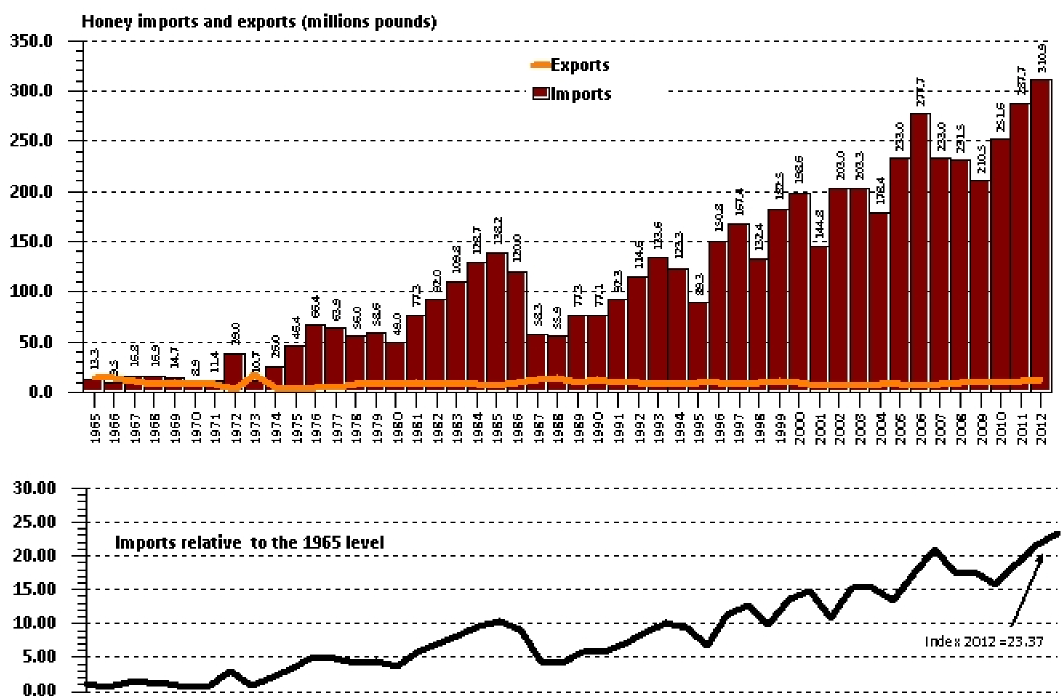

Figure 3. U.S. honey imports and exports in millions of pounds.

While not directly a part of the evaluation data needed, another interesting statistic for the imports is the foreign source. From 1989 to 2000, Asia supplied 36.5% of the imported honey and South America, 40.7%. Major shifts after that period occurred with Asia's share being 47.6% and South America's equaling 31.3%, thus, pointing to the growing importance of Asia as a source of honey. Between the two periods, Asia's volume grew by 135% and South America's by 38%.

Combining domestic and imports provide a complete picture of available honey within the U.S. marketplace that must be utilized and marketed. Within the bars in Figure 4, the lower bars represent domestic production (see Figure 1) and the upper bars are imports. By 2012, total honey available to the U.S. marketplace reached 458 million pounds with imports accounting for approximately 68% of the total. That number is contrasted with 1965 when imports supplied around 5% of the total.

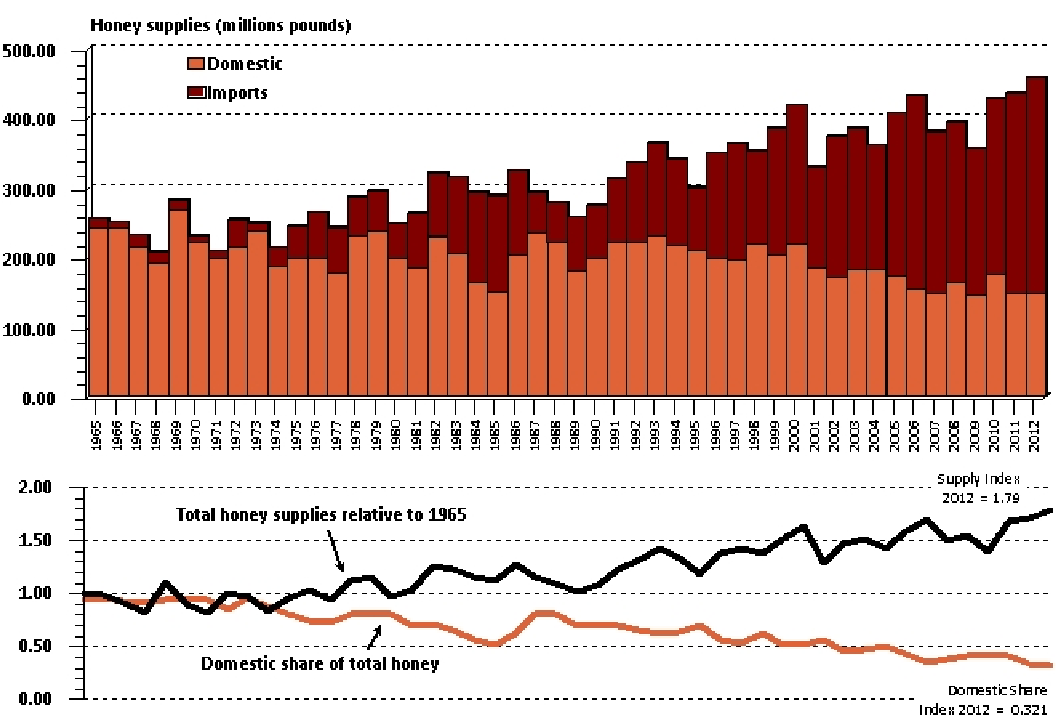

Figure 4. Total honey supplies available to the U.S. marketplace.

Figure 4 best illustrates the combined structural change in the honey industry. Total honey availability has increased by a factor of 1.79 times the 1965 pounds. Yet domestic honey accounted for around 32% of the total by 2012. Even with the U.S. colony collapse and productivity trends, total pounds of honey available to U.S. consumers has increased as a direct result of the growing imports of honey.

Changing Honey Prices and Value

Using the same years as the earlier charts, a second component for exploring demand is having measures of the economic value of honey as reflected with price. Average honey prices are known and even some prices based on the color and market level. As a general rule, all honey prices are highly correlated even with premiums and discounts based on sources and colors. For example, domestic honey has averaged nearly a 43% premium

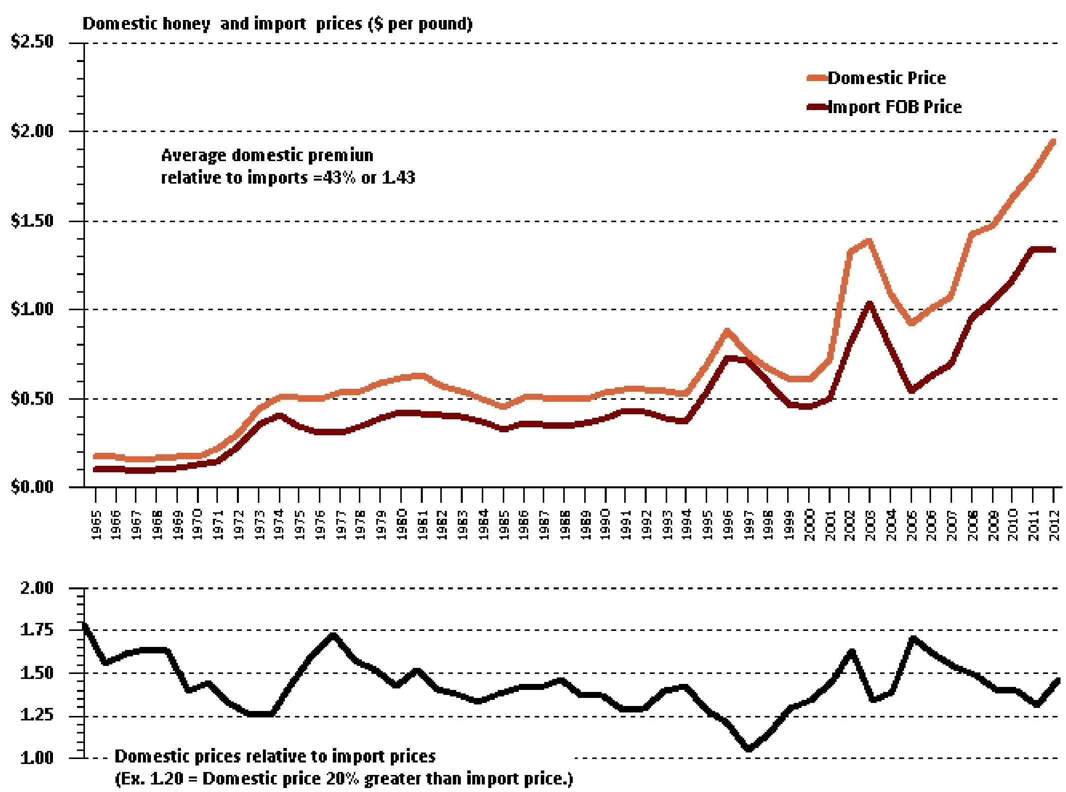

Figure 5. Domestic and import honey prices at the producer and FOB levels.

over imports. Yet the correlation between the two price series is .974.

In Figure 5, both domestic and import prices are plotted and then domestic is expressed relative to the imports. Domestic honey prices have risen from $0.18 per pound to over $1.95 per pound between the 1965 through 2012 years. That is nearly an 11-fold increase in price over the time span. Recall that the domestic supplies declined by a factor of .4 over the same period and total supplies increased as shown in Figure 4. Prices have increased even with the net increase in total honey availability.

Prices are available for some honey colors and sources but comparable quantities are not. Without the volume there is little empirical use for the prices other than the overall prices for honey. That is, it is much more difficult if not impossible to measure demand by color or variety due to incomplete data on production by source.

Figure 6 brings the prices and volumes together to provide an historical measure of the dollar value of the industry over time. The middle chart gives the total value and the lower chart shows the domestic value as a share of the total. As of 2012, the total value of the domestic and imports was calculated to be $702.9 million at the producer and FOB levels. Over the years up to 2005, domestic value exceeded imports and the two were basically the same in 2007 through 2009. After 2010, import values surpassed the domestic value as seen in the upper chart of Figure 6. Note that the domestic value grew even with the major declines in domestic pounds. The strong economic value is all attributed to the major increases in domestic prices since domestic poundage dropped over the years. Similarly, import values grew perceptively along with the price increases and that is what contributed to the import values surpassing the domestic value.

In the lower chart of Figure 6, the domestic share of the total honey value is plotted over the years since 1965. Among all of the previous trends, these shares best depict the underlying structural change where the domestic market has moved from having almost 100% of the economic value to around 41% in 2012. Note in Figure 4, domestic share of the pounds was 32% while the value share is 41%. That difference with the stronger value share is due to the much higher domestic prices presented in Figure 5. Yet even with those stronger prices, the domestic share continued to decline over most of the years shown.

The previous six figures provide the database documenting the available honey to be used for both manufacturing and non-manufacturing purposes. Utilization depends on

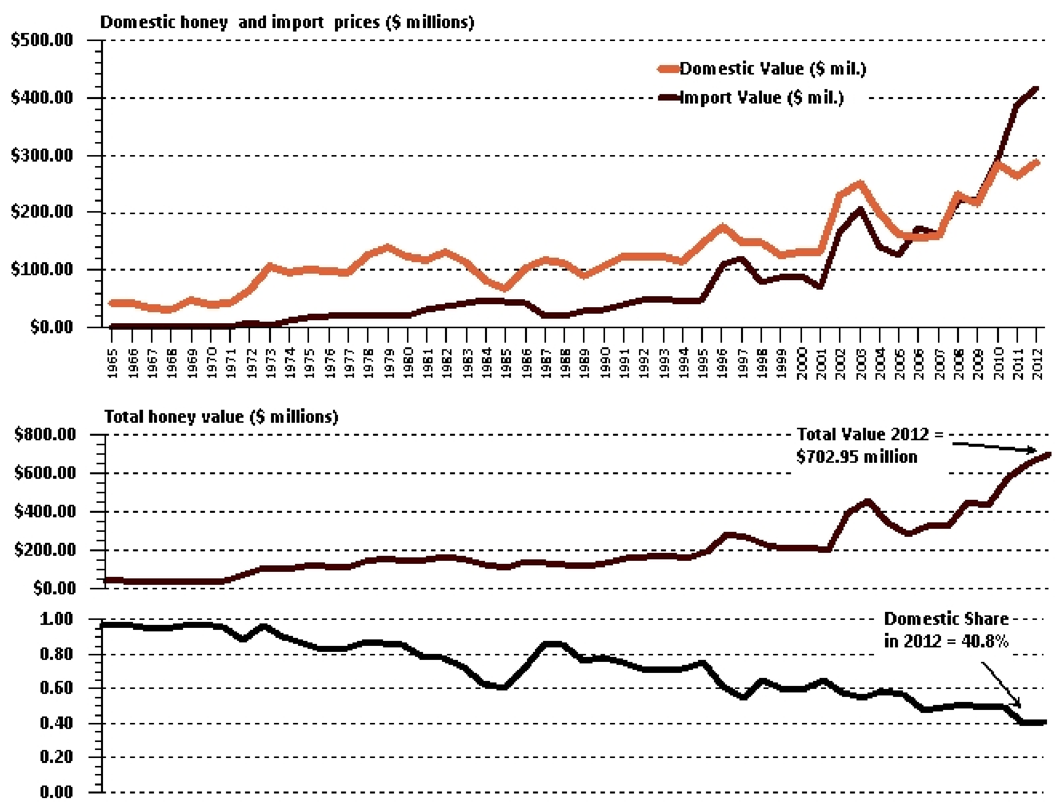

Figure 6. Honey market value for domestic and imports.

the demand for honey in the various consumption sectors (i.e., manufacturing and non-manufacturing). That demand is driven by economic and non-economic factors commonly referred to as the *demand drivers*. One of those drivers is potentially the programs funded by the NHB and, as noted at the outset, is the focus of this report.

Honey Utilization

Honey is used for both direct consumption, with the product clearly identifiable to the consumer, and as ingredients in a wide range of food and non-food products. To trace the utilization, the data are categorized according to manufacturing and non-manufacturing uses. Utilization is clearly far more complex than just these two categories, yet these two broad groupings suffice to capture the essence of the demand for honey. In particular, the non-food uses are small with very limited data on the flow of honey into the manufacturing sector. To gain insight into the utilization, the annual data presented in the previous section are again used. Then another measure of the non-manufacturing sector is shown based on Nielsen retail store audit data. The Nielsen data are more limited in coverage and periods reported but give additional insight into the honey retail market.

Annual Honey Utilization

Utilization totals can differ from the total supplies presented in Figure 4 because in addition to the domestic production and imports there is an inventory of honey existing within the U.S. distribution system at any point in time. Figure 7 shows the utilization between the two groups with the non-manufacturing including table honey, exports and honey stocks. The lower darker bars in Figure 7 are the annual manufacturing uses of honey and the upper bars, the non-manufacturing with the total of the two included in the label values. In 2012, total utilization was 490.88 million pounds compared with the 457.90

million pounds from domestic production and imports from Figure 4. This difference is the honey stocks in 2012 or 32.98 million pounds. Imports are also plotted overlaying the bars.

