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U.S. Honey Supply Chain: Structural Change, Promotions and the China Connection

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Among almost all natural food goods, honey is probably one of the most unique in terms of its production history and importance. It is often a by-product from the primary function of pollination by bees. Honey color and flavor is directly related to the types of plants being pollinated. For some agricultural products, honey has limited economic value beyond the food source for the bees, while for others, such as citrus, the value of the honey is much greater since the flavor, texture, and color yields highly desirable honey attributes. Bee pollination is essential to almost every sector of agriculture. For some agriculture goods, beekeepers recoup their returns through payment for the pollination services. When the pollination leads to desirable honey varieties, the value of the honey serves as the indirect payment for pollination services. Hence, the economic viability of the honey market is an essential element for supporting the bee colonies needed for pollination. A weak honey market should directly affect beekeepers' abilities to provide essential pollination services to all agriculture sectors. Efforts to enhance the demand for honey clearly have implications far beyond just the value of the honey since the cost of pollination would be significantly higher if it were not for the sales of honey.

From a demand perspective, honey is particularly interesting in that it is easily recognized and consumed for what is usually referred to as "table use." Yet a substantial portion of honey supplies goes directly into food manufacturing as ingredients where sometimes the presence of honey is not readily apparent, depending on the food product. Often the honey used as an ingredient is highly visible such as honey cereals, honey coated candies or sweets, or even honey coated peanuts. Demand for honey in these forms may be more related to the demand for the processed food where honey is just one of many ingredients or additives. Whereas, bottled or packaged honey is usually displayed and presented in forms where the honey is the only good or, at least, the primary product being sold. Most often in supermarkets, separate sections are allocated to just honey in various containers where the color and texture can be seen and the flower variety labeled. There are several recognizable brands of honey as well as honey identified by country-of-origin. Combined, all of the varieties, brands, and packaging lead to an aggregate demand for honey. Likewise, all of the demands for honey as ingredients lead to the manufacturing demand for honey.

Beyond the table and manufacturing uses, honey is readily storable for extended periods but at a cost and possibly some changes in color and other attributes. For decades the United States (U.S.) federal government subsidized the industry by becoming an alternative buyer and placing the honey in storage or distributing the honey into noncommercial channels. Hence, any effort to measure honey demand must account for those programs by the federal government. Unlike the government purchases, the honey promotion. Unlike the government purchases, the honey promotion programs are intended to influence the commercial markets for honey by enhancing the aggregate demand for honey.

Honey Supplies

Domestic supplies depend on the number of bee colonies at any point in time as well as honey yield per colony. In Figure 1 annual numbers and colony yields are shown over an extended period from 1965 through 2006. Most apparent is the change with the number of bee colonies trending downward over most of the years and dramatically starting in the mid-80's. In the more recent years, mites and viruses have been major contributors to the decline in colonies. Yet over the same period, the productivity per colony has shown substantial improvement. Over the 40-year period domestic bee colonies have been cut in half from a high of 4.6 million to 2.4 million colonies in 2006. Since 2000, the numbers have been between 2.4 to 2.5 million colonies. Over the same period, colony yields increased from an average of around 48 pounds per colony prior to 1985 to 72 pounds per colony since 1985. Since 2000 the general yield has remained fairly stable near the 72 pounds level. Statistically the relative variation in the number of colonies compared with the yield variations is nearly the same (i.e., the Coefficient of Variations (CV) is .22 for colonies and .23 for yields). That simply means that the change in total supplies is not just due to one of the two measures.

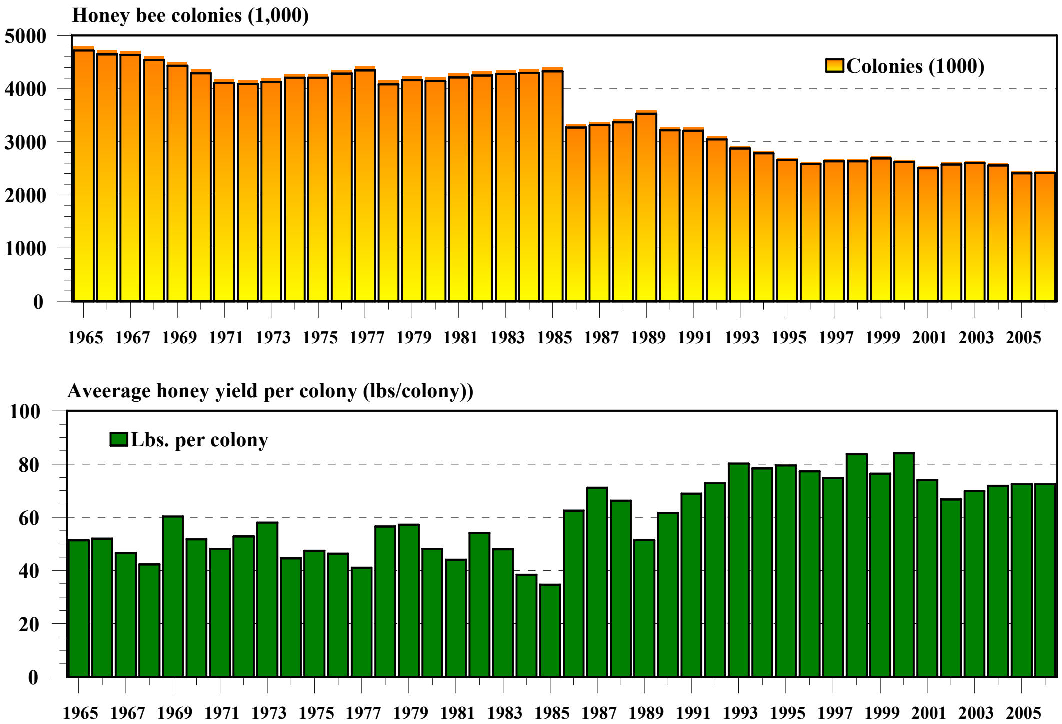

Figure 1. Average honey yield per colony (lbs/colony)

The colonies time the yield provide the domestic production as plotted in Figure 2 with the domestic honey supplies expressed in millions of pounds of all varieties. While there is year to year positive and negative changes, the overall trend in the U.S. bee industry points to a declining level of domestic honey production. Peak production occurred in 1969 with almost 267 million pounds to approximately 175 million pounds in 2006 giving nearly a 35 percent drop in domestic production over the four decades. Again, since 2000 the total domestic production has been more stable remaining near the 175 to 180 million pounds level. Honey is produced throughout the U.S. with California (13.7%), North Dakota (12.6%), South Dakota (9.6%), Florida (9.4%), Minnesota (5.9%), Montana (4.7%), and Texas (4.0%) generally accounting for nearly 60 percent of the supplies. The percentages by each state represent an average share of the U.S. production over the last decade and show that production is not concentrated in one or two states even though the seven states combined account for a substantial share of the domestic production. This geographical distribution is important in that any enhancements in demand attributed to generic promotions should benefit producers throughout the country since the state with the largest market share is less than 14 percent. This should be equally true for any public policy impacts.

Import Honey Supplies

Probably the most significant change in the U.S. honey market is seen with the growth of imports with most of the foreign produced honey coming from China. As early as 1965 imports existed in small levels but continued to increase each year until by 2006 imports accounted for nearly 60 percent of the available supplies. By 2000 imports surpassed domestic production as shown in Figure 2. While domestic production continued to decline as noted earlier, with the growth in imports total availability of honey in the U.S. domestic market consistently increased over most of the years shown in Figure 2. By 2006, total honey supplies exceeded 452 million pounds representing the maximum available honey supplies over the four decades. Since the late 80's the trend toward imports having an increasing share of the U.S. market has been evident.

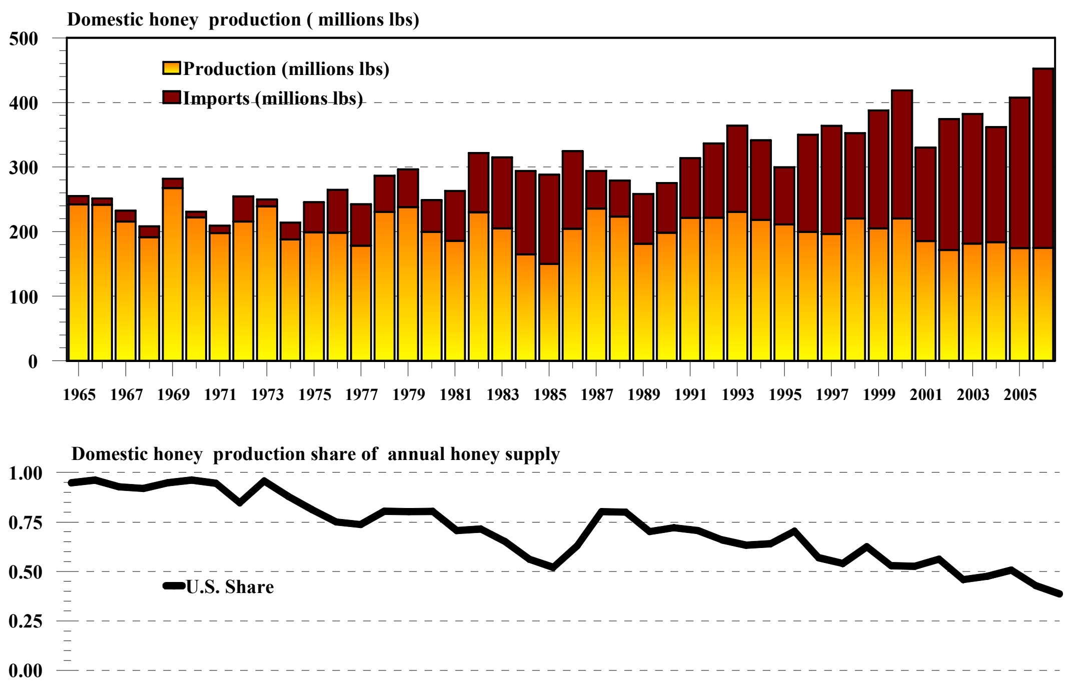

Figure 2. Domestic production and imports of honey (million lbs)

By 2006 the U.S. population reached 298 million people compared with 196 million in 1966. On average over the entire database since 1966, the average per capita consumption of honey for all uses equaled 1.23 pounds per capita. For the years starting with 2000, per capita consumption averaged 1.34 pounds per capita thus showing an increase in the consumption of honey in all forms. Hence, when honey utilization is expressed on a per capita basis the growth in available stocks is not as profound as suggested with the production statistics in Figure 2. Whether the total is used or the per capita numbers, the most important observation is with the growth in imports.

While not shown in the figure, there is considerable month to month variation in imports. Yet since honey is storable from month to month, imports on a monthly basis were of less importance to later demand analyses. Also, as will be discussed later, all of the demand modeling will be based on annual data using the honey stocks reported in Figure 2. In addition to the production and imports, in any one season there is usually 60 to 80 million pounds of honey in storage that can be drawn into the marketplace.

Annual farm equivalent value of honey has ranged from less than $50 million in 1965 to more than $333 million in 2006. While domestically produced honey has declined, the total farm value of domestically produced honey generally trended upward over the years since the mid-60's. Likewise, import honey value increased to the point that the import value exceeded the domestic value in 2006. Up until the last few years, almost 70 percent of the total honey value was from domestic stocks. Starting in the late 90's, each honey source contributed close to 50 percent of the total honey value. Substantial gains in domestic honey prices more than offset the decline in domestic honey stocks.

Honey prices have generally increased throughout the study period, reaching historical highs in 2004 with domestic honey selling for $1.39 per pound and imported honey selling for $1.04 per pound. From Figure 2 we know that total honey supplies increased during those same years. If all other market conditions had remained fixed, rising stocks should have depressed honey prices. Yet, honey prices increased during those exact periods when total stocks, primarily from imports, increased. Given the usual negative relationship between prices and quantities, other factors must have positively impacted the honey market for both prices and total quantities to have increased.

Honey demand is profoundly influenced by use in food manufacturing compared with non-manufacturing consumption (or what is referred to as "table honey"). Likewise, the varieties of honey, especially by color, influence whether it enters directly into the consumer marketplace versus food manufacturing. Available data allow separating honey used for manufacturing and non-manufacturing but do not facilitate separating the honey supplies by color and variety in a consistent way over time. Hence, all demand analyses are limited to the two use categories of food manufacturing and non-manufacturing. Adding existing stocks in storage to annual domestic production and imports gives the total supply of honey available each year. From this total, the two uses are recorded as shown in Figure 3. The expectation is that most of the imported honey goes to the manufacturing sector while recognizing that the data do not reveal a precise measure of that utilization.