Growth in utilization is seen and the bottom plot shows that the non-manufacturing share of the honey use generally remained in the 28% to 40% range with the 2012 share being 28.6% and the average being 33.6%. A total of 11.02 billion pounds were used over the 1986 through 2012 period with the non-manufacturing sector totaling 3.69 billion pounds (i.e., the 33.6%). Note in the charts the starting year of 1986 was selected because of USDA not reporting honey stock data in a few prior years.

As already shown, imports accounted for an increasing share of the total honey supplies (see Figure 6) and those imports are plotted in the top portion of Figure 7. While it is nearly impossible to track how imports are used, the general expectation is that the bulk

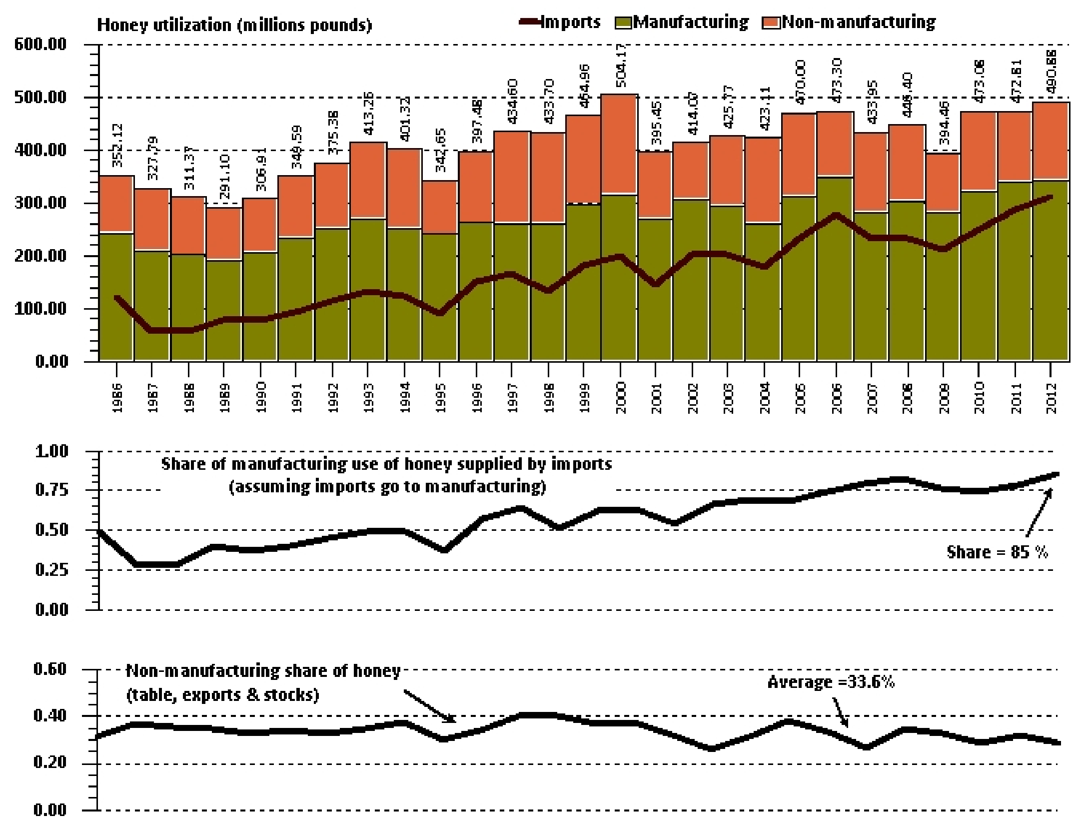

Figure 7. Utilization of honey for manufacturing and non-manufacturing purposes.

of imports goes directly to the manufacturing sector. Accepting that premise, the middle chart in Figure 7 shows the imports as a share of manufacturing with the 2012 value of 85% or 85% of the manufacturing could have been supplied through imports. Again, that is not known for certain since some imports could enter the non-manufacturing part of the distribution chain. Given the significant decline in domestic production and growth in manufacturing use of honey, it must be that an increasing share of the honey for ingredients comes from imports. The 85% for 2012 gives a reference point recognizing that the percentage is an upper level. For later modeling purposes, the source of honey is not as important as knowing the actual utilization of honey for the two distinct food sectors (i.e., ingredients and table use). Later, empirical demand models are estimated based on the distinction set forth the Figure 7.

Non-manufacturing distribution of honey includes the table honey (e.g., commonly founds on the grocery shelves), honey stocks, and exports. The cross section of the non-manufacturing among these three are presented in Figure 8 with the upper portion of the bars accounting for the table honey and the very small middle portion of each bars being the exports. Table honey has averaged around 57% of the non-manufacturing use of honey but in 2012 this percentage increased to nearly 70%. Since 2006, the table use of honey as a share of non-manufacturing has trended upward as illustrated with the lower chart in Figure 8.

Nielsen Retail Honey Store Audits

Since 2008, the NHB has purchased retail store audit honey sales data from A.C. Nielsen, a well-known data service company. Unlike the annual data, these store audits are based on 4-week store audit periods that can be closely matched with calendar months. Hence, the data provide more insight into the use of honey within a year. A major downside is that these data are just a sample of the total retail purchases of honey (non-manufacturing) and are based on sales through retail chains with at least $2 million in annual sales. Even with these limitations, the information is collected consistently and published on a well-defined periodic bases. The data provide another possible way for exploring the non-manufacturing demand for honey at least at the retail outlet level.

While the Nielsen data are 4-week periods, they can be added to give annual totals for 2008, 2009,.., 2012 or some of the years included in the annual data from the previous figures. Within those five years, Nielsen reported 297 million pounds of honey which is equivalent table honey. During the same years, the USDA non-manufacturing honey was 696 million pounds of which 439 million pounds was table honey or 63% of the non-manufacturing use for the 2008-2012 years. Dividing the Nielsen total by the table total

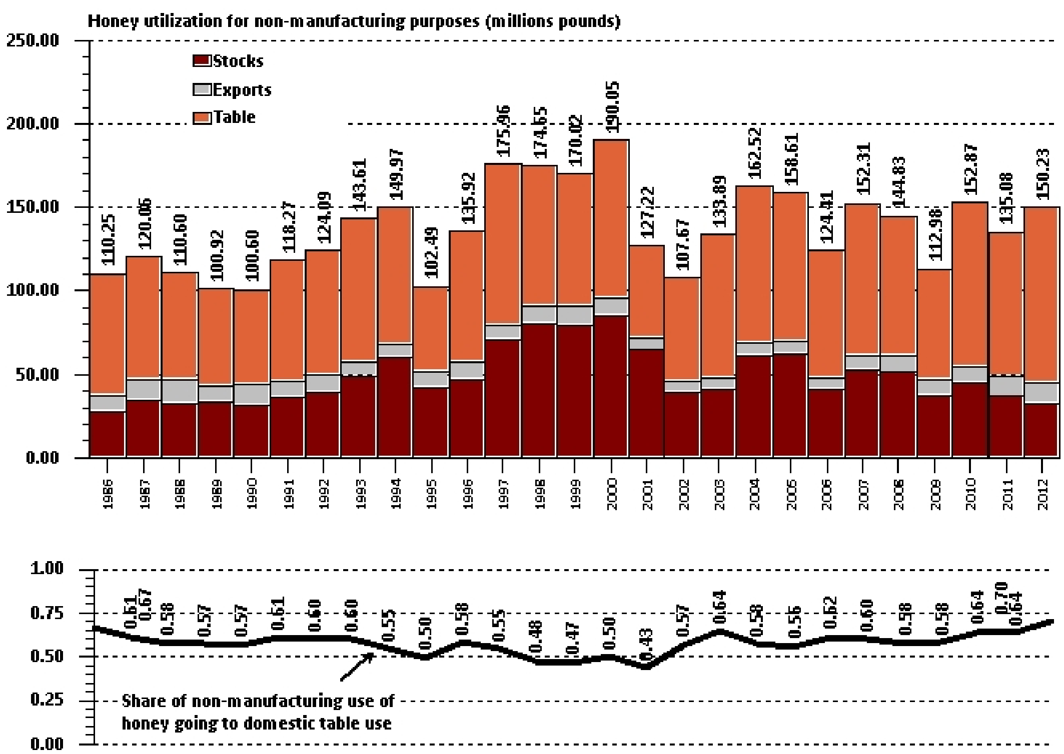

Figure 8. Distribution of honey in the non-manufacturing category.

gives a Nielsen coverage of 68%. That is, the Nielsen large retail store sample captured 68% of the table use honey and that percentage is a general indication of coverage. This coverage factor will be used when drawing inferences from a Nielsen demand model estimated later. The Nielsen coverage is 43% when compared to the total non-manufacturing uses of honey.

Comparing Nielsen with the annual table honey on a year-to-year basis, there is almost no correlation between the two annual values. The same is true when comparing Nielsen with the annual non-manufacturing category. Most likely the annual series of just five years is too short to calculate meaningful correlations. Also, purchases of honey through large supermarkets are likely to show buying habits where repeat shopping experiences occur. Since honey is so storable and stable, purchases of honey in other retail outlets are plausible since one can respond to seeing the product and the risk of purchases should be low. This observation is conjecture but a possible factor contributing to the low correlation between Nielsen and the USDA series. Of course, there can be reporting errors with both series.

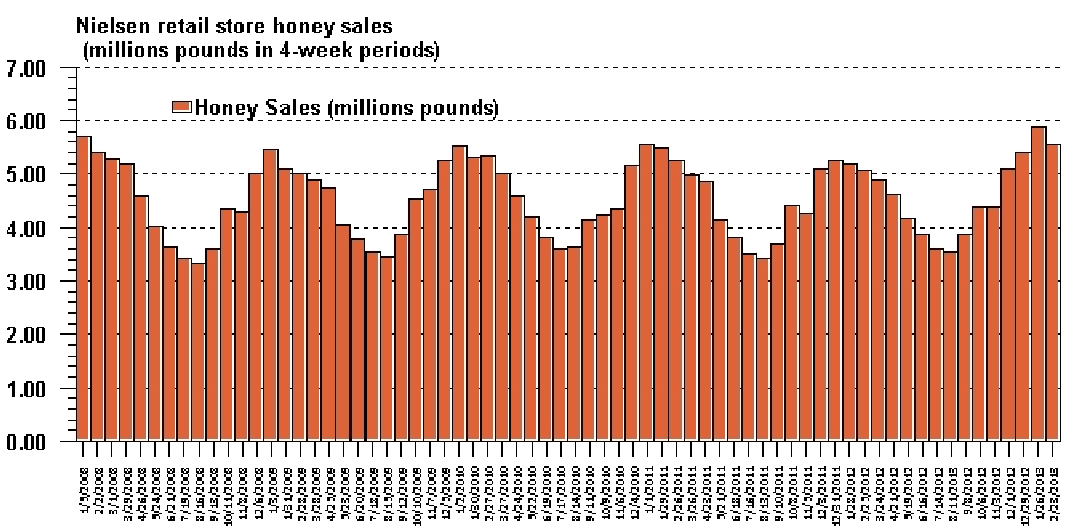

Figure 9. Nielsen reported retail consumption of honey in 4-week periods.

A completely different perspective on honey is seen when viewing honey consumption across the 4-week survey periods. Figure 9 shows major seasonality in the sales that cannot be seen with the annual data. Consumption peaks in the winter months and is lowest in the summer. Later in the demand sections, a model capturing this seasonality is presented where the Nielsen demand factors embedded in the Figure 9 data are estimated.

The National Honey Board (NHB)

Commodity promotion programs have their roots in industries that need to enhance the demand for their product where the product has mostly common attributes among the producers. Promoting the commodity and not the brand (when it exists) has the potential for positively driving total demand and benefits all producers of the commodity. If the benefits are positive and distributed equitably, then those same producers should share in the cost of the programs. The essence of a commodity promotion program through a national or state checkoff program is to setup a system for "getting messages out" about the commodity and having a means for paying for the programs via assessments. The NHB is one such program operating under the National Research and Promotion Act (AMS).

The history of the NHB is best summarized by repeating two short paragraphs taken directly from the NHB website.... (National Honey Board, 2013).

> "The Honey Board began in the mid-1980's when a group of honey producers and other industry representatives got together to discuss a powerful new idea: What would happen if they pooled their resources to work to spread the word about honey? By working together, they theorized, the industry could advertise, conduct research and promote honey in ways that were simply too costly and time-consuming without a cooperative effort. The original National Honey Board was authorized by an Act of Congress and established under the rules and regulations of a subsequent federal Order. The Board began operations in early 1987.
>
> In April of 2008, first handlers and importers of honey and honey products voted to approve a new national honey packers and importers program. The vote was taken

> in a referendum conducted by USDA's Agricultural Marketing Service (AMS). Operations of the previous Honey Board were picked up by this new program and the name National Honey Board was kept. The board is authorized by the Commodity Promotion, Research and Information Act of 1996, and was established under the rules and regulations of the Honey Packers and Importers Research, Promotion, Consumer Education and Industry Information Order that was published in the Federal Register on May 21, 2008. The Board's programs are administered under USDA supervision."

Like most promotion boards, the details of each program are far too complex to summarize in one report and probably not necessary for the broader evaluation of the impact of the programs. As noted above, the NHB was reorganized in 2008 with producers no longer being directly subject to the mandatory assessment. Structurally, the NHB programs remained similar including the administrative and operational oversight. Hence, for evaluation purposes one can treat the periods before and after the reorganization without major concern with fundamental changes in the program content. Analytically, one can test for structural change as will be considered within the honey demand models.

NHB programs can be generally grouped into those presented in Figure 10. While the groups are listed separately, they are all clearly interrelated and essential to the goal of enhancing the quality of honey and demand for honey. The NHB does not buy or sell honey, but the *Honey Locator* on the website is a clearinghouse of information for connecting potential buyers with suppliers. The Honey Locator has a facilitating function and is not an exchange where transactions take place. Given the colony collapse as documented in Figure 1, the NHB has a research arm dedicated to finding ways to maintain the health of honeybee colonies and, hence, quality of honey entering the supply chain. Likewise, research projects designed to find new and improved uses for honey in foods and other products contribute to the overall mission of enhancing the demand for honey.