Figure 3 shows the two uses of honey with the total including domestic production, imports, and current storage. Over the complete time period, honey used for food manufacturing has accounted for between 60 to 80 percent of the total honey stocks. Since the mid-90's the non-manufacturing use (or table honey) equaled around 35 percent of the total honey supplies as shown in the lower portion of Figure 3. In general, there are year to year changes in the utilization but no strong trend toward more or less share of the honey going to one sector or the other. Honey moves between the two sectors depending on the underlying demand for honey in each market.

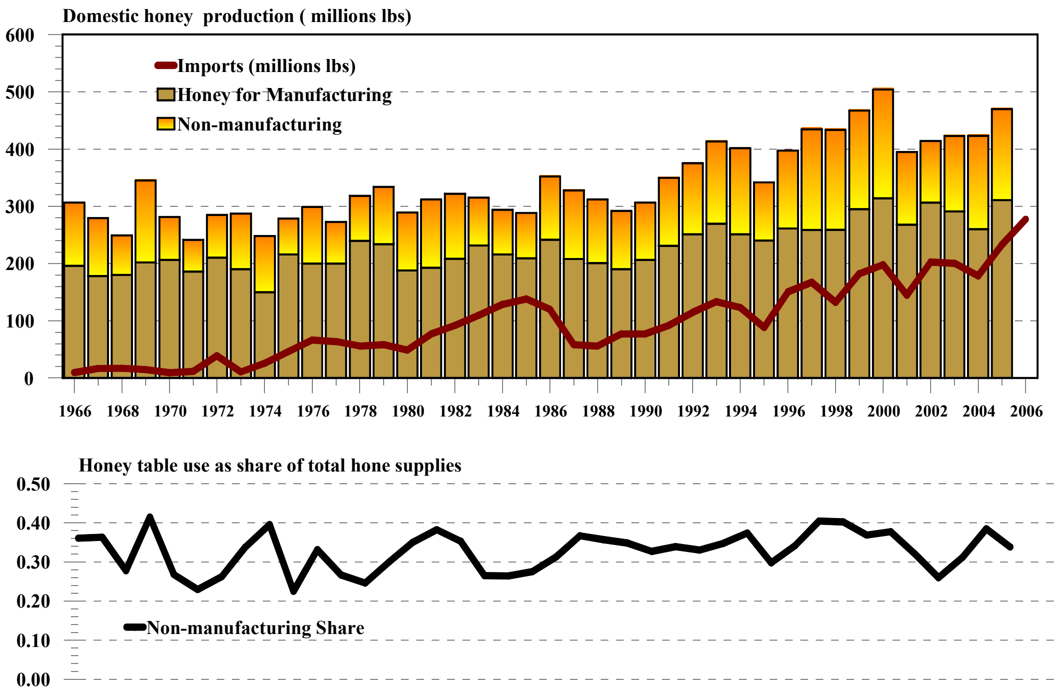

Figure 3. Honey supplies and use for manufacturing (millions lbs.)

In Figure 3 total honey imports are plotted in order to show that imports do not fully supply the manufacturing needs. Simply compare the import line to the honey for manufacturing bars where in each year the imports are lower than the total use of honey for manufacturing. If all of the imported honey moved into the food preparation sector there still would be a considerable portion of domestic production being used in the food manufacturing sector. If one assumed that all of the imports entered the manufacturing sector, import honey would have moved from supplying less than 5 percent of the manufacturing demand in the 60's to almost 70 percent of the manufacturing demand in the latter years. With this assumption, then domestic supplies contribute about 30 percent of the manufacturing needs. Again, the assumption used is that all imports go to manufacturing. The major point is that even with the increasing level of imports, the manufacturing sector still depends on domestic honey stocks but to a much lesser degree than seen in earlier periods.

Honey is one of several sources of sweeteners in the food manufacturing sector and to some degree must compete with other sweeteners. Yet, when put in perspective with the manufacturing demand for sweeteners, honey accounts for an extremely small share of the sweetener market. Corn syrup and sugar supply almost 99 percent of the food manufacturing demand for sweeteners and the remaining one percent is from honey and other syrups. Even if honey provides unique sweetener attributes, its .7 percent of the sweetener market clearly suggests that the honey industry likely has little leverage in the manufacturing sector. That is, events in the food manufacturing sector most likely influence the use of honey and not events in the honey industry. By 2000, sweeteners used in manufacturing totaled nearly 40 billion pounds annually of which honey was a very small component.
Honey used for manufacturing is extremely important to the honey industry but honey still remains a very small player in the sweetener market.

A Conceptual Framework of Honey Demand

As first noted in Figure 3, demand for honey is most distinguishable by its use for manufacturing compared with table use. They are uniquely different uses of honey and require separate approaches to the demand modeling. In Figure 4 a graphical approach is particularly useful. At any point in time (e.g., a year) there are usually a reasonably fixed number of bee colonies that provide a definable yield per colony. The actual colonies and yields were first shown in Figure 1. These in turn lead to a level of domestic honey production as was presented in Figure 2. At any point in time there exist a level of honey stocks used for supporting the market needs. In a complete modeling effort it would be desirable to explain things that influence storage. Yet if storage follows historical patterns and shows little to no response to price changes, then the storage can be assumed as predetermined for a given point in time. In Figure 4 storage is assumed to be influenced by events external to the honey industry and, hence, is influenced by exogenous conditions with exogenous meaning those variables outside the honey price/quantity relationship in the same time period. Honey exports are such a small portion of the total honey industry that it is also reasonable to treat exports as exogenous. Then as shown in Figure 4 total U.S. domestic honey supplies destined for the domestic market is the domestic production plus stocks less the exports or as in the figure, QDKE = QDOM + QSTK-QEXP. In all cases the quantities are measured in terms of millions of pounds of honey each year. As drawn, this implies that the domestic sources of honey are fixed within a given year and are not influenced by the price of honey in the same year. It could be that those supplies change in response to prior year prices but then prior year prices are exogenous to the current year. Using these arguments, the first representation of demand is that current domestic honey prices are determined by the available domestic supplies as identified with Model 1 in Figure 4. With the estimates of Model 1, one would have measures to show movements along the honey demand curve for honey not used in manufacturing.

From initial indications using Figure 3, a sizable portion of honey goes to the manufacturing sector but honey accounts for less than one percent of the sweeteners used in food manufacturing. Given the size of the food manufacturing industry and its demand for sweeteners, the expectation is that the demand for honey used in manufacturing is almost totally driven by the demand for sweeteners in general. While the honey promotion programs do not directly target this sector, it is possible that product development and emphases on the food service sectors could have some impact on ingredient use of honey. Even uses of honey for aesthetic purposes such as cosmetics fit into the manufacturing sector. Expectations are that the impact would likely be very small. Note in Figure 4, the line linking the generic promotions to the manufacturing demand for honey is drawn lighter than the linkage to the non-manufacturing honey. This linkage is noted as Model 3 for the manufacturing demand for honey where the argument would be that there is a positive relationship between the demand for sweeteners and that for honey. Yet with some promotions, the rate of response to more sweeteners could be increased with the promotions (i.e., the honey manufacturing response rotates upward.)

Figure 3 showed the level of imports and illustrated the close association with manufacturing. Given much of the color and other attributes of imported honey, the hypothesis is that honey imports are strongly related to the demand for honey used in manufacturing. That is, import quantities are a function of the demand for honey as an ingredient to other processed foods. This linkage is depicted with Model 4 and must be estimated.

There is a strong correlation between domestic and import honey prices. For simplicity purposes, it is argued that the import price can be directly mapped to the domestic market conditions where the import honey price (PIMP) is related to the domestic price of PDOM. Note that the honey promotions impact the domestic honey price directly and the import price indirectly through the linkage between Model 1 and Model 2. If the promotions impact the domestic price, then they impact the import price to the extent that the results from Model 2 are statistically significant. Similarly, if the promotions impact the adoption of honey into food manufacturing, then imports also increase.

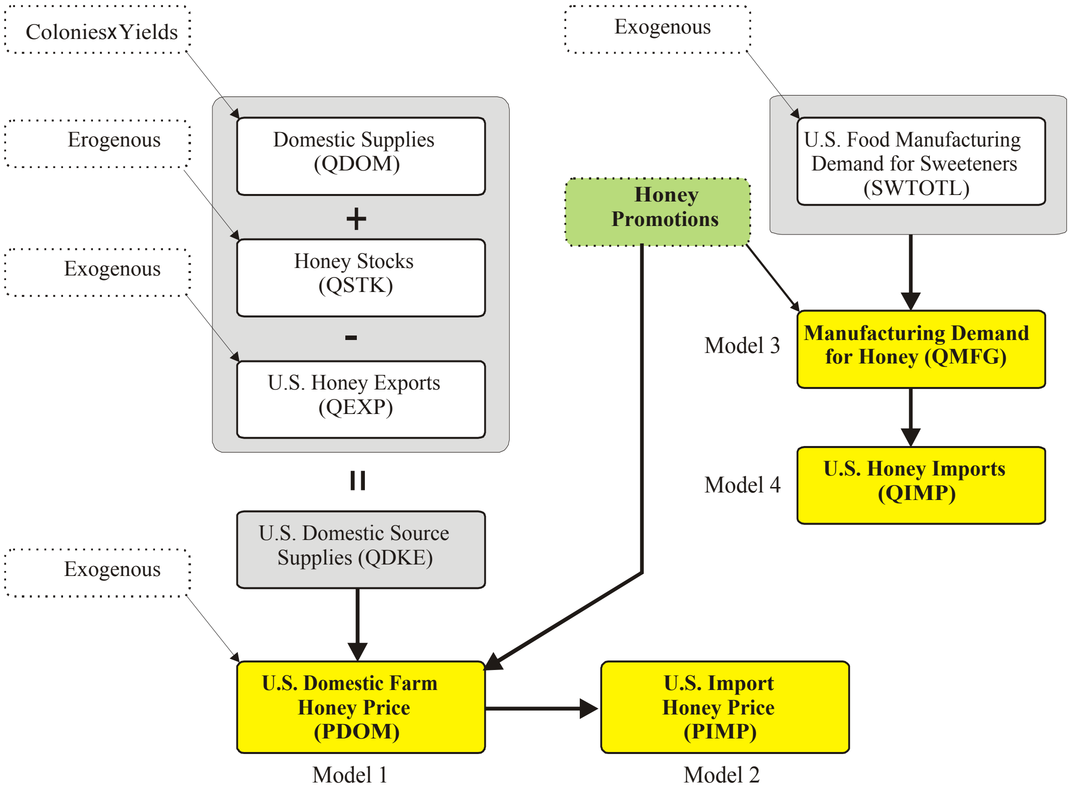

Figure 4. Conceptual framework for measuring honey demand

While the models are simplified in some aspects, they do provide a very useful way for measuring the impact of the generic promotion efforts on the honey industry for manufacturing and non-manufacturing uses. Once all of the estimates are complete, the models have a particular important use for showing the impact of the generic promotions of honey. First, the models can be used to predict prices and imports. Then set the promotions to zero and again predict prices and imports. With these two predictions, the gross revenues can be estimated with and without the promotion activities. From these gross dollar sales, the differences between the two levels would be attributed to the generic efforts. In the next several subheads, the four models will be estimated and then the results are incorporated into a simulator for estimating the promotion effects.

Farm Level Demand for Honey

Following the notation from Figure 4, let PDOM be the average U.S. domestic colony level honey price ($ per pound) in a given year with the year denoted using the "t" subscript. QDKE represents the domestic source honey supplies available to enter the domestic market with the supplies expressed in millions of pounds of honey. From Model 1 (in Figure 4) the domestic price of honey is related to the existing domestic stocks. Once that relationship is known, one has the essentials for showing movement along the honey demand curve. While many things influence the market from day to day, when dealing with annual averages many of those events are averaged out of the relationship. A recent USDA study on the impact of federal crop reports on honey prices is a good example of how price responses average out over a reasonably short period of time (Taylor, 2008). Some events occur randomly but are not necessarily measurable and those create noise or unexplained variation in the demand model. Two factors of particular interest to the price dependent model are the long term price supports (either direct or indirect) by the federal government and the efforts by the National Honey Board. These two variables are defined as represented with the notation SUPPORT and HBPRG with the latter being the Honey Board programs.

The federal support program for honey has a long history and is far too complex to describe in this paper and is also beyond the primary goal of measuring the promotion impacts. Even so, any modeling that includes influencing honey prices must account for the price support impact on the honey market. Several support mechanisms have been used ranging from government honey purchases to support prices to various loan repayment plans, all having the ultimate effect of providing some support to honey prices. The variable SUPPORT is the reported support price series that best reflects the underlying support mechanisms that have been used over the years. This variable is included in the model as the best direct way for capturing the role of the federal government through the many changes in the support program. More refined measures of support would be desirable if the study were focusing on that dimension of the honey industry but the goal here is to capture the essence of the support efforts in the model without making the analysis unduly complex. Hence, SUPPORT is a reference price support series expressed in dollars per pound of honey per year.