Industry services and marketing/promotions both entail a wide range of programs to reach consumers and the foodservice sectors, as well as, keep the industry informed about honey uses and market opportunities. In the lower right portion of Figure 10 these types of programs are listed and the interested reader should go directly to the NHB website to see the content. From printed or electronic promotional materials to spokespersons, the marketing programs are designed to reach potential users of honey whether for table or ingredient needs. Figure 10 captures the efforts and the challenge of this report is to determine scientifically if the combined efforts have had a role in shifting the overall demand for honey. An essential step in the evaluation process is having numerical measures

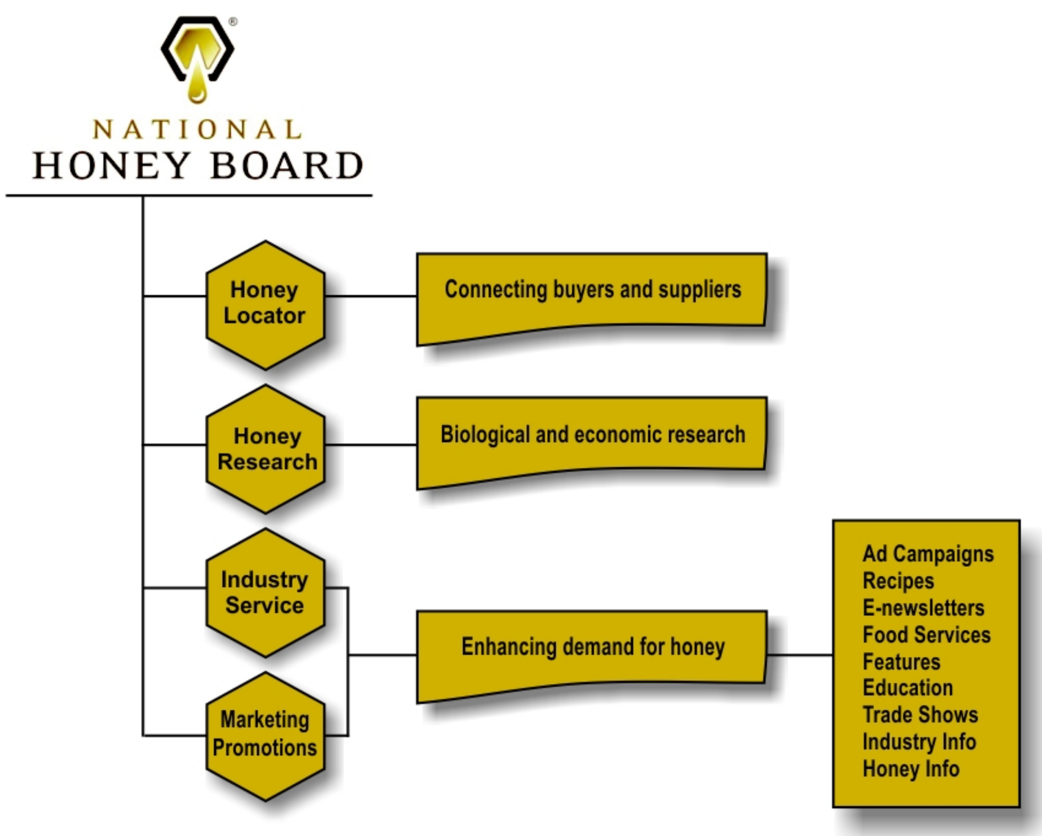

Figure 10. General structure of the National Honey Board programs.

of the NHB program intensity.

NHB Assessments

The current order became effective on May 22, 2008 after honey packers and importers of 250,000 pounds or more per year voted in favor of the program. The assessment rate is $0.01 per pound with packers and importers supplying less than 250,000 pounds of honey per year being exempt from the assessments. Within the rules are provisions for changes in the assessment rate up to a fixed level.

With the new provisions and rates, both the assessments and supplies are known for 2009 through 2012. Note that 2008 is excluded since there was just a partial year under the new program. In Table 1, these data are shown to give an insight into the assessment coverage and one measure of the ability of the NHB to fully capture the pounds subject to the assessment. The distribution of suppliers under 250,000 pounds is not fully documented and this table provides an indirect way to judge the Board's ability to recover assessment where appropriate.

Assessments are on a per-pound basis and the total U.S. production and imports (see

Table 1. Implied assessment coverage since the new NHB programs started.

	2009	2010	2011	2012
Assessments ($.01 per lb.)	$3,345,542.98	$3,769,657.41	$4,043,493.98	$4,247,865.40
Total Honey Production and Imports (1,000 lbs.)	356,946.19	428,065.58	436,046.46	457,980.02
Pounds Subject to Assessments (1,000 lbs.)	334,554.30	376,965.74	404,349.40	424,786.54
Implied Coverage	93.73%	88.06%	92.73%	92.75%

Figure 4) are shown for the years 2009 through 2012. Total assessments were roughly $4.2 million in 2012 and the other levels are seen in the first row of Table 1. Since the assessments for those years was $0.01 per pound, it is a straight forward calculation to determine the equivalent pounds of honey assessed during those four years. For 2012, honey production and imports were 457.98 million pounds while 424.77 million were subject to the assessments. That is, 92.75% of the total honey (excluding stocks) were assessed in 2012. For each of the four years except 2010, the percentage was nearly 93% as shown in the bottom row of Table 1.

Table 1 establishes that the honey checkoff program is applied to the bulk of the honey entering the U.S. supply chain. How much of the remaining 6% to 7% of honey is from smaller suppliers who are exempt is not known given the current public data. At this point, the NHB has been successful with the assessment procedures for the bulk of the honey supply chain recognizing that most of the 6% to 7% noted in Table 1 is probably from exempt honey.

NHB Expenditures

Program expenditures provide the most analytical means for measuring the intensity of the NHB's programs. Variation in those intensities over time is essential in order to statistically measure the impacts with a degree of statistical confidence. Between 1990 and 2012, NHB expenditures have ranged from a low of $2.63 million to a high of $5.05 million in 2007. Over that same period, the Coefficient-of-Variation or CV (e.g., [Standard Deviation]/Average) for total expenditures was 14.4. That simply means the variation in expenditures was reasonably high with zero implying no variation. In turn, that means that it is possible to include this measure of program intensity in later demand models.

Rather than showing the year-to-year changes, in Figure 11 the cumulative NHB efforts are plotted. Through 2012, total HNB expenditures reached $85.54 million with 70% (i.e., $59.97 million) of those funds going to what is broadly defined as market enhancement efforts outlined in Figure 10. Through 2000, that same percentage was 63.6% and in 2012, 67.9% as illustrated in the pie charts at the bottom of Figure 11. That portion of the pie charts labeled "All Other Areas" includes administrative, board meetings, oversight, startup and capital, and reserves. While the expenditures can be grouped into areas with the marketing programs most directed to demand enhancement, all categories in Figure 11 are required for the full operation of the NHB. From 2007 through 2012, the years of the re-structuring of the NHB, direct administrative costs were 10.5% of the total expenditures for those years. That percentage is generally in line with what is seen in other commodity

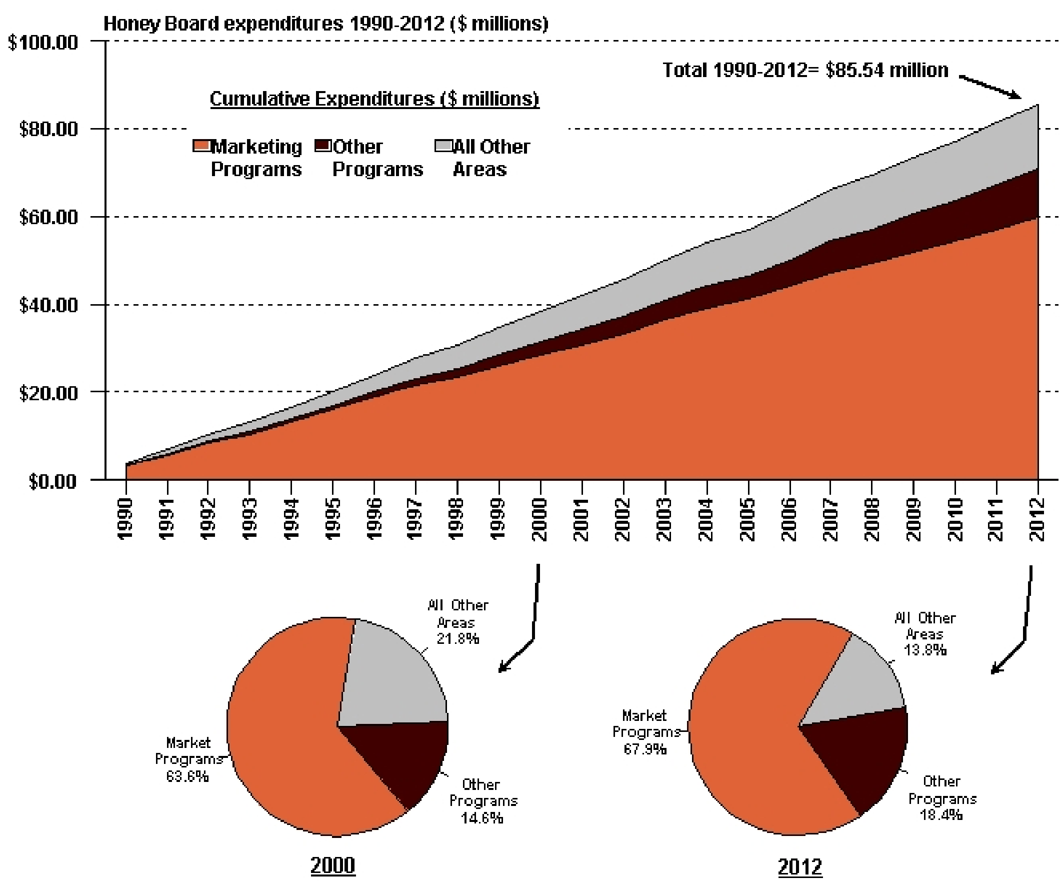

Figure 11. Cumulative expenditures by the National Honey Board since 1990.

boards with similar size budgets. Overall, these cumulative totals provide a clear picture of the efforts of the National Honey Board and includes 23 years of annual data for later modeling purposes.

NHB Website

Websites have become an essential part of almost all commodity promotion programs where there is a direct link with the potential buyer or consumer. As such, the websites must be designed to reach those potential markets. For honey, that includes both the manufacturing and non-manufacturing sectors. The NHB's website has been re-designed since the re-structuring and is rich with information about the honey industry as suggested with the website headers in Figure 12.

Across the top headers are three distinct areas: Honey at Home; Foodservice; and

Figure 12. The National Honey Board website (www.honey.com).

Honey Industry. Within each header there are many divisions providing a wealth of information about the honey industry. From recipes and history, one can find information relating to almost every aspect of the honey industry. While the purpose of this report is to be scientific in evaluating the impacts of the NHB programs, a visual impression of the website is that it gives a good indication of the NHB's efforts to reach the wide audience interested in the honey industry, as well as, providing considerable detail about the science of honey.

The lower portion of the website is unique with the inclusion of the Honey Locator mentioned earlier. It is an interactive tool for locating honey suppliers across the states and by variety or types of honey. Given that honey is produced throughout most of the U.S., this tool appears to be particularly appropriate to the industry.

Figure 12 is included in this report since it does provide a strong qualitative dimension to the overall evaluation of the programs and is a relatively new tool for

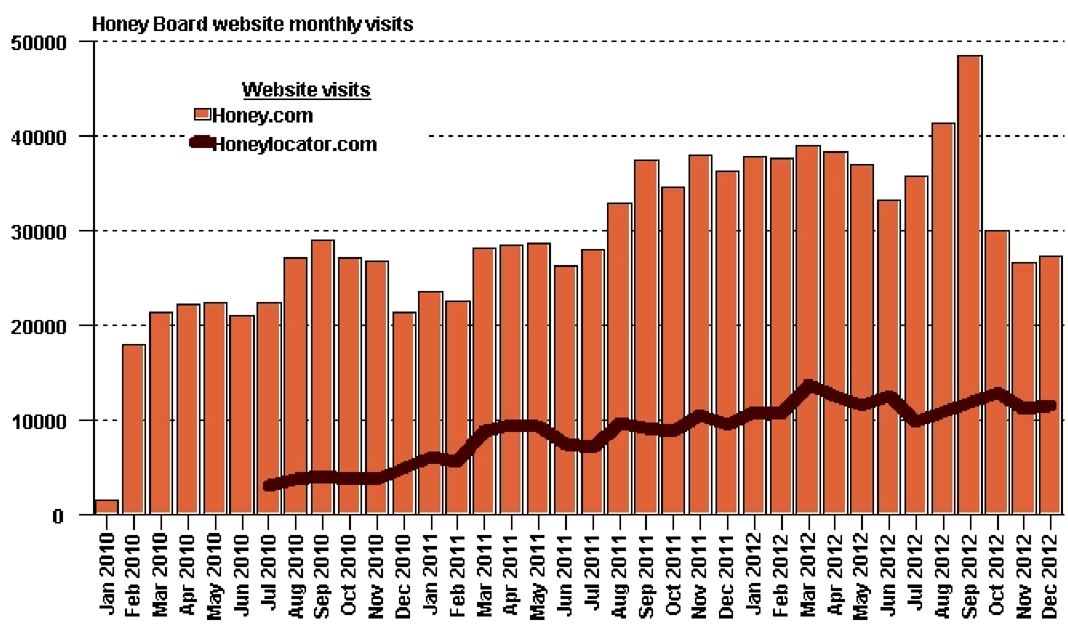

Figure 13. Monthly visits to the National Honey Board website.

enhancing demand. Since the re-designed site is relatively new, the actual website hits were available only since January 2010. Those hits are recorded in Figure 13 with the bars showing the monthly total visits and the line giving the use of the honey locator.

Over those months shown, the average monthly hits were 30,204 and there is a clear upward trend in the visits as well as seasonality in the hits. Similarly, trends are seen with the use of the honey locator. After accounting for the normal seasonality, a simple trend model of the website visits indicates that over the period shown there is a statistically significant positive trend of 431 more hits each month or over a year's time that would point to nearly 5,200 more hits. Even with the positive growth, the total hits drop off with the seasonality and again recover with the peak hits in August and September. This simple model is shown in equation (1) below with Trend being just a number starting with one and increasing by one each model. The t-value on the trend coefficient is 2.79 and the simple model was corrected for serial correlation. Hence, the trend coefficient is statistically different from zero with over a 95% confidence level. All of the other coefficients are just the seasonality measures (see Appendix A).

$$\begin{aligned} NHBWeb = {} & 19512.4 + \{431.08 \times Trend\} - \{715.57 \times Feb\} \\ & + \{2625.27 \times Mar\} + \{2556.03 \times Apr\} + \{1884.71 \times May\} \\ & - \{892.74 \times Jun\} + \{650.69 \times Jul\} + \{5336.61 \times Aug\} \\ & + \{9431.57 \times Sep\} + \{1265.33 \times Oct\} + \{732.58 \times Nov\} \\ & - \{1944.68 \times Dec\} \end{aligned} \tag{1}$$

A website hit does not immediately translate into increases in demand, but does give some insight into a consumer's interest and the potential for increases in demand. It implies a level of usefulness to gain general information as well as connecting with suppliers via the honey locator. Given the previous data and efforts by the NHB, we now turn to actually measuring the demand for honey.

Measuring Honey Demand

Demand is an economic term used by almost everyone and most have an intuitive understanding of the concept. The concept is essential to any market system and change in demand is a driving force leading to the success and failure of any industry. Demand is basically a register of consumer/user buying decisions for a specific price and all of the factors leading up to the purchasing decision. The price/quantity relationship maps movements along a negative sloping line (or curve) and that relationship is typically measured with the elasticity of demand (i.e., a percentage change in price causes a percentage change in quantity in the opposite direction). Price flexibility measures the percentage change in price given a percentage change in quantity. That price/quantity relationship depends on the attributes of that good with some of those attributes being real and some perceptional. For example, honey flavor, sweetness and storability are real attributes. Whether honey is part of the daily diet is a matter of perception, habits and consumer preferences.

Understanding attributes of a commodity is acquired through experience and exposure to information. Information comes in many forms including advertising and promotions. Likewise, perception, habits and preferences evolve through experience and acquired information. If a consumer already has full knowledge of a product's attributes and their perceptions, habits and preferences were absolutely fixed, then there should be little place for major programs to infuse more information in the marketplace.

Potential consumers never have full information; the pool of potential consumers changes with time; innovations in the use of a potential product change; and consumer preferences and habits are subject to randomness and influence. Thus, for most goods, there is always the need for information and messages to help direct buying decisions. In some cases, the message is about the brand while for many foods the message is about the product category. Generic promotion of honey fits within this later group and that is precisely the function of the NHB to impact honey demand via informing potential buyers about honey. The expectation is that such generic programs can enhance the demand for honey for the total industry. As initially documented in Figure 7, honey demand is for both manufacturing and non-manufacturing uses. The expected role of generic promotions should fundamentally differ with these two broadly defined markets (Ward and Boynton).