The National Honey Board maintains programs designed to enhance the demand for honey and honey products. Those annual dollars are defined as HBPRG to represent that annual effort. Given the nature of the honey programs, the expectation is that there is likely some carryover effect of honey promotions and other efforts between years. That is, honey promotions this year are likely to carry over into the next year especially when much of the effort is through printed materials and longer lasting media copy such as recipes and menus.

Preliminary analyses suggest that the impact of the honey programs most likely have a one year carryover where programs this year impact prices but also programs from the previous year also influence the current year. One approach to this measurement is to include both HBPRG from the current period t and last year's programs t-1. The expectation is that the current year activities should have a larger impact than the previous year's programs. Define N1 as a weight between zero and one that scales the current and previous year program expenditures. Then in equation (1) the honey program variable can be included in the model once the weight is known.

$$NHBPRG_t = HBPRG_t \times N1 + HBPRG_{t-1} \times (1-N1) \tag{1}$$

While shown later, preliminary estimates suggest that the weight for N1 is .60 or that 60 percent of the promotion impact is in the same year and 40 percent in the subsequent year. Adopting the definitions above, a relevant but simple model of domestic honey prices follows as specified with equation (2).

$$PDOM_t = \beta_0 + \beta_1 (QDKE_t) + \beta_2 (SUPPORT_t) + \beta_3 (NHBPRG_t) + e_t \quad (2)$$

In equation (2), the coefficient β_1 shows the movement along the honey demand curve while β_2 and β_3 give indications of shifts in demand as discussed earlier. Most important for this analysis is the value of β_3, the honey program effect. If β_3=0, the model would indicate no measurable impact from the honey programs. If it is positive and statistically significant, the impact is estimated with a given level of confidence. Suppose the honey program level is HBPRG for year t, its impact on demand is $\beta_3 \times N1$ in the current year and $\beta_3 \times (1-N1)$ in the subsequent year. Similarly, once the model is known, it can be used to explore the influence from actual Honey Board programs relative to setting the programs to zero and measure the demands in both situations. This gives the demand response with and without the honey checkoff.

Import Price Linkage

The correlation between domestic and import prices was shown to be .97. Furthermore, given the support history, promotions, and historical dominance of the domestic supplies, the expectation is that import prices are related to domestic prices. Again, this is a simple linkage but background analyses suggest that the linkage has been very stable over time.

From Figure 4 define the import prices ($ per pound) as PIMP. The linkage between domestic and import prices is shown with equation (3).

$$\log(PIMP_t) = \delta_0 + \delta_1 \log(PDOM_t) + e_t \quad (3)$$

If δ_1=1, there is a linear relationship between the two prices with the difference being reflected with δ_0. It is clear that δ_1 is not zero from the results in Figure 1.5 since the correlation is so strong. If $0<\delta_1<1$ or $\delta_1 >1$, the linkage between the two prices is nonlinear. Equation (3) is realistic, simple and provides a way for showing how the generic promotions could also influence the price of imports indirectly. Equation (3) corresponds to Model 2 in Figure 4.

Honey Sweetener Demand

Model 3 in Figure 4 assumes that the demand for sweeteners for food manufacturing is the driving force impacting the use of honey as one of the ingredients. Recall that honey accounts for less than one percent of all sweeteners. Assuming that the need for sweeteners is totally independent of the honey industry, then honey for manufacturing is a function of the demand for sweeteners. Note that sweetener demand is a function of many factors including income, demographics, health concerns, and consumption habits, all of which are independent of the honey industry. Changes in any of these should have an indirect effect on the demand of honey for manufacturing since they influence the demand for sweeteners in general. Given the extremely small role of honey in the food manufacturing industry and more limited non-food uses, the manufacturing linkage shown in Figure 4 is represented with equation (4). Define SWTOTL to be the annual pounds of sweeteners (million pounds) and QMFG the pounds of honey used for manufacturing. Let NCSWE be the sweetener total net of honey. In Figure 4 QMFG (quantity of honey for manufacturing) is related to the sweeteners and is possibly influenced by the honey promotion activities. The expectation is that information about honey may not shift the demand for honey for a given level of sweetener demand, but more likely could influence the rate of adoption of honey as the total demand for sweeteners change. Without the promotions the rate of use of honey relative to all sweeteners follows one path, while with the promotions the rate of adoption may follow a slightly higher path. Given the lead time needed in the food manufacturing sector compared with the table use, the expectation is that honey promotion information likely has a delayed impact. With these arguments, equation (4) provides a mathematical representation of Model 3 in Figure 4.

$$QMFG_t = \lambda_0 + \lambda_1 (NCSWE_t) + \lambda_2 (NCSWE_t) \times (NBPRG_{t-1})^{.5} + e_t \qquad (4)$$

If in equation (4) λ_2=0, the Honey Board promotions have no impact on the manufacturing sector. If λ_2>0, the relationship between sweeteners and honey for manufacturing is larger depending on the magnitude of λ_2. Note also that the honey promotions are expressed to the power .5. This implicitly assumed that the impacts of any honey promotions have limits where the marginal gains (if they exist) decrease with greater expenditures. For evaluation purposes, the most important estimate is λ_2 since it directly provides some indication of the role of honey programs on the manufacturing sector. Again, the expectation is that the relationship would be small. As with the other equations, the specification of (4) is based on background research leading up to this final specification with equation (4) corresponding to Model 3 in Figure 4.

Import Demand Related to the Manufacture Demand for Sweetener

It was noted early in the discussion that the mapping of imported honey for manufacturing versus table use could not be precisely traced. In Figure 3 the relationship suggested that most of the imported honey goes to manufacturing. Using that premise, let QIMP be the pounds of imported honey and QMFG, the manufacturing use of honey defined above. Equation (5) is specified as the simple link between the two variables.

$$QIMP_t = \alpha_0 + \alpha_1 (QMGF) + e_t \qquad (5)$$

Implicit in the manufacturing sector is that the use of honey for manufacturing is not driven by prices but by the momentum of the demand for sweeteners with honey use being an extremely small part of total sweetener demand. Clearly, a much more complex modeling effort of the overall sweetener sector would be required to measure the competitiveness of honey relative to other sweeteners. Even then the handling requirements and unique attributes of honey likely make it much less substitutable with the major sweeteners such

as corn and sugar. While this limited specification of the model is recognized, it probably has very little impact on the evaluation conclusions for the honey programs.

Econometric Honey Model Estimates

Each model for Figure 4 has now been specified and explained with the coefficients identified to be estimated. Table 1 provides the empirical estimates for each model and the associated statistics. Each column in Table 1 is by Model and the rows give the estimated coefficients in bold with the t-values reported immediately under each estimate. Supporting statistics are recorded in the lower portion of each column. Below, the results are discussed and then in the final major section these models are used to draw inferences about the impact of the National Honey Board program impacts of the demand for honey.

First in Table 1 domestic supplies (QDKE from Model 1) are shown to have a negative and statistically significant impact on domestic honey prices as seen with the coefficient value of -.001374. For each estimate if the t-value is greater than 2.0 the coefficient is statistically different from zero as is the case for the price / quantity relationship shown for Model 1. Price supports have a positive impact and are very close to the 95 percent confidence level. Most important for the evaluation efforts, the National Honey Board programs are shown to have a positive and significant impact on honey prices as seen with the coefficient value of .0815 and t-value of 2.24. Furthermore, a search over values of the N1 from equation (1) shows the maximum likelihood value peaks when N1=.60. Around 80 percent of the honey price variation over time is explained with the model and the other statistics are acceptable. Note that the model was corrected for serial correlation even though that is less usual for annual models. The coefficient for NHBPRG (i.e., the honey promotions) is the first test for the impact of the honey programs and the results provide statistical evidence of the positive impact of the honey programs.

Table 1. Honey model estimates corresponding to Figure 4

Variables	Model 1 PDOM	Model 2 logPIMP	Model 3 QMFG	Model 3 QIMP
Intercept	**0.542750**	**-0.304340**	**113.559900**	**-285.525180**
	2.427550	-11.19656	3.980880	-7.99095
QDKE	**-0.001374**	-	-	
	-2.004650	-	-	
SUPPORT	**0.581270**	-	-	
	1.904830	-	-	
NHBPRG	**0.081564**	-	-	
	2.240020	-	-	
	-	-	-	
logPDOM	-	**1.05367**	-	
	-	31.7615	-	
HCSWE	-	-	**0.003329**	
	-	-	3.103040	
	-	-	-	
(HCSWE) ×	-	-	**0.000394**	
HBPRG(T-1)	-	-	1.718510	
	-	-	-	
QMFG	-	-	-	**1.671680**
	-	-	-	10.335660
Rho	0.703620	-	-	-
N1=	0.6	-	-	-
RSquared=	0.806855	0.963699	0.772021	0.753333
DW=	1.4755	0.700762	1.91451	0.737596
Mean Dep.=	0.58355	-0.98874	229.875	98.7524
Obs.=	40	40	41	41

Column 2 shows a strong linkage between import prices and the domestic honey prices with the relationship being almost linear. This model explains 96 percent of the variation in import prices and the model intercept provides the basis for estimating the domestic price premium over import prices.

Model 3 in column 3 of Table 1 shows the honey demand for manufacturing is strongly related to the overall demand for sweeteners (see the estimates for HCSWE in the table). A relationship between honey for manufacturing and total sweeteners is shown to slightly increase with the generic promotions. As anticipated, the response is small and only statistically significant at the 90 percent confidence level (i.e., t-value=1.718).

Finally, the last column measures the relationship between quantities imported and honey needed for manufacturing. The relationship is positive and highly significant and the model explains about 75 percent of the variation in imports. Other factors likely influencing honey imports are not captured in the model. Even so, the most dominant force for imports is the need for honey for food manufacturing and relationship between the two is most apparent.

Overall, the models conformed to prior expectations and have good statistical properties. All of the coefficient signs are consistent with the theory and the strength of the statistical significance in each case conforms with earlier arguments. These results provide the structure for determining the magnitude of the honey programs impact on demand. Most evident, if the coefficient for NHBPRG were zero there would be no need for the next section. With the positive and statistically significant value, the overriding question then becomes ... how much is the impact and is it worth the investment by the Honey Board?

Calculating the Impact of the National Honey Checkoff

Using the models from Table 1, the primary approach most often used in evaluation studies is to predict the industry revenues with the existing program expenditures and then do the same prediction while setting the program levels to zero. Revenues will differ from year to year because of the exogenous changes in supplies and other conditions. By setting the program efforts to zero and using the same conditions, then any differences in industry revenues from year-to-year must be attributed to the generic promotion activities. To summarizing, in Figure 4 the models are used to predict prices and imports over the existing promotion levels. Then the same models are used except the promotions are set to zero and a new prediction made. Industry revenues are then calculated from the predictions with and without the checkoff dollars. Several aspects of these procedures are explored in the following subsections.

Prior to 1990 the program impacts were likely small since it was near the startup of the honey checkoff. And the impact of those early programs should be captured in the lagged promotions included in the model. Hence, before 1990 the impacts should be miminal. From 1990 forward, the differences should be observed and positive since the estimated honey program coefficients were positive. Two aspects of the gains are noteworthy as initially illustrated in Figure 4. Gains to the domestic side of the market result from increases in the domestic honey price attributed to the honey programs. Then for the moment ignoring quantity gains from the manufacturing side, gains on the import side with the quantity fixed are due to the improved import prices. Domestic revenues with and without the honey programs are simply the domestic production times the price improvement attributed to the demand enhancing efforts. Likewise, revenue gains to the imports are a result of increases in the import prices with the honey programs. These gains differ from year to year in direct relationship to the changes in program expenditures each year. Adding up the gains from period 1990 through 2006 gives a total of $270 million of increases in farm level value of domestic honey directly attributed to the Honey Board generic programs. To those values, the gains resulting from the import price increases associated with the Honey Board are added to give the total value of imports each year. These import gains are completely due to the price changes and not to changes in the manufacturing sector for a total of $162.8 million in additional import value.

Combined, the domestic and import gains total $433.7 million additional dollars to the industry that is a direct result of the honey promotions and other demand enhancing programs. Equally important, these values are derived from using estimated coefficients that were statistically very significant.