Specifying the Demand for Honey - Non-Manufacturing (technical)

Figure 14 shows the theoretical demand for the non-manufacturing uses of honey with the honey price on the vertical axis, the pounds of honey on the bottom right axis, and the marketing efforts on the third axis as labeled. Demand in this figure is viewed as a nonlinear surface with a negative slope for the price-pounds coordinates and positive for the price-marketing coordinates. The surface is nonlinear to illustrate the concept that the demand drivers marginal impacts may change across values. From points (a) to (b) represent movements along the demand curve while movement from (a) to (c) gives upward shifts in the demand curve due to the marketing efforts. For supplies or pounds at (q1) and no marketing efforts, honey prices would be at (p). With pounds increased to (q2), then honey prices fall below (p). Similar points can be traced for any three coordinates over the surface. If the surface from (a) to (c) were perfectly flat, that would indicate the marketing efforts had no impact on demand. While the extent of the rise from (a) to (c) indicates the magnitude of the gains attributed to the checkoff marketing programs.

Finally, the surface is drawn in a particular location across the three axes. Those coordinates are for a given set of other demand drivers. For example, potentially if income were increased, one would expect the entire surface to rise. Other demand drivers could have the reverse effect pushing the surface down. Using this concept, the empirical counterpart is to statistically estimate the precise coordinates. Only with the estimates can one definitively show if the honey programs have had a meaningful impact on honey demand.

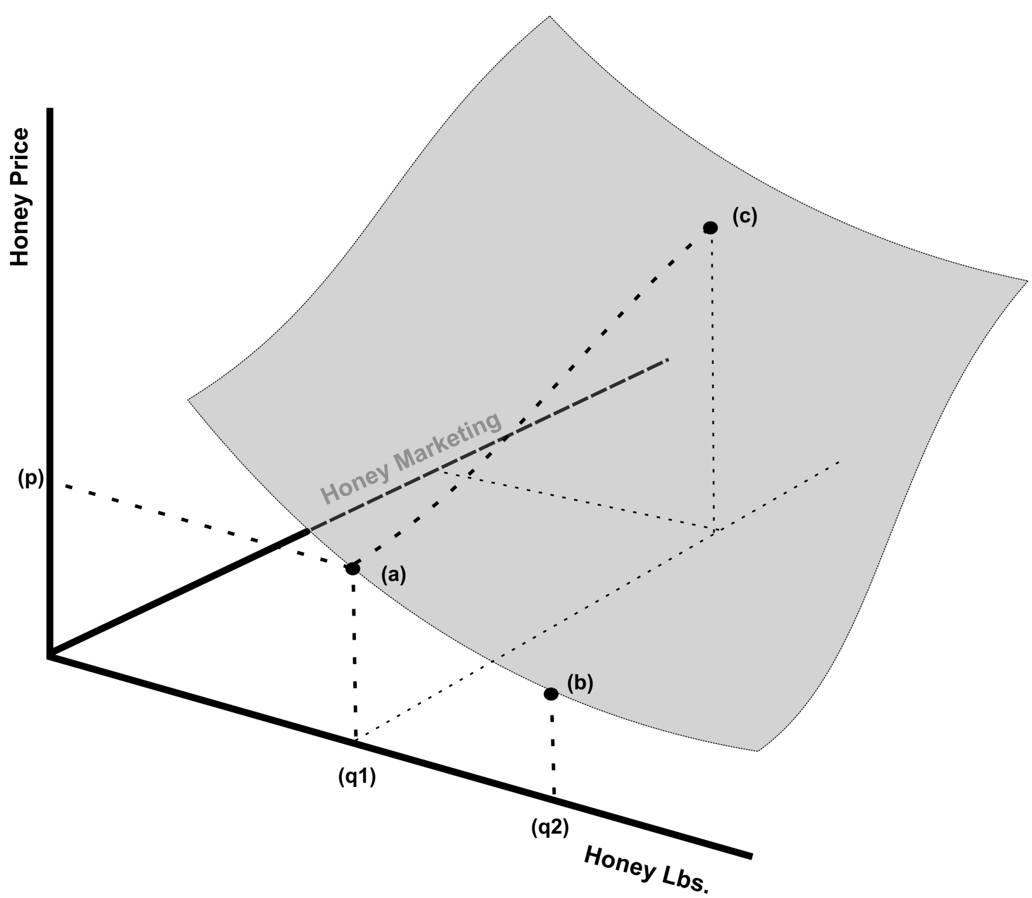

Figure 14. Non-manufacturing honey demand concept.

Using the variables defined below, equation (2) provides one mathematical representation of the demand surface in Figure 14. Let:

PDOM	=	Producer level honey price per pound ($/lb.)
QDOM	=	U.S. domestic honey production (mil. lbs.)
QIMP	=	U.S. honey imports (mil. lbs.)
QSTK	=	U.S. honey stocks in storage (mil. lbs.)
QEXP	=	U.S. honey exports (mil. lbs.)
DPI	=	U.S. disposable personal income ($ billions)
SUPPORT	=	Historical honey price support ($/lb.)
HBPRG	=	National Honey Board program expenditures ($ mils.)

QSUP= (QDOM+QSTK+QIMP)= Total U.S. supplies (mil. lbs.)
QDOK= QDOM+QSTK = Total U.S. domestic supplies (mil. lbs.)
QDKE= QDOM+QSTK-QEXP = U.S. domestic supplies net of exports (mil. lbs.)

All data are recorded in annual increments noted with a t subscript. Since domestically within the same year supplies are basically fixed (e.g., you cannot immediately add new colonies), the domestic honey price is a function of those supplies and the other demand drivers. Furthermore, the expectation is that domestic conditions drive the price and not the imports because most of the imports flow to the manufacturing sector. While those issues have been explored analytically, equation (2) provides an alternative to represent the non-manufacturing demand for honey within the U.S. marketplace.

The NHB's programs within a year are captured with $HBPRG_t$. Given that the expenditures are for the full year and that by design the programs should have a longer term impact, it is also reasonable to expect that the efforts at least from the previous year have some impact on the current year demand. That is, $HBPRG_{t-1}$ should be considered in the demand equation. Other drivers will be discussed in the estimation section and, for now, the model corresponding to Figure 14 is reflected in equation (2).

$$PDOM_t = \left(QDKE_t^{\beta_1}\right)\left(\frac{PDI_t}{CPI_t}\right)^{\beta_2}\left(\exp^{\beta_0+\beta_3 SUPPORT_t+\beta_4(\delta HBPRG_t+(1-\delta)HBPRG_{t-1})}\right)$$

$$\begin{aligned}\log(PDOM_t) = \beta_0 + \beta_1 \log(QDKE_t) + \beta_2 \log(PDI_t/CPI_t) + \beta_3 SUPPORT_t \\ + \beta_4\left(\delta HBPRG_t + (1-\delta)HBPRG_{t-1}\right)\end{aligned} \quad \textbf{(2)}$$

Equation (2) must be estimated to see the statistical importance of each variable, as well as, determining how much of the variations in prices have been explained. The price flexibility is noted with β_1 and the income effect with β_2. There are two coefficients associated with the impact of the NHB programs. If β_4 is statistically not different from zero, then the conclusion is that the programs have not had a measurable impact on honey demand. If β_4 is positive and statistically significant, the model is used to determine the magnitude of the impact and ultimately the returns from the generic programs. Note the δ term within the NHB variable. If $\delta=1$ the full impact of the program is in the same year and if $\delta=0$ all of the impact would be from the previous year's NHB programs. The expectation is that $0<\delta<1$ implying a degree of impact in the current year but with some carryover effect from the previous year. Estimations of both δ and β_4 are major components to the evaluation of the NHB effectiveness to enhance the demand for non-manufacturing uses of honey.

Specifying the Demand for Honey - Manufacturing (technical)

Honey is an ingredient in many foods and frequently the visual identity of honey may be lost in the process. For many consumer foods such as cereals, the word honey may be visible on the packaging even though it is often a sweetener ingredient. For the bulk of the manufacturing use, it is an ingredient source of a natural sweetener mostly in the baking industry. There is a strong positive correlation between the baking industry and the demand for sugars for manufacturing. For example, the correlation between the use of sugar for manufacturing and flour production is .92. The pounds per capita of natural sugar used in baking has averaged 74.81 pounds per capita; high fructose corn syrup, 36.53 pounds; glucose, 13.72 pounds; dextrose, 3.67 pounds; and syrups, .50 pounds per capita. In contrast, for the same period, honey was .95 pounds per capita for manufacturing. Honey accounts for 0.72% for the total sweeteners used in the manufacturing sector. Honey is an extremely small component of the sweetener market for manufacturing and the demand for honey for manufacturing is driven by what happens in the baking industry. Growth in the baking industry can be expressed with the proxy variable of sugar since the two are so strongly correlated. If the manufacturing use of honey is tied to the baking industry then the manufacturing demand for honey should be linked to the use of natural sugar in manufacturing, since sugar use and baking are so highly correlated.

In Figure 15, the concept of linking manufacturing demand for honey directly to the the use of sugar for baking is drawn. On the box x axis is the use of sugar for baking and the vertical axis, the use of honey for manufacturing. At point s0 there is very low demand for sugar and no demand for honey as an ingredient. As the demand for natural sugar increases, so should the demand for honey for manufacturing. With no generic promotions and the use of s1 pounds of sugar for manufacturing, the honey level is expected to be h0 in Figure 15 (see point (a)). With the promotions, the honey level would be slightly above h0.

Movement from (a) to (b) reflects the increase in honey demand as overall food manufacturing increases as measured with the sugar proxy. Again, with no generic promotions, honey increases from (h0) to (h1) with the use of more sugar from (s1) to (s2). Now suppose there were effective generic promotions programs and sugar is at (s2). Honey demand theoretical could be at (h2) instead of (h1) and the difference (h2)-(h1) represents the gains attributed to the generic efforts or the NHB efforts. At this point, we only know the concept and, hence, need the empirical estimates to determine if (h2)-(h1) is positive and statistically different from zero. Just like for the non-manufacturing demand, a mathematical counterpart to Figure 15 is needed.

Honey for manufacturing is defined in millions of pounds (QMFG) and the use of sugar (QSWT) in the same units. As set forth in the relationship above, QMFG is some function of QSWT with QSWT directly related to food manufacturing production, hence, the demand for sweeteners. Equation (3) captures a possible representation of Figure 15.

$$QMFG_t = \lambda_0 + \lambda_1 \log(QSWT_t) + \lambda_2 \left(\log(QSWT_t) \times HBPRG_{t-1}^{\eta}\right) + \lambda_3 \log(QSWT_t) \times \left(1 \Big/ \sqrt{((t <= 2007) + (t > 2007)(t - 2007))} \right) \quad \textbf{(3)}$$

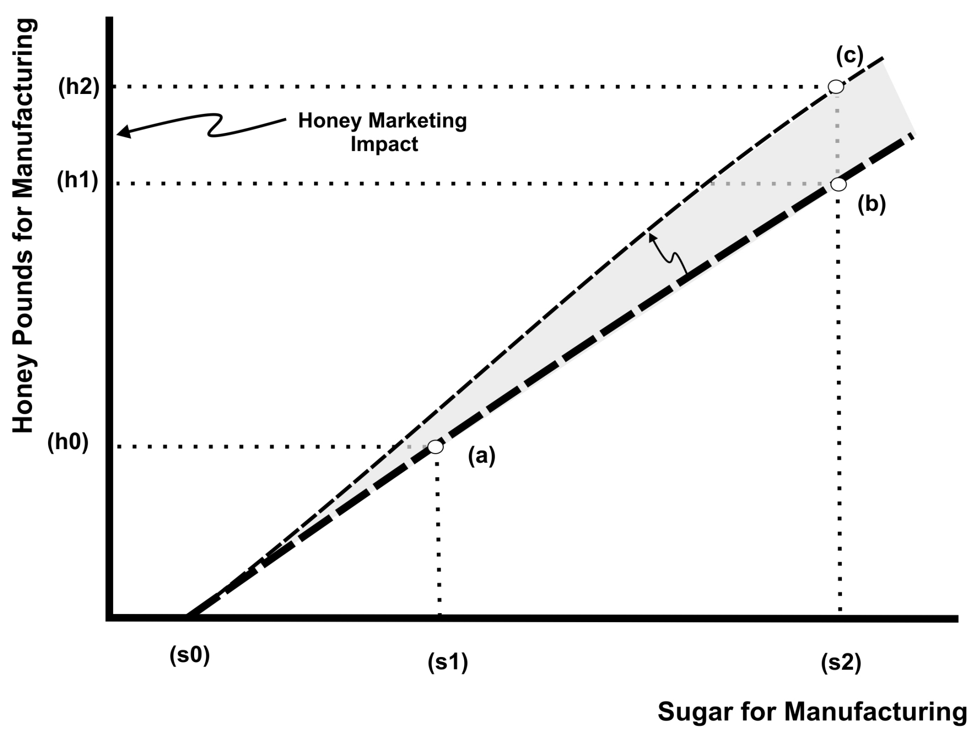

Figure 15. Manufacturing demand for honey.

All values in the right-hand side of equation (3) are related to QSWT or equivalently the slope of the relationship between honey and sugar use depends on the estimated values λ_1, λ_2, and λ_3. The far right term in equation (3) will be used later to account for possible changes in the slope of the relationship related to structural changes not attributed to the NHB programs. Whereas, λ_2 is a measure of the possible effect of the NHB programs on the honey-sugar slope. The η symbol associated with HBPRG is simply a way to allow for marginal changes in the effectiveness of the NHB programs on the use of honey for manufacturing. Most important to the evaluation is λ_2, for if λ_2=0 the generic programs have no measurable impact on the use of honey for manufacturing. With λ_2>0 implies a shift upward in the slope (i.e., the gray area) in Figure 15. The extent of that gain depends on the statistical estimates of λ_2. Finally, λ_1 is the slope along the coordinates (honey, sugar) from (s0) to point (b). Both λ_2 and λ_3 are showing the amount of deviation from λ_1. While both the figure and equation are technical concepts, they are absolutely essential to measuring the NHB ability to shift the manufacturing demand for honey.

Reference back to Figure 6, around 2007 the imports equaled or exceeded domestic production. Likewise, most of the imports likely go to manufacturing although the flow cannot be precisely measured as noted in earlier discussion. Yet the expectation is that there may have been potential changes in the use of honey for manufacturing starting in that period that is separate from the NHB programs. The right part of equation (3) is a theoretical way to measure that potential structural change in the relationship and is relatively simple once the notation is clear. For notational convenience T is the annual year and if T≤2007 it is one, otherwise it is zero. Next, for the second term in the far right part of equation (3) is (T>2007)×(T-2007). If T>2007 it is one, otherwise zero, then multiplied by T-2007. The net effect is that the series up to 2007 is one and after 2007 the series take the values two, three, four, five, and six. The square root of the series just makes it nonlinear. If λ_1 and λ_3 are known, the slope becomes $\lambda_1+\lambda_3 \times \{ (T\leq 2007) + (T>2007)\times(T-2007)\}^{-.5}$. If λ_3 is not equal to zero, there has been a structural shift in the relationship between honey for manufacturing and the sugar proxy for food manufacturing starting around the assumed year 2007. Again, that year is selected because of the evidence in Figure 6. If a structural change occurred and is not modeled, it might be possible that the change could be attributed to the NHB when in fact it is due to other factors changing over time. This potential shift is included to make sure that any gains attributed to the NHB are not overstated.