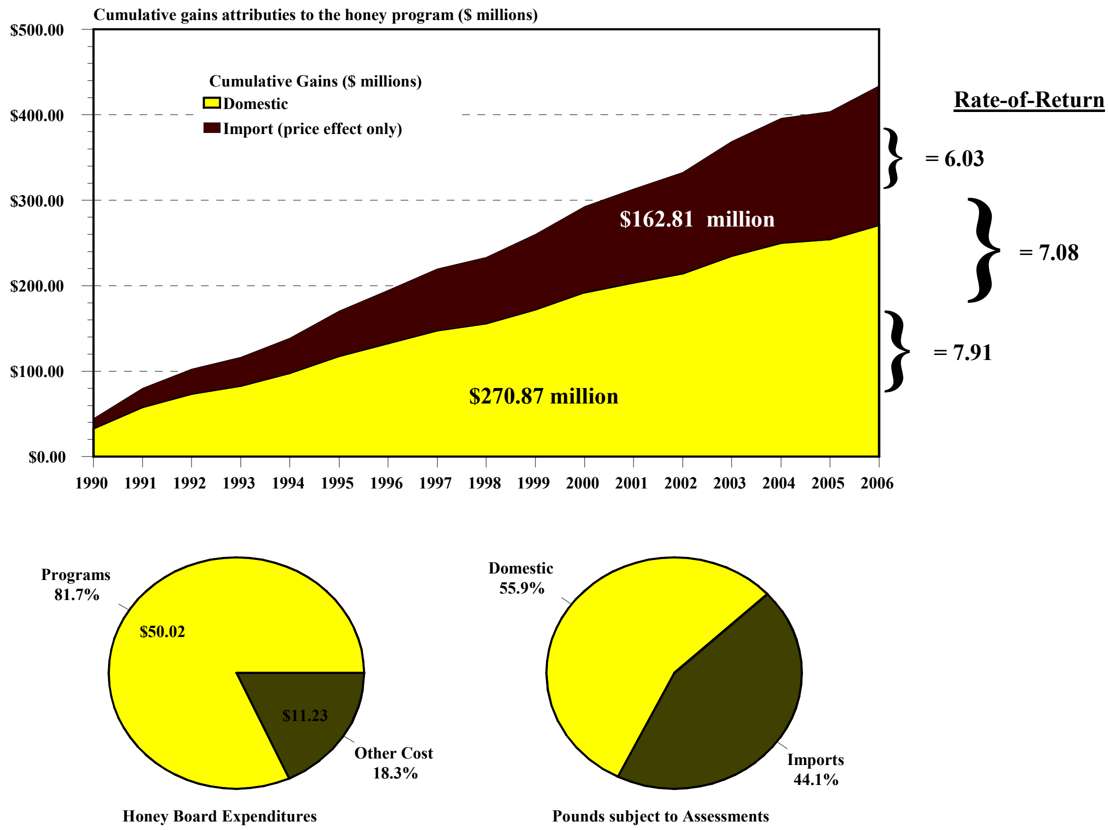

Figure 5. Estimated Rates-of-Return to the National Honey Promotion programs

Typically, the rate-of-return to the various checkoff programs is estimated by dividing the program cost into the estimated gains in revenues that can be attributed to the programs. The best way to illustrate the gains is to first plot the cumulative gains from both the domestic and import sides of the marketplace. In Figure 5 these gains are shown starting with 1990 through 2006 with the values expressed in cumulative terms. For example, by 2006 the values represent the total gains resulting from the honey programs net of the manufacturing side. The values are stacked first showing the domestic gains and then the import gains. By 2006 the total additional revenues at the farm level and equivalent imports equal slightly more than $433 million in added value. Domestic gains account for 62 percent of the value added compared with the 38 percent for imports for the full time period.

The National Honey Board programs and other costs total $61.25 million over the 1990 through 2006 periods. For this, $50.02 million was for direct market enhancement activities. During this same period domestic production accounted for 55.9 percent of the honey supplies and imports 44.1 percent. Since the checkoff assessments are based on a per pound basis, those percentages should closely approximate the relative contributions to the Honey Board by domestic producers and importers. Multiplying $61.25 million by 55.9 percent gives a total $34.24 million from domestic sources and $62.25 million × 44.1 percent gives the import assessments of $27.01 million. Since both importers and domestic producers must pay the assessment, it is of interest to see the rates-of-return to each group while recognizing that the overall rate-of-return is the most important measure of performance. The resulting calculations are shown in Figure 5 for both honey sources. For the domestic supplies, the estimated average rate-of-return to domestic producers is 7.91 or $270.87 ÷$34.24=7.91. For importers, the average rate-of-return net of the manufacturing response is $162.81 ÷ $27.01= 6.03. For each dollar of assessments paid by domestic honey producers, the models point to a rate of gain $7.91 in addition farm value. This ROI is usually referenced as 1:7.9. A similar interpretation follows for the imports with the ROI being slightly less. Combining the two sources of gains give a ROI of 1:7.0 or for each dollar invested in the honey checkoff, approximately seven dollars in added value are realized. Most commodities boards are seeing rates-of-returns similar to the above values. The beef checkoff usually quotes a ROI 1:5 and a recent study of the watermelon checkoff shows an ROI of around 1:10. These results illustrated with Figure 5 are clearly in the range of most other programs if not slightly higher than several of them.

Model 3 from Figure 4 linked the honey programs to the manufacturing sector and the resulting estimates were given in Table 1. As noted, the honey coefficient was positive but the level of confidence was much lower than seen with the domestic side of the market (i.e., the t-value = 1.718). While one can estimate the impact from the manufacturing sector the results must be interpreted with caution since the promotion linkage is less reliable.

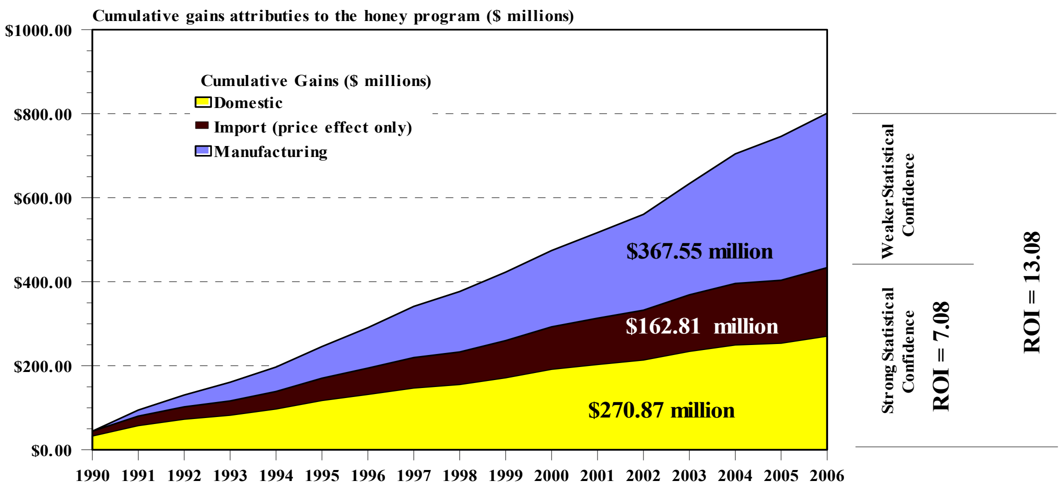

Figure 6. Incorporating the manufacturing gains into the honey model

Model 3 has the honey promotions slightly raising the response rate between honey demand for manufacturing and the total needs for sweeteners. Theoretically and empirically the manufacturing demand for honey increases as the need for sweeteners increases. Estimates from Model 3 indicated that the relationship rotated upward slightly with the presents of the honey programs. While the rotation did occur based on the estimates in Table 1, statistically we cannot have very strong confidence that the change is different from zero. The rotation is positive but there is likely a 10 percent or greater chance that the results are wrong.