Estimation of the Honey Demand Models

Equations (2) and (3) estimates are reported in this section along with the statistical properties for both models. Well accepted econometric procedures are used to estimate the models (Greene, 2003; Gujarati, 2003). Table 2 includes the estimates for both the manufacturing and non-manufacturing demand models (i.e., equations (2) and (3)).

Honey Demand Model Estimates

Table 2 provides the statistical values for the coefficients set forth in equations (2) and (3). The notation column corresponds exactly to those included in the equations and the next column gives the empirical values. For the non-manufacturing model, the direct relationship between honey prices and pounds is shown with β_1=- 1.3060 (i.e., β_1 is the price flexibility). The estimate is negative as should be the case (see the negative slope in Figure 14) and is statistically highly significant given the t-value=-4.99. If there were very weak substitutes for honey, then the price elasticity is almost the reverse of the flexibility coefficient β_1. In that case, the honey elasticity would be approximately -.765. That is, for each 10% change in honey prices, the pounds demanded change in the opposite direction by 7.65%. Honey is price inelastic but near the upper range of -1.0 or unitary elasticity.

The income effect is positive and statistically significant as is the price support measure. Most important to the current goal of measuring the impact of the NHB programs is the value of β_4 and δ. The likelihood values ultimately pointed to δ=.60, thus, indicating that around 60% of the promotion effect is realized within the same year and 40% is a carryover effect from the previous year efforts. β_4 is positive and statistically significant with a 95% confidence level using the appropriate one tail statistic criteria. That is, there

Table 2. Econometric estimates of the honey demand models (see Appendix B).

	Non-Manufacturing Demand (see Equation (2)			
Variable	Notation	Coef	t-value	Statistics
Intercept	β_0	2.1207	1.2930	R^2=.8905
LQDKE	β_1	-1.3060	-4.9902	F=42.7019
SUPPORT	β_2	3.4884	2.38748	Obs=26
DLDPI	β_3	.9597	2.5521	Period=1987-2012
RHBPRG	β_4	.0849	1.86986	DW=1.3683
	δ	.6000		LogLike=13.2315
				σ^2= .0262
	Manufacturing Demand (see Equation (3)			
Intercept	λ_0	-957.4969	-2.6113	R^2=.8056
LNCSWE1	λ_1	123.0237	3.4324	F=59.3989
LHNCSWE1R	λ_2	1.8148	1.8845	Obs=47
DDHB	λ_3	-9.1237	-5.3872	Period=1966-2012
	η	,3800		DW=1.67317
				LogLike=- 211.232
				σ^2= 512.693

is less than a 5% change of a Type I error when concluding that the NHB programs have positively impacted the non-manufacturing demand for honey.

Supporting statistical indicators are included to the right of the estimates with the model explaining 89% of the variation in non-manufacturing honey demand. The F statistic and the Durbin-Watson are all within acceptable ranges. In the next section the performance of the model will be illustrated graphically.

The lower portion of Table 2 gives the estimates for the manufacturing demand for honey as illustrated in Figure 15 and equation (3). First, the direct relationship between honey for manufacturing and use of sugar as the proxy for food manufacturing is clearly seen where λ_1=123.0237 and has a t-value of 3.4224. There is a very strong positive linkage between the use of honey and use of sugar for food manufacturing. Next, λ_2 is the coefficient for linking the NHB programs to the manufacturing demand and that coefficient is positive (i.e., λ_2= 1.8148) and statistically different from zero with a 95% confidence level. Similar to β_4, λ_2 is the essential measure for deriving the numerical impact of the NHB programs on the use of honey as an ingredient. Finally, the supporting statistics to the right of the manufacturing demand are all within acceptable ranges and in all cases the coefficient estimates have the correct theoretical signs.

Using the results in Table 2, the final demand models can be written as shown in equations (4) and (5). While these models can be used for many dimensions for demand analyses, the most important is asking what would have been the demand values with and without the NHB expenditures (e.g., what happens when HBPRG =0)?

$$PDOM_t = \left(QDKE_t^{-1.306}\right)\left(\frac{PDI_t}{CPI_t}\right)^{.9597} \times \left(\exp^{2.121+3.488\,SUPPORT_t+0849(.6\,HBPRG_t+(1-.6)\,HBPRG_{t-1})}\right) \quad \textbf{(4)}$$

$$QMFG_t = -957.497+123.024\log(QSWT_t)+1.815\left(\log(QSWT_t)\times HBPRG_{t-1}^{.38}\right) -9.124\log(QSWT_t)\times\left(\frac{1}{\sqrt{((t<=2007)+(t>2007)(t-2007))}}\right) \quad \textbf{(5)}$$

To repeat from Table 2, the two most important conclusions are that the NHB expenditures have had a measurable impact on honey demand. The magnitude of that impact is set forth in the next several sections. Also note that in equation (5), there definitely was a structural shift starting in the mid-2000's as seen in the last part of the equation with λ_3=-9.1241.

Performance of the Honey Demand Models

There are many dimensions to judging the performance of a model based generally on the statistics presented in Table 2. Coefficients of determination or R^2 are most frequently presented and give a direct measurement of a model's ability to regenerate the data from which it was estimated. Quite obviously, the higher R^2 is preferred as long as the model addresses the pertinent issues and is theoretically plausible. For both models in Table 2, all of the empirical events point to plausible results with the coefficient signs and statistical significance. In the next subsection, both demand models' predictive values are compared to the actual values and then with the estimated demand without the NHB programs.

Estimated Demand With and Without the NHB

The bars in Figure 16 are the actual recorded annual average honey prices for honey going to non-manufacturing use. The prices are plotted since in the table honey demand equations, price is a function of the pounds of honey instead of the reverse (i.e, see equation (2)). As expected from the R^2 of .89 and the upper line estimates for honey prices in Figure 16, the model captures most of the turning points and the positive upper trend in prices. Since 11% of the demand is not explained, one would expect that the mapping between the bars and the red line would not be perfect. The errors or difference between the two is a normal occurrence and given the DW of 1.378, there are no statistical problems with patterns in the residuals across the years (i.e., serial correlation is not a statistical problem). This basically means that the t-values reported in Table 2 for the non-manufacturing estimates can be believed with statistical confidence.

Next, in Figure 16 the honey prices are estimated with the assumption that no NHB

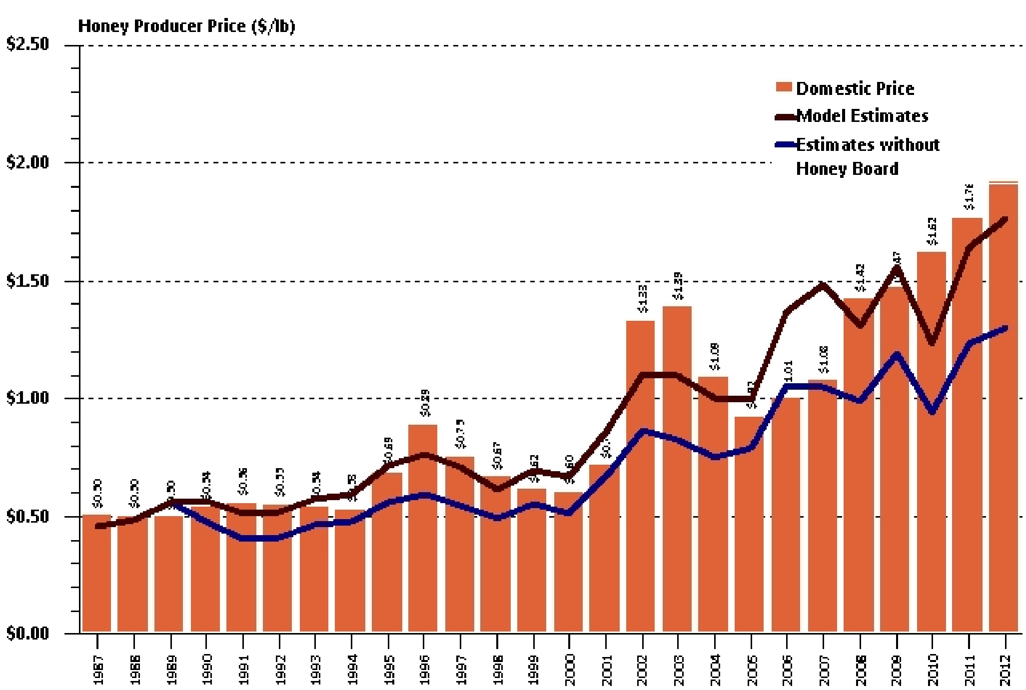

Figure 16. Estimated honey prices for the non-manufacturing use of honey.

programs were in place. Prices are predicted while setting HBPRG to zero. If β_4=0 or the NHB marketing programs were totally ineffective, then the dark red and blue lines would be identical. With the positive value for β_4, the difference seen in Figure 16 between the two lines reflects the full impact of the honey promotions on non-manufacturing honey demand.

Differences between the two depend on the estimated coefficient and the levels of the demand enhancing efforts. From Figure 11, expenditures by the NHB change from year to year, hence, the year to year differences seen in Figure 16 would be expected.

Figure 17 provides a similar plot of the predicted manufacturing demand for honey with and without the NHB programs. For Table 2, the R^2=.80 for the full period from 1965 forward. Note that the manufacturing demand extends back to 1965 while the non-manufacturing started in 1987. That time difference is because some of the stock variables for the non-manufacturing use of honey were not reported prior to 1987. Also, in Figure 17

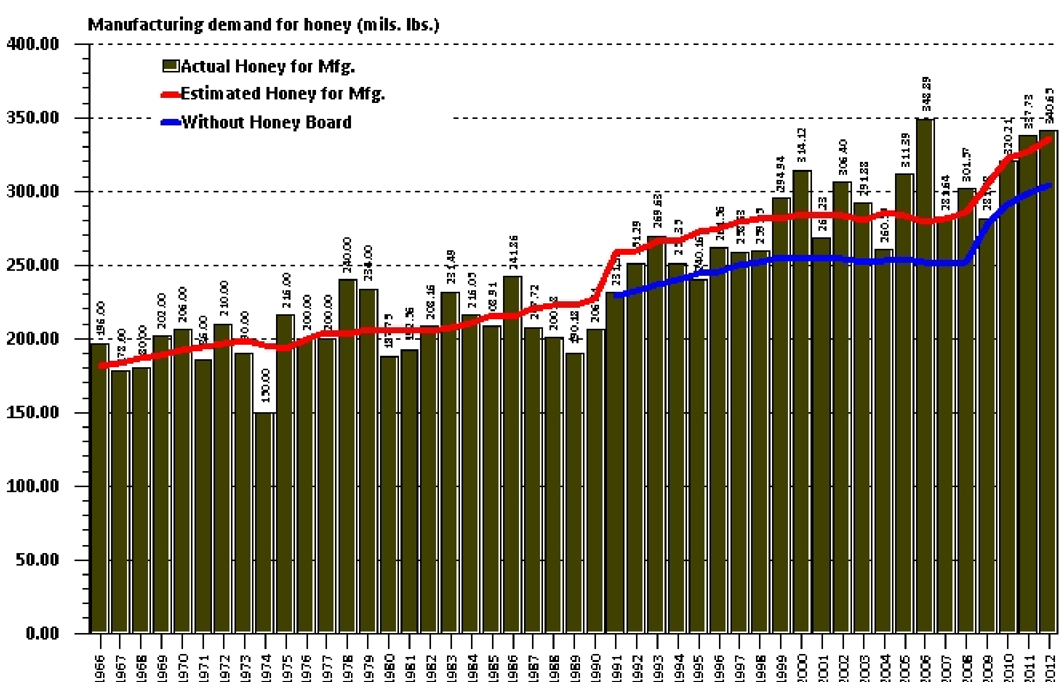

Figure 17. Estimated demand for honey going to manufacturing.

the predicted values (i.e., blue line) start with 1990 or the first fully recorded NHB expenditures. Overall, the manufacturing model performs well in capturing the changes in honey for ingredient purposes. For evaluation purposes, the differences between the predicted with and without the NHB are the essential numbers.

Predicted Economic Value With and Without NHB

Table 3 includes the estimated economic values of both demands for honey starting

Table 3. Estimated dollar value of honey demand according to use.

	Non-Manufacturing ($ mil.)			**Manufacturing Demand ($ mil.)**		
Years	**Actual**	**With NHB**	**Without NHB**	**Actual**	**With NHB**	**Without NHB**
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7
1987	60.392	54.998	54.998	73.950	78.477	78.477
1988	55.298	53.595	53.595	68.665	76.174	76.173
1989	50.259	56.657	56.657	69.224	80.932	80.931
1990	54.021	57.118	47.951	81.127	89.275	89.275
1991	65.757	60.490	47.611	99.875	111.846	98.805
1992	68.249	64.767	50.924	107.163	110.620	99.321
1993	77.406	82.219	66.517	104.020	102.688	91.385
1994	79.183	89.363	71.701	93.075	98.424	89.080
1995	70.206	73.641	57.112	127.738	145.125	129.800
1996	120.697	104.183	80.679	192.327	202.385	180.889
1997	132.325	124.425	96.007	185.800	200.382	179.416
1998	116.787	107.143	85.780	152.224	165.484	148.095
1999	104.660	118.796	93.589	140.028	133.668	121.074
2000	114.627	126.535	97.364	141.642	128.172	114.714
2001	90.937	109.442	85.244	132.572	140.320	125.747
2002	143.174	118.673	93.338	250.369	231.700	208.131
2003	185.704	147.211	110.485	302.398	290.640	261.124
2004	176.818	163.074	122.382	204.455	223.775	198.720
2005	146.233	157.910	125.700	167.783	153.009	136.975
2006	125.027	170.488	131.596	217.105	173.833	157.113
2007	164.039	225.999	160.088	196.813	196.957	175.336
2008	205.800	189.710	142.964	288.014	273.235	240.792
2009	166.418	176.515	134.591	294.547	318.778	289.907
2010	247.497	188.584	143.938	372.566	375.558	339.138
2011	238.410	221.939	166.451	454.616	440.913	402.064
2012	293.098	265.123	195.349	455.803	449.097	406.717
Totals	3,353.036	3,308.611	2,572.624	4,973.899	4,991.467	4,519.211
Gains			735.987			472.256

with 1987. Columns 2 to 4 give the non-manufacturing annual dollar value for actual, estimated and then estimated without the NHB. Columns 5 to 7 give the same for the ingredient uses of honey. Totals at the bottom of the table are for the full period from 1987 through 2012 with all units in millions of dollars.

For the full 26 years, the honey value at the producer/import levels totaled $8.327 billion in economic value and the models predicted $8.300 billion. That is less than a .33% difference when considering the cumulative total. For this total, 40.26% was from non-manufacturing uses of honey and 59.74% for ingredients. The model predictions for the cumulative totals were 39.87% and 60.13%, respectively. Columns 4 and 7 show the predicted economic value without the NHB programs (i.e., assuming the program expenditures were zero). Total gains equaled $1,208 million over the life of the NHB with 60.91% coming from the non-manufacturing demand and 39.08% from the manufacturing uses of honey.

Total gains as a percent of estimated economic value is 14.56%. That is, total economic value of the honey industry at the producer/import levels is an estimated 14.6% greater due to the NHB marketing and promotion programs along with the supporting programs as outlined in Figure 10.

Estimated Return-on-Investment (ROI) to the NHB

Assessments paid to the National Honey Board are earmarked for programs to enhance and support the demand for honey. As such, the funds cannot be used for other purposes or investments unrelated to the mission of the NHB. Assessments paid by handlers and importers are mandatory according to the legislative authority where private funds are channeled into this cooperative effort. Since it is mandatory, there must be assurance that the programs are working effectively for both those paying the assessments and those responsible for oversight of the programs. Oversight is from the NHB Directors and the U.S. Secretary of Agriculture through the AMS-USDA. While oversight includes reviewing the full operations of the NHB and its programs, it also requires the use of analytical tools as already presented in the modeling sections. The most widely used measure of effectiveness is an estimated return-on-investment (ROI) for the total funds used to support the generic programs. Another approach is to estimate the marginal gains associated with incremental increases in the generic expenditures. Both approaches are discussed below.

ROI to the NHB

For the years since 1987, the NHB expenditures totaled \$85.54 million as first documented in Figure 11. Over those years, 83% of the funds were directly supporting programs or 17% went to overhead, oversight, Board meetings, and related facilities. As with all generic programs, the enhancement programs could not exist without the supporting staff and facilities. When estimating the final ROI to the generic programs, any estimated gains must be expressed relative to the full program cost. That is, the gains shown in Table 3 must be expressed relative to the \$85.54 million (again see Figure 11).

Figure 18 presents the final ROI based on both demand models first shown in equations (2) and (3) and the estimates from Table 2. Total gains directly attributed to the NHB were estimated to be \$1,208.24 million over the 1986 to 2012 years. In the right pie chart of Figure 18, non-manufacturing accounted for 60.9% of the gains and the ingredient market, 39.1%. Dividing the total gains by the NHB total expenditures (i.e. \$1,208.24 ÷ \$85.54) gives a ROI of 14.12. On average, for each dollar spent by the NHB, \$14.12 dollars in returns were generated for the honey industry. Subtracting the program costs, a net ROI is 13.12. Between 1987 through 2007, the estimated ROI was 13.87 and now for the full periods through 2012, the same ROI is 14.12. That is a slight numerical increase over the earlier analyses (Ward, 2008). When compared to many other generic promotion programs, the ROI for NHB is on the upper side of the scale.

Simulating Gains Across NHB Expenditure Levels

Building on Table 3, Figure 19 shows the incremental changes in the industry dollar value over a range of NHB simulated expenditures for the full 1987-2012 period. That is, what is the estimated total value if the NHB dollars were some percentage of the actual? To the far left on the horizontal axis, the 0% simply means the elimination of the programs or zero expenditures. The vertical bars for that percentage correspond exactly to columns (4) and (7) in Table 3. In the lower part of Figure 19 and for the zero percentage, total industry estimated value would have been 14.56% less than with the NHB programs. In direct contrast, if the programs were 50% greater than the historical or actual expenditures, the

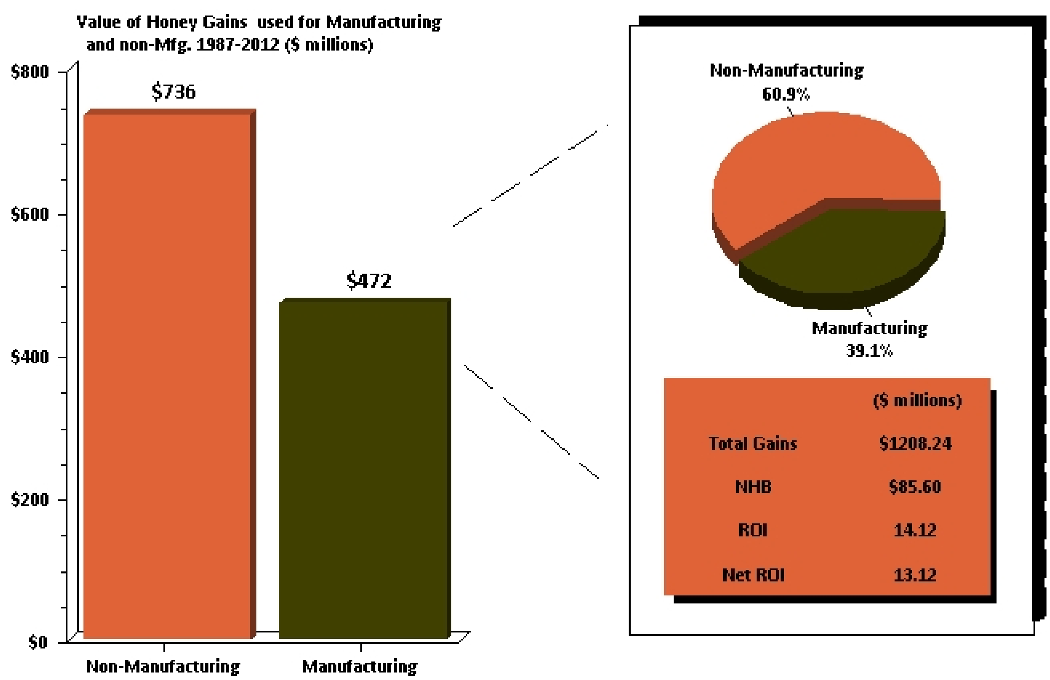

Figure 18. Estimated ROI to the National Honey Board (NHB).

figure shows that the total industry value would have been 6.37% above the actual value with the existing board expenditures. In the bottom chart, the responses with 10% incremental changes in NHB expenditures indicate an almost linear positive relationship with those changes. A 100% reduction causes a 14.46% decline in value and a 50% increase leads to around a 6.37% increase. The base expenditures were $85.54 million from 1990 through 2012 and a 50% increase implies an additional $42.77 million. That same increase would have generated an additional $528.78 million in producer/import level value. That is equivalent to a ROI of 12.36 associated with the additional program dollars. With the 100% reduction in the NHB programs as discussed earlier, the value loss in Figure 19 is $1.208 billion or going from zero to the actual (100%) NHB expenditures produced the ROI of 14.12 presented in Figure 18.

Using the above principal, one can estimate the same concept for a specific year or any future year as long as the other demand drivers are known. For illustration purposes, the same calculations are completed just for 2012, the most current period in the analyses.

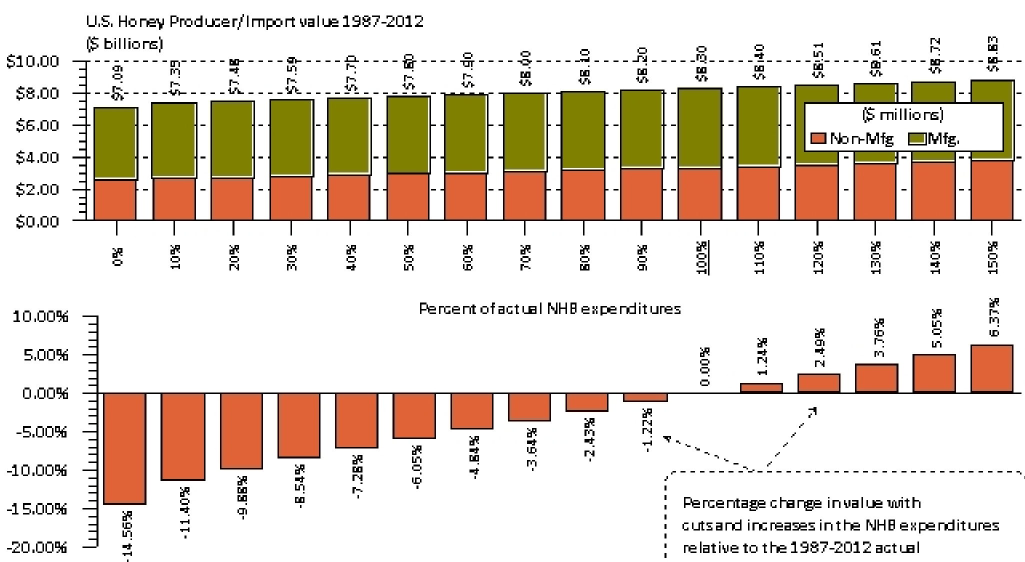

Figure 19. Estimated percentage change in honey value with adjustments in the NHB expenditures based on the 1987-2012 full period.

Simulating Honey Demand for 2012

Honey demand will depend on the demand drivers for each year and the non-linear nature of the demand models shown. Also, the ROI presented in Figure 18 is over the full dataset from 1987 through 2012. Actual year-to-year responses will differ since for each year one may be on a different point on the promotion response curve. The promotion impact coefficients are known from Table 2, yet the marginal responses to the NHB can differ since the dollar value depends on the market conditions and level of NHB expenditures. To explore this further, the demand for non-manufacturing uses of honey are simulated for the conditions in 2012 except for changing the level of NHB expenditures. In the following figure, first a honey demand curve is shown based on the actual promotion levels in 2012 and then with a 50% increase in those expenditures for the same year.

Define domestic demand as the quantity produced domestically (QDOM) plus stocks (QSTK) less net imports (QMFG-QIMP). That quantity in millions of pounds of honey is plotted on the bottom axis of Figure 20. In 2012, this quantity stood at 150.3 million pounds of honey for non-manufacturing uses and the producer price was $1.77 per pound of honey (i.e., see the coordinates ($1.77, 150.2) at the intersection (a) in Figure 20). That is the starting point with the area under those coordinates giving a total value of approximately $265.1 million (see Table 3, Col. 3 for 2012). All points along the curve from (a) represent movements along the honey demand curve for 2012. If honey prices increased to $2.00 in 2012, the model indicates that table honey demand would drop to near 135 million pounds. Similarly, if prices dropped to near $1.00 per pound, honey demand would increase to very near 200 million pounds. The response along this lower demand curve is based on the price flexibility estimated to be -1.30 from Table 2. The response also implies a price elasticity near -.77 or the honey market is price inelastic. Inelastic demands simply mean that revenues rise with rising prices and fall with falling prices. Or price flexibility means that a small drop in quantities causes proportionally larger increases in price and, thus, increases in total revenues.

Now with point (a) as the starting point for the conditions in 2012, what does the model show if the NHB expenditures were increased by 50% while assuming the same type of programs used in 2012? The total expenditures in 2012 were $4.08 million so a 50% increase is near $2.0 million additional program dollars for the year. Using the positive

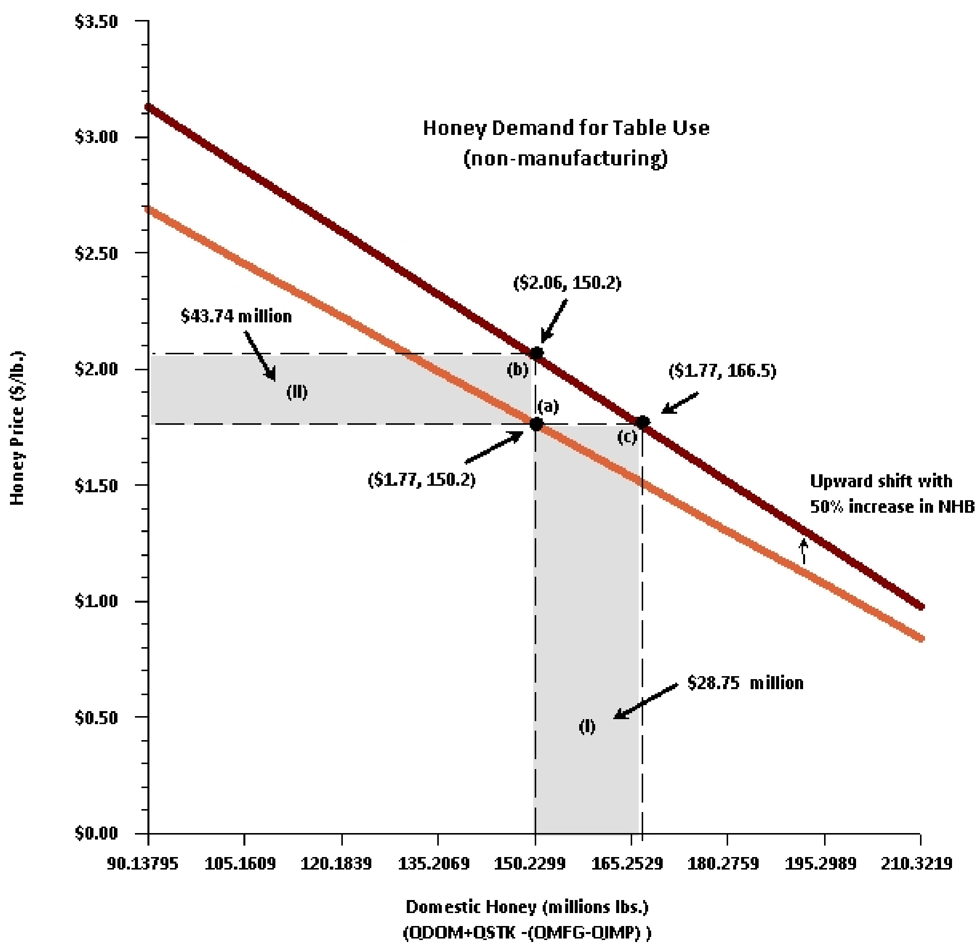

Figure 20. Estimated table use honey demand for 2012 with increases in the promotion programs.

promotion response estimated with β_4 in Table 2, the demand curve for 2012 shifts upward as plotted with the top demand curve in Figure 20. For the same quantity, the new estimated honey price is $2.06 per pound or the coordinates at point (b). If prices stayed the same and quantities increased instead, the coordinates would be at point (c) with the quantities increasing to 166.5 million pounds. This shift in demand associated with a 50% increase in program dollars either created an additional $28.75 million if prices stayed the same or $43.74 million if quantities stayed the same. Quite obvious, the marginal gains for this specific year depends on the new equilibrium points (b) or (c). In either case, the effectiveness of the additional generic dollars is most apparent since the marginal responses are at least 14 or greater. From (a) to (c) the quantity demanded increases by 10.8% while from (a) to (b) prices increase by 14.2%. The obvious implication of Figure 20 is that increased honey assessments used effectively can be beneficial to the honey industry. Note also, these marginal gains are just for the non-manufacturing part of the demand equation.

Generic promotions of honey have now been shown to impact the use of honey for ingredients (i.e., manufacturing) and the impacts were calculated for the years 1986 through 2012. Much like the table honey demand, the level of impacts depend on the promotion intensity and current market conditions. To illustrate, the conditions for 2012 are used in the same manner adopted above for the table honey demand. Growth in baking increases the demand for honey and the link between honey and sugar used as a proxy for manufacturing needs was clearly established. Using the manufacturing model in Table 2 and equation (3), simulation techniques have been used to illustrate the linkage for 2012.

Figure 21 is the empirical counterpart to the theoretical model first presented in Figure 14. On the bottom axis of Figure 21 are levels of sugar used for manufacturing with 40.359 billion pounds being used in 2012. Point (a) shows, for that level of sugar used, honey totaled 335.6 million pounds. If food manufacturing declined to only 60% of the 2012 level, honey demand would have dropped to 273.3 million pounds or a 18.6% decline in honey for ingredients. Whereas, if sugar use was 40% above the actual, honey would have increased to 376.7 million pounds or a 12.2% increase. Movement along the lower response curve provides the honey industry an empirical tool for gauging the manufacturing demand for honey under various conditions in the baking or food manufacturing industries.