For discussion purposes, the gains from the rotation have been estimated in a similar way done for the domestic and import gains just shown. The upper area in Figure 6 is added to those values reported in Figure 5. As most apparent the gains from the manufacturing sector are substantial if one had strong confidence in the results. An additional $367 million in value to the import sector would be realized because the model assumed that the manufacturing growth attracted more imports which is in fact the case. Combining those manufacturing gains to the earlier reported gains yields an overall ROI of 13.08 versus the more reliable 7.08 ROI. Note the caution in the figure that the manufacturing gains lack the same statistical confidence that can be placed on the 7.08 rate-of-return. More than likely, the final rate is some place between these two with the expectation that it is closer to the lower number. This conclusion is based on the fact that most of the Honey Board programs do not directly target the manufacturing sector and the gains are indirect through improvement in the consumer demand for honey via the promotions and related programs.

Conclusions

Every commodity board includes an administrative structure; methods for designing and delivery its messages; systems for judging performance; and assurance of fairness and equity. Major weaknesses in one or more of these four building blocks of a generic program will ultimately lead to failure. Judging each aspect of a commodity promotion board requires both subjective and objective insight into the operations of the programs. Accountability and innovativeness are both essential. Determining innovativeness and creativeness is sometime difficult to analytically measure and may require one to make subjective observations about the level of achievement. For example, one can turn to the Honey Board's website and see marketing dynamics and creative ways to market honey. The Honey Locator within the website is a great example of creativeness and a potential major way for linking buyers and sellers. Analytically, it is almost impossible to determine its impact on the industry but logically the impact should be positive.

Accountability is more objective in that one can audit financial records and monitor meetings to assess the Board's day to day operations. Similarly, using analytical models as presented in this report, an objective assessment of the impact of the programs can be made using the appropriate modeling techniques. Beyond the financial accounting, the ultimate evaluation signal is if there are measurable demand enhancements that can be statistically attributed to the Honey Board's programs. That measure has been the focus of this report using accepted econometric modeling techniques.

Has the demand for honey been enhanced through the National Honey Board's programs? The answer is yes based on the following major bullet points.

- There are two distinct uses of honey, one for table use and the other for manufacturing. Any impact of generic promotion activities should be inheritently different between the two types of honey demand.

- The U.S. honey industry has experienced a major structural change with over 50 percent of the honey now coming from imports. At the same time, domestic production has consistently declined with the loss of colonies attributed to viruses and diseases.

- Honey prices are intrinsically linked where most prices move in similar patterns while having premiums and discounts depending on the sources. Pricing linkages both vertically and horizontally within the distributions systems seem to be quite strong for non-manufacturing uses of honey. The price linkage is less with honey going to manufacturing.

- For the table use of honey, the analyses indicate that over the life of the programs the honey promotions generated an additional $433 million in sales above what would have existed in the absence of the Honey Board for the years from 1990 through 2006. Putting this in perspective for the same years, the $433 million shows that in the absence of the Honey Board programs, farm level equivalent revenues without considering enhancement in manufacturing demand would have been approximately 13.9 percent lower. These responses were derived using model coefficients that have a 95 percent reliability level (i.e., 95 confidence level).

- During the above years, the Honey Board spent $61.25 million of which 81.7 percent was for direct demand enhancement efforts. Dividing these expenditures into the $433 million gives an average rate-of-return of 7.08. Again ignoring the manufacturing response, the average rate-of-return shows that for each dollar spent produces seven times that in additional revenues or a ROI of 1:7.

- In terms of equity, the rates-of-return to imports is estimated to be 6.03 compared with the domestic of 7.91. Given the closeness of the two numbers there appears to be a reasonable level of equity in sharing the benefits between the two honey sources (see Figure 5).

- Additional gains in the manufacturing sector's use of honey were positive but statistically less reliable. That is, the confidence level for the manufacturing sector was less than the 95 percent level. Combining the additional gains with the non-manufacturing gains yields an average rate-of-return of 13.08 to the honey programs. Clearly, this is substantially above the more reliable number of 7.08.

- Beyond the statistical modeling, the rate-of-return is consistent with the rates seen for most other commodities. For comparisons, beef is usually quoted as (1:5); watermelons (1:10); pork (1:4.8); eggs (1:4.7); dairy (1:5.4); cotton (1:3.7); citrus (1:4.0); or apples (1:6.7). Sometimes these rates are quoted as averages, sometimes net of the checkoff costs, and in a few cases just the marginal rates are reported. For honey, the rate 1:7.08 is the average rate before netting out the promotion cost. The average honey ROI net of the checkoff cost is 1:6.08. Whether considering the average or net ROI, the evaluations show that the honey programs have been beneficial to the honey industry and the program expenditures are substantially below the break-even level. While not included in this report, the models can be used to simulate the breakeven level of checkoff expenditures (Ward, 2006).

- The value of the honey represents a small portion of the total value of bees since the honey is a by-product of pollination. The economic value of pollination is difficult to evaluate since it is essential to both commercial agriculture as well as natural plants. Placing a value of the pollination of natural plants is nearly impossible. Likewise, data on pollination services to commercial agriculture by beekeepers can only be approximated and is not consistently documented. Clearly, the loss in bee colonies is much bigger than losing a share of the honey supplies. As documented early in the report, imports have filled much of the gap in honey supplies but imports do not replace the pollination needed throughout the country. That is why solving the declining colonies first noted in Figure 1.1 is far bigger than just the honey industry.

Summarizing, the statistical models presented in this report have been limited to determining if the National Honey Board's demand enhancement programs have worked. The conclusion is that they have benefitted those subject to the honey checkoff assessment with the rate-of-return beginning around seven dollars for each dollar invested in the Honey Board. That rate is on the conservative side of the impact since that quoted rate does not include the less reliable impacts on the use of honey for manufacturing as set forth in Figure 5.

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