More direct to the impact of the promotions in this sector, Figure 21 shows the increase in manufacturing demand assuming a 50% increase in NHB dollars. Point (a) is the honey demand for the existing NHB dollars. With the 50% increase, the response curve

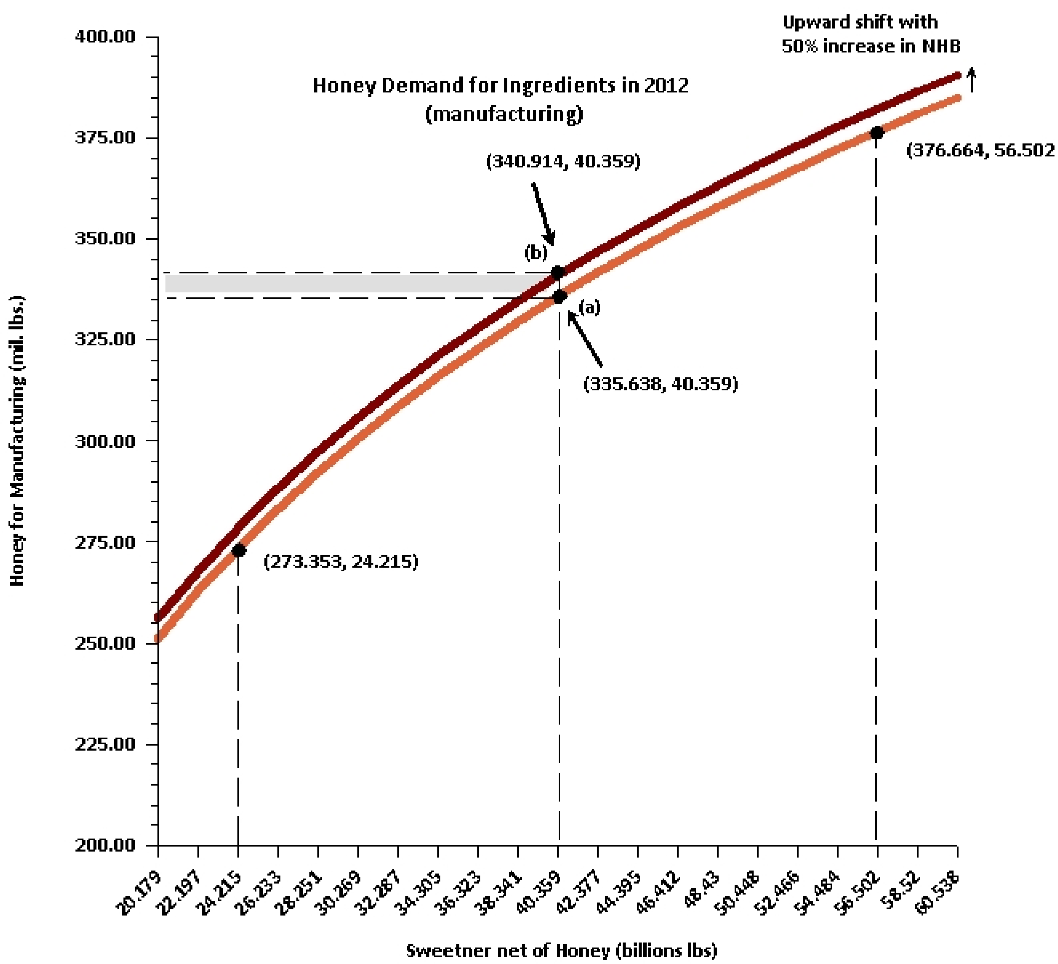

Figure 21. Manufacturing demand for honey as an ingredient.

shifts upward with one point being (b). For the same food manufacturing demand, honey demand increases from 335.639 to 340.914 million pounds or only 5.27 million pounds. The 50% increase in NHB efforts generated only a 1.57% increase in manufacturing demand for honey. While statistically significant, numerically the gain is small relative to that shown for the table honey demand increase somewhere in the range of 10% to 14%. Clearly, for the conditions in 2012 the domestic table use of honey is where the larger gains could be realized.

Extending the Analyses to the Retail Marketplace

All of the analyses up to this point have been based on annual data. Hence, all conclusions regarding the ROI and marginal responses depend on those data. Having an additional independent data source to compare similar demand analyses would be optimal but that is seldom the case. For the honey industry, the Nielsen data first discussed using Figure 9 are the best available alternative to the annual data. Nielsen's store audit honey data are reported every four weeks starting with 2008. That is five years of monthly retail data of table honey recorded within the larger food chains. For statistical analyses, the most limited factor is that even with the monthly periods, the generic promotions data are recorded for the annual periods and matching annual NHB expenditures with monthly Nielsen data is problematic. Also, only five years of data for the NHB are limiting when estimating the promotion response at the retail level.

An alternative to directly incorporating the generic promotions in a retail demand model would be to specify a retail demand model including a trend proxy variable. The intent of a trend is to determine if there is an underlying growth in retail honey demand after removing the price effect and seasonality that is most apparent from Figure 9. In fact, a quick non-statistical view of Figure 9 does not suggest much of a trend if any. If a positive trend exists, then the question is if any of the trend is attributable to the NHB. Below such a demand model is specified and estimated.

Estimated Retail Honey Demand Model

Equation (6) is a specification of the retail table honey where QVOL is the Nielsen retail honey in millions of pounds and PRC is the retail honey price in dollars per pound of honey. ZMT denotes the equivalent months corresponding to the 4-week reporting intervals (e.g., ZMT2= Feb, ZMT3=Mar, ...ZMT12=Dec.). TRN is a continuous trend variable starting with TRN=1 in Jan. 5, 2008. Response to price is estimated with α_1 and to the TRN with γ. Table 4 has these estimated parameters.

Both PRC and TRN carry the expected signs and are statistically highly significant.

Table 4. Estimated table honey retail demand model (see Appendix C).

Variables	Symbols	Coefficients	t-Values
Intercept	α_0	8.45618	6.5072
PRC	α_1	-1.12822	-3.1304
ZMT2	α_2	.858490	17.7063
ZMT3	α_3	.573267	10.9829
ZMT4	α_4	.219332	4.0539
ZMT5	α_5	-.318398	-6.1437
ZMT6	α_6	-.632099	-12.2120
ZMT7	α_7	-.869044	-16.6629
ZMT8	α_8	-.949824	-18.4903
ZMT9	α_9	-.632012	-12.1265
ZMT10	α_{10}	-.108770	-1.9933
ZMT11	α_{11}	.016011	.3028
ZMT12	α_{12}	.770577	15.0473
TR	γ	.015218	3.2610
RHO	ρ	.502777	4.1780
R^2= .973			
DW= 1.95			
Obs=68			

Using the α_1 and the mean levels of QVOL and PRC, the retail price elasticity is -1.002 or a 1% change in honey prices causes a 1% change in honey demanded but in the opposite direction. The price elasticity is for price responses within monthly periods and at the retail level. Earlier, the annual model suggested a price elasticity of -.77 at the producer/import level. With the storable nature of honey, one would expect a more elastic response with monthly compared with annual data. With monthly price changes, consumers may stock up when prices are reduced since the product is storable. Yet for prices from year to year, that same stocking up should be less likely. Seeing elasticities with such similarity adds confidence to the overall modeling efforts. Also, the model explained 97% of the variation in pounds of honey reported through the store surveys. Any serial correlation problems (i.e., ρ=.50) have been corrected using the normal 1st-order auto-regression procedures. The resulting DW=1.95 points to no additional statistical issues with the residuals.

Figure 22 shows how well equation (6) captures the monthly (4-week) movements in retail honey pound sales. The bars are actual Nielsen recorded volumes and the darker line is the model estimates. The seasonality is most apparent but the price and trend effects are confounded within the prediction. However, the model was then used to predict honey demand, but now assuming the TRN stayed at the starting value of one. The prediction is shown with the lower line and the differences between the upper and lower lines are apparent. There is a strong upward trend as estimated with the coefficient in Table 4. Without the empirical model, it was nearly impossible to see that trend since it is far less pronounced than the seasonality effects. Yet the upward trend in honey demand exists within this sector of honey demand. Note that several alternative models were explored and

$$QVOL=\alpha_0+\alpha_1 PRC+\sum_{j=2}^{12}\alpha_j\left(ZMT_j\right)+\gamma TRN+\mu \qquad \textbf{(6)}$$

the results in Table 4 and Figure 22 seem to give the best overall performance. In the next section, the difference between the two lines is used to draw additional inferences about the NHB efforts.

Trends in the Retail Honey Demand

From Figure 22, the two estimated lines of honey sales in pounds include the price changes and seasonality with and without the trend (lower line). Basically, the lower poundage line gives the estimated values by removing the trend. A ratio of the two lines then gives an index of change in demand separate from the price and seasonal effects. That ratio is plotted in Figure 23 and the positive trend is evident (see γ and the t-value in Table 4.) Ratio values differ period to period and reached a nearly 15% growth rate by 2012 relative to the starting period. Between 2008 through early 2013, the retail model reveals

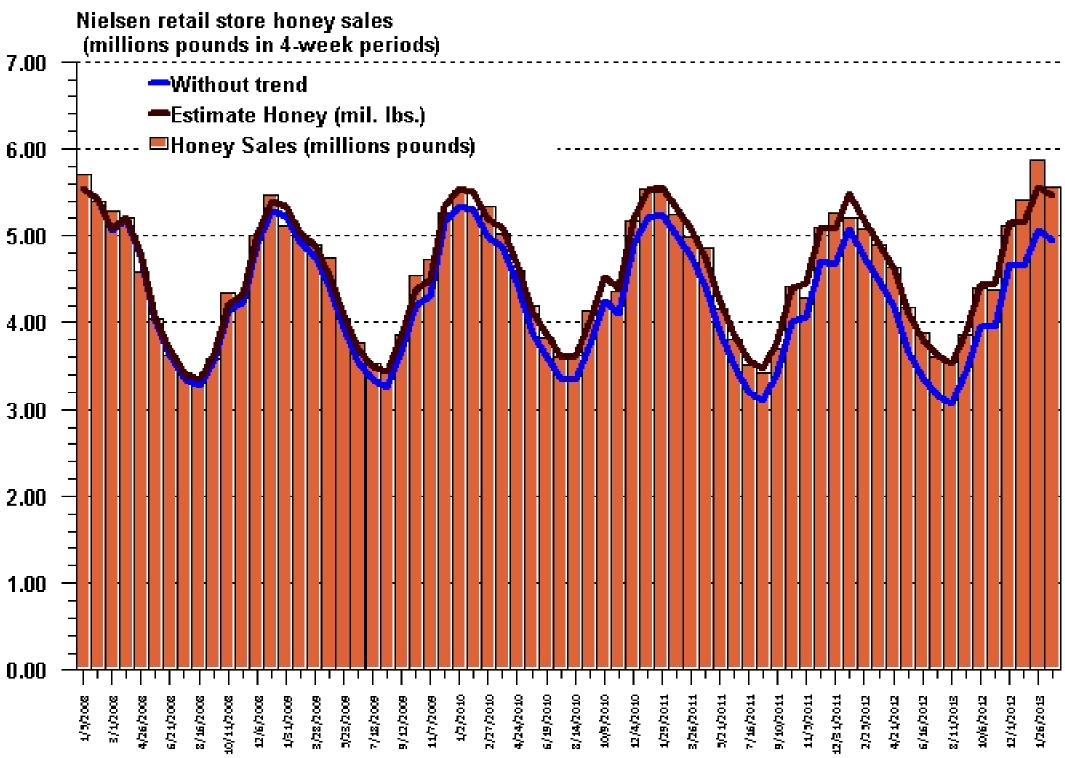

Figure 22. Actual and estimated retail table honey pounds since 2008 for 4-week intervals.

a positive growth but does not directly show what contributed to that growth. One approach to this question could be to ask what would be the gains if all of the growth were attributed to the increases in the NHB programs? We know that the programs have impacted demand from the annual models, so the NHB should have been at least a contributing factor in the trend in Figure 23. For calculation purposes, if all of the growth were attributed to the NHB, the resulting number should be an upper limit since other demand drivers could also contribute to the growth.

Defining $QVOL^T$ and $QVOL^O$ to be the two estimated honey pounds in Figure 22 with the T denoting the trend, then the retail consumer expenditure difference attributed to the trend is $dRETAIL\$ = \sum[(QVOL^T - QVOL^O) \times PRC]$. Nielsen coverage of the table honey market is approximately 66.4% (i.e., Nielsen data captures 66.4% of the total non-

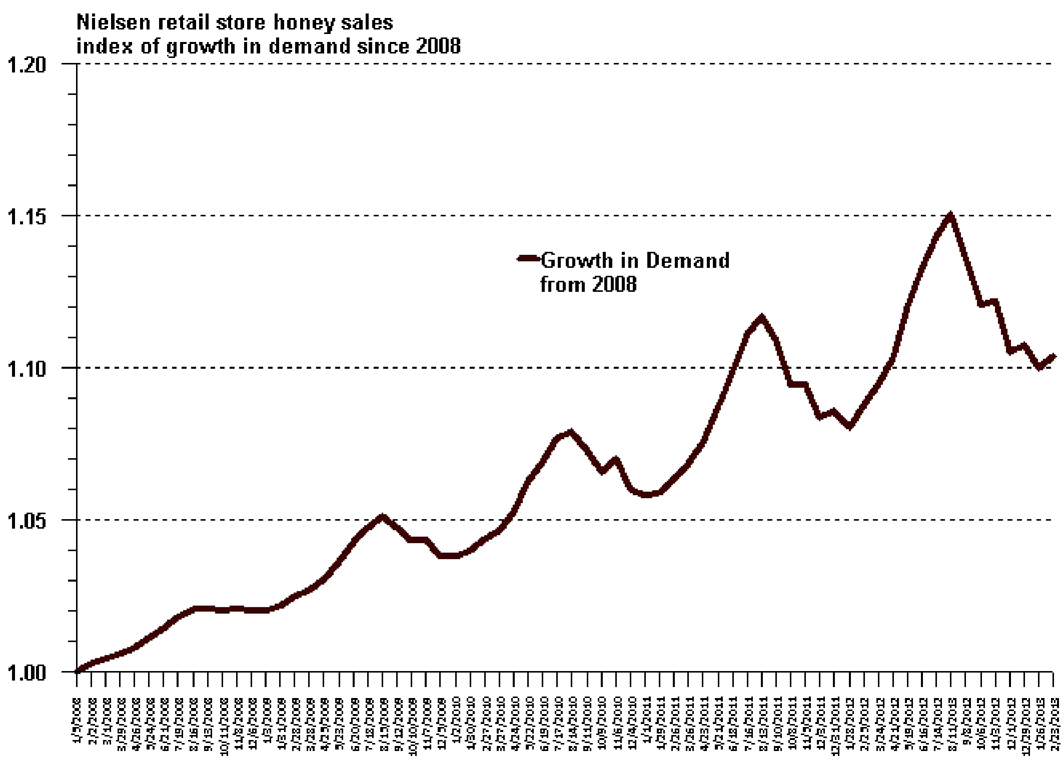

Figure 23. Index of growth in retail honey demand based on Nielsen store audits.

manufacturing pound sales). Similarly, Nielsen retail price average markup from the producer honey price is 77.6% above the average producer honey price or, stated differently, producer prices are 56.3% of the Nielsen reported honey price. These coverage and markup factors are then used to express the dollar gains from the trend effect at the producer level where $dPRODUCER\$ = \sum\{ [(QVOL^{T} - QVOL^{O}) \div .664] \times [PRC \times .563]\}$. dPRODUCER$ represents the total dollar gain in sales at the producer level that is directly attributed to the positive trend in retail honey demand. During that same period, the NHB expenditures increased by $3.63 million.

Figure 24 illustrates these calculations where the two left vertical bars give the retail values in the Nielsen honey sales after applying the coverage factor (i.e., 66.4%). Applying the markup factor, the two right bars show the equivalent dollar values from the trend but

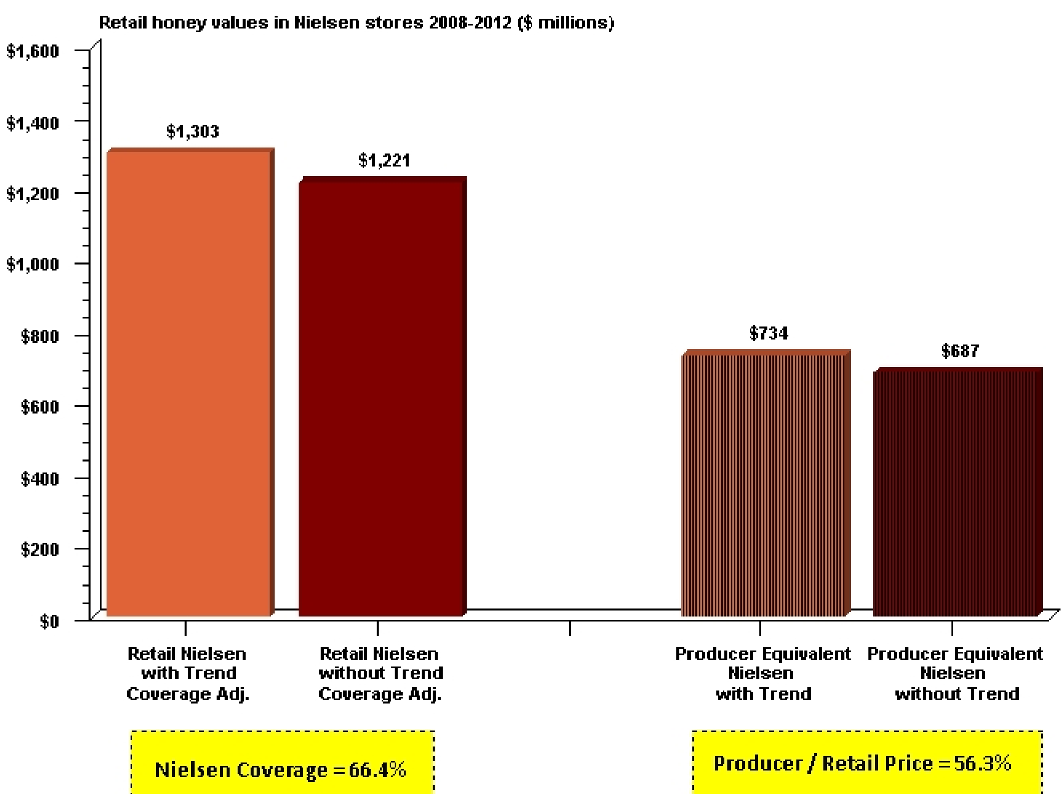

Figure 24. Estimated dollar honey sales from the retail model using Nielsen data.

now expressed at the producer level. All values are for the years 2008 through 2012. Total value at the equivalent producer level is $734.2 million and without the trend, $687.5 million. For comparison for the 2008-2012 period, the annual model pointed to $732.24 million and the Nielsen adjusted, $734.19 million so even from two independent data sources the aggregate values are quite close.

In Figure 24, the gain attributed to the trend, calculated at the producer level, is $46.69 million. With the positive trend the value of table honey would be $46.69 million more at the producer level. During those same periods, the NHB spent an additional $3.63 million more than if the programs had remained at the 2008 level. We know from the annual models that part of the total demand is a result of the NHB efforts. If the NHB programs had remained at the 2008 level, then possibly the volumes from 2008 through 2012 would have been close to the lower (blue) line in Figure 22. The marginal increase in program expenditures was $3.63 million mentioned above. Dividing the marginal gains of $46.69 million by the marginal program costs gives a maximum return-on-investment of 12.85, all based on the Nielsen data. This calculation, of course, assumes that the gains from the trend resulted from the generic promotions and there is no way to statistically verify that link except that the annual model also indicated a statistically significant response to the NHB programs.

At this point, the Nielsen data are still limited in terms of periods covered but the trend model is suggestive of a linkage between the trend gains and the generic promotions. The returns between the two independent methods are in similar positive ranges. It is also important to note that the retail model is just for the table honey for sample stores and the non-manufacturing demand model is for all honey not used for ingredients.

Conclusions

The National Honey Board's slogan conveys the message of the "all natural" attributes of honey. Consumers are generally aware of honey both on the grocery shelf and use in many manufactured foods. Yet awareness does not necessarily translate into greater demand. Unlike some foods, honey does not carry attributes that could be perceived negatively. It is highly storable and has a wide range of uses as a complement to many other foods. These attributes all impact honey demand and, hence, a fundamental question for the National Honey Board (NHB) is its impact on driving the U.S. demand for honey. Measuring that impact was the focus of this report.

Drawing on both annual volume and price data and retail store audit data, demand models were estimated for both manufacturing and non-manufacturing uses of honey. These demands are distinct and required two different approaches to quantifying honey demand and the potential impact of the National Honey Board. From those data and scientific modeling methods, the following major inferences were set forth that specifically relate to the overall effectiveness of the NHB to impact the demand for honey.

General Observations:

- The organizational structure and adherence to the enabling legislation and oversight are in place and fully functional. This is based on reviewing the accounting records (not an audit), meeting schedules, and observance of the board interaction and involvement. Likewise, it is based on the feedback from the NHB staff and review of the volumes of promotional materials.

- Reported use of assessment funds are consistent with most other commodity checkoff programs. Most of the funds are directly used in market enhancement efforts as documented in Figure 11 and the administrative costs are consistent with other commodity boards of similar size

- Actual dollars of assessments are consistent with the reported poundage of honey subject to the assessments based on the records for 2009 through 2012 (see Table 1).

- Hits on the NHB website show a strong growth trend. Based on a simple website visit model, the annual growth of around 5,200 hits per year would be expected. Likewise, the use of the Honey Locator shows a similar growth over the period since the middle of 2010.

Specific Observations:

- Economic demand models for both the manufacturing and non-manufacturing uses of honey are consistent with expected parameter signs and all of the model properties are within normal acceptable ranges.

- The NHB's estimated impact on the demand for non-manufacturing use of honey (table honey) is positive and statistically significant with a 95% confidence level (see Table 2 and Appendix B). Likewise, approximately 60% of the program impact is within the same calendar year and 40% from the previous year programs.

- The NHB's estimated impact on the demand for manufacturing use of honey (ingredients) is positive and statistically significant with a 95% confidence level (see Table 2 and Appendix B). For the manufacturing demand, the full impact is from the previous year's programs. That is, it takes longer for the programs to move the manufacturing demand for honey contrasted with the table use. This is seen in equation (3) with the t-1 subscript in $HBPRG_{t-1}$.

- Both models explain a substantial amount of the variation in demand with the non-manufacturing having 89% explanatory power and the manufacturing model, 80%.

- Over the 1986 through 2012 years, the NHB spent $85.54 million on programs and support to the programs. Using the two demand models, the return-on-investment (ROI) is estimated to be 14.12. That is, for each dollar spent, the gross return at the producer/import level is 14.12 times greater. That ROI is slightly higher than seen in the 2008 results. For the full period, approximately 61% of the gain was realized from the non-manufacturing demand, and 39% from the ingredients market.

- For the 1986 through 2012 years, total producer/import revenues were 14.56% greater directly attributable to the NHB efforts.

- The models were further used to show the marginal changes in revenue with increases (or decreases) in the NHB expenditures. Each 10% rise (or decline) in expenditures causes revenues to rise (or decline) by around +/- 1.2% (see Figure 19).

- The models were further used to show the potential gains from increasing the NHB programs by 50% using the conditions in 2012.

- As a secondary approach to using the annual honey data, a retail month demand model was estimated using Nielsen store audit data. A statistically significant growth trend was estimated in the retail demand. If all of that growth were attributed to the NHB, the implied marginal gain was estimated to near 12.85. While the linkage between the trend and NHB is conjecture, the estimated gain is in a consistent range from those gains shown with the annual models.

The overall conclusion is that the statistical results and scientific models show that the NHB programs have been effective in enhancing the U.S. demand for honey for both the table and ingredient markets and with the stronger impact being in the non-manufacturing honey demand.

References

Agricultural Marketing Service. (2013). "Honey Research, Promotion, and Consumer Information Order." Fruit and Vegetables Programs. Research and Promotion Acts. AMS-USDA. www.ams.usda.gov/fv/rphoney.html.

Greene, William. (2003). *Econometric Analysis*. Prentice Hall. 5th Edition. Upper Saddle River, NJ.

Gujarati, Damodar N. (2003). *Basic Econometrics.* McGraw-Hill/Irwin. 4th Edition. New York, NY.

NASS. (2013). "Table 46--U.S. honey production, imports, exports, stocks, and average price, by calendar year". National Agricultural Statistics Service, USDA, and Bureau of the Census, U.S. Dept. of Commerce. Washington, D.C.

National Honey Board. (2013). "National Honey Board Website." www.honey.com

Nielsen Companies. (2013). "National Honey Board Topline Report Total US Over $2 Million." AC Nielsen Data. New York, NY.

Nielsen Companies. (2013). "National Honey Board - Honey Sales and Growth Trends." AC Nielsen Data. New York, NY.

Ward, Ronald W. (2006). "Commodity Checkoff Programs and Generic Advertising." Choices. 2nd Quarter, 2006. 21(2): 55-60.

Ward, Ronald and Bruce Boynton. (2010). "U.S. Honey Supply Chain: Structural Change, Promotions and the China Connection." Int. J. of System Dynamics. 1(2010):13-25.

Appendix A. Estimated model for the NHB website (see equation (1), page 24).

```
FIRST-ORDER SERIAL CORRELATION OF THE ERROR

 Dependent variable: HONEYCOM
 Current sample:  2010:2 to 2012:12
 Number of observations:  35

Mean of dep. var. = 30203.6
R-squared = .867501
Std. dev. of dep. var. = 7141.53
Adjusted R-squared = .785478
Sum of squared residuals = .229830E+09
Durbin-Watson = 1.68257
Variance of residuals = .109443E+08
Schwarz B.I.C. = 349.572
Std. error of regression = 3308.22
Log likelihood = -324.684
```

Parameter	**Estimate**	**Standard Error**	**t-statistic**	**P-value**
C	19512.4	3702.85	5.26957	[.000]
TRN	431.085	154.440	2.79127	[.005]
MT2	-715.573	1864.21	-.383848	[.701]
MT3	2625.27	2261.42	1.16090	[.246]
MT4	2556.03	2496.65	1.02378	[.306]
MT5	1884.71	2636.83	.714761	[.475]
MT6	-892.745	2711.83	-.329204	[.742]
MT7	650.690	2735.48	.237871	[.812]
MT8	5336.61	2711.98	1.96779	[.049]
MT9	9431.57	2637.63	3.57577	[.000]
MT10	1265.33	2499.68	.506196	[.613]
MT11	732.586	2270.74	.322621	[.747]
MT12	-1944.68	1889.54	-1.02918	[.303]
RHO	.767177	.115257	6.65622	[.000]

Appendix B. Estimated honey demand models (see Table 2, page 34).

Honey Non-manufacturing Demand Model (see equation (4), page 36

Dependent variable: LPDOM
Current sample: 1987 to 2012
Number of observations: 26

Mean of dep. var. = -.173094
LM het. test = 3.72501 [.054]
Std. dev. of dep. var. = .448321
Durbin-Watson = 1.35833 [.003,.223]
Sum of squared residuals = .550137
Jarque-Bera test = .639703 [.726]
Variance of residuals = .026197
Ramsey's RESET2 = .252067E-05 [.999]
Std. error of regression = .161855
F (zero slopes) = 42.7019 [.000]
R-squared = .890515 Schwarz B.I.C. = -5.08625
Adjusted R-squared = .869661 Log likelihood = 13.2315

Variable	Estimated Coefficient	Standard Error	t-statistic	P-value
C	2.12089	1.64024	1.29304	[.210]
LQDKE	-1.30603	.261719	-4.99020	[.000]
SUPPORT	3.48836	1.46117	2.38738	[.026]
DLDPI	.959700	.376040	2.55212	[.019]
RHBPRG	.084935	.045426	1.86976	[.076]
N =.60				

Manufacturing Honey Demand Model (see equation (5), page 36)

Dependent variable: QMFG
Current sample: 1966 to 2012
Number of observations: 47

Mean of dep. var. = 241.755
LM het. test = .181713 [.670]
Std. dev. of dep. var. = 49.6522
Durbin-Watson = 1.67317 [.051,.256]
Sum of squared residuals = 22045.8
Jarque-Bera test = 3.12023 [.210]
Variance of residuals = 512.693
Ramsey's RESET2 = 5.80235 [.020]
Std. error of regression = 22.6427
F (zero slopes) = 59.3989 [.000]
R-squared = .805603 Schwarz B.I.C. = 218.933
Adjusted R-squared = .792040 Log likelihood = -211.232

Variable	Estimated Coefficient	Standard Error	t-statistic	P-value
C	-957.497	366.674	-2.61131	[.012]
LNCSWE1	123.024	35.8419	3.43240	[.001]
LHNCSWE1R	1.81484	.963020	1.88453	[.066]
DDHB	-9.12369	1.69357	-5.38725	[.000]
J = 0.38000				

Appendix C. Estimated model for retail honey demand using Nielsen data (see Table 4, page 49).

```
Dependent variable: VOL
 Current sample:  1 to 68
 Number of observations:  68

Mean of dep. var. = 4.53656
R-squared = .973000
Std. dev. of dep. var. = .714017
Adjusted R-squared = .965868
Sum of squared residuals = .922408
Durbin-Watson = 1.95028
Variance of residuals = .017404
Schwarz B.I.C. = -18.2109
Std. error of regression = .131924
Log likelihood = 49.8572
```

Parameter	**Estimate**	**Standard Error**	**t-statistic**	**P-value**
C	8.45618	1.29951	6.50720	[.000]
PRA	-1.12822	.360402	-3.13045	[.002]
ZMT2	.858490	.048485	17.7063	[.000]
ZMT3	.573267	.052196	10.9829	[.000]
ZMT4	.219332	.054104	4.05393	[.000]
ZMT5	-.318398	.051825	-6.14370	[.000]
ZMT6	-.632099	.051760	-12.2120	[.000]
ZMT7	-.869044	.052154	-16.6629	[.000]
ZMT8	-.949824	.051369	-18.4903	[.000]
ZMT9	-.632012	.052118	-12.1265	[.000]
ZMT10	-.108770	.054566	-1.99337	[.046]
ZMT11	.016011	.052871	.302835	[.762]
ZMT12	.770577	.051210	15.0473	[.000]
TR	.015218	.466673E-02	3.26103	[.001]
RHO	.502777	.120339	4.17801	[.000]

```
 Standard Errors computed from analytic second derivatives (Newton)

 ELAST = -1.00174
```