

An Economic Analysis of Market Impacts of the National Watermelon Promotion Board

Dr. Harry M. Kaiser
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Executive Summary

The National Watermelon Promotion Board (NWPB) has been in operation since June of 1990 with the current mission to increase consumer demand for watermelon through promotion, research, and educational programs. Funded by a 3-cent per cwt. assessment on growers and handlers of domestic watermelons, and a 6-cent per cwt. assessment on imports, the NWPB raises about \$3.4 million annually with \$1.6 million specifically earmarked for promotional (communications, marketing and foodservice) and educational efforts to provide information to consumers to enhance demand.

Since the 1996 Farm Bill, all federal checkoff promotion programs must be evaluated so that their return to investors can be determined. Accordingly, the purpose of this research study is threefold, to: (1) determine the domestic market impacts of the NWPB's demand enhancement programs, (2) compute a rate of return on investment (ROI) for the promotion activities conducted by the NWPB, and (3) measure the broader economic effects of the NWPB on employment, labor income, value added, and total economic output.

Both per capita watermelon consumption and watermelon prices have generally increased over the past 15 years. Per capita consumption has increased from 13.8 pounds in 2000 to 14.7 pounds in 2015, which represents a 6.5% increase. Real inflation adjusted grower prices have grown by 60.8% since 2000, while retail prices have increased by 39.3% since 2003. This increase in watermelon demand (as reflected in both quantity and price) is critical to the health and vitality of the watermelon industry. That is, the increase in per capita consumption that has

occurred since 2000 has been accompanied by a positive trend in grower revenue. In 2000, total grower revenue was \$334 million. In 2015, total revenue grew to \$489 million, an increase of 46.3%. Clearly, it behooves the industry to market watermelons effectively, since growth in consumption is so beneficial to grower revenues. To disentangle the impact of domestic marketing by the NWPB from other demand factors, we need to turn to more sophisticated statistical models from a field of economics called econometrics.

Monthly retail scanner data on watermelon prices and volume sold, and cantaloupe and honeydew melon volume sold since 2007 are combined with monthly NWPB promotional expenditure data to estimate a retail watermelon demand function. These data are further decomposed on a U.S. regional basis to look at cross-sectional variation as well as changes over time. Specifically, the data are divided into eight separate regions including: California (CA), Great Lakes (GL), Mid South (MS), Northeast (NE), Plains (PL), South Central (SL), Southeast (SE), and West (W). The econometric model uses statistical methods with these time series and cross sectional data to measure how strongly various retail watermelon demand factors are correlated with retail watermelon prices in the U.S. The following factors are included as explanatory variables of the retail watermelon price: quantity of cantaloupe sold, quantity of honeydew sold, current and lagged promotion expenditures by the NWPB, and regional indicator variables for the eight regions specified above. To compare the relative importance of each factor on disappearance, the results from the statistical (econometric) model are converted into price “flexibilities.” A price flexibility measures the percentage change in the retail watermelon price given a 1% change in a specific demand factor, holding all other factors constant. For example, a price flexibility coefficient of -0.75 means that a 1% increase in quantity available would decrease the retail price by 0.75% when holding all other demand factors constant.

Determining the statistical significance of this variable is therefore of crucial importance in the analysis that follows.

All the explanatory variables in the estimated retail watermelon demand model are statistically significant except for quantity of cantaloupes, and collectively explain about 93% of the variations in the retail watermelon price over time for the eight regions. Most importantly, the statistical results indicate that NWPB domestic promotion programs have a positive and statistically significant impact on increasing retail watermelon demand. The combined promotion activities by the NWPB have a price flexibility coefficient of 0.056. This indicates that a 10% increase in NWPB promotion expenditures results in an increase in the retail watermelon price of 0.56% holding all other factors constant. In the version of the model disaggregating these promotion activities, the results suggest that NWPB marketing has a price flexibility of 0.028, communications has a price flexibility of 0.019, and foodservice has a price flexibility of 0.012. All of these are statistically significant.

The estimated retail demand model is used to simulate market conditions with and without the NWPB. Specifically, two scenarios are simulated over the time period 2012.01 – 2016.12: (1) baseline scenario, where the retail watermelon price is simulated based on all explanatory variables sets to their historical levels, and (2) no-NWPB scenario, which is the same as the baseline except NWPB promotion expenditures are set to 1% of the historical levels. A comparison of the simulated retail watermelon prices between these two scenarios provides a measure of the impact of the NWPB's impact on retail prices over this five-year time period. In addition, using the price spreads between historical retail and farm watermelon prices, one can estimate the impact of NWPB promotion efforts on the farm price. Over the period 2012 through 2016, the retail price averaged 77.9 cents per pound with the NWPB and 62.5 cents per

pound without the NWPB. In other words, had there not been any promotion by the NWPB over the last five years, the average retail price of watermelons would have been 15.4 cents per pound lower than it actually was. That is, the NWPB had the impact of increasing the retail watermelon price by almost 20%. Hence, retailers of watermelons clearly benefit from the NWPB's promotion efforts over the past five years.

A more important question is how do the stakeholders of the NWPB benefit from these promotions? Over the entire period, the farm price averaged 17.9 cents per pound with the NWPB and 14.4 cents per pound without the NWPB. In other words, had there not been any promotion by the NWPB over the last five years, the average farm price of watermelons would have been 3.5 cents per pound lower than it actually was.

If we assume that the retail and farm pounds of watermelon are equivalent, one can multiply the increase in the farm price due to the promotions by the NWPB by retail U.S. sales (quantity) to derive the gain in total dollar sales at the farm-level. Over the five-year period 2012-2016, the results indicate that the NWPB promotion effort resulted in an increase in total farm sales of watermelons of \$519.4 million. The total cost of the watermelon checkoff program over this period was \$15.7 million. Therefore, the rate of return on investment (ROI) from the NWPB promotion is equal to:

$$\text{ROI} = (519.4 - 15.7) / 15.7 = 32.08.$$

In other words, each dollar invested in NWPB promotion returned \$32.08 in net farm revenue to the U.S. watermelon industry.

Questions often arise about the accuracy of such estimates of ROIs in economic evaluations of commodity promotion programs. The resulting ROIs are generally quite large because promotion expenditures are exceedingly small relative to product value so only a small

demand effect is needed to generate large positive returns. For example, average NWPB promotion expenditures in 2010 were a mere 0.5% of the farm value of watermelon. Still, this relatively small investment in watermelon promotion increased net revenue by almost \$104 million per year over the past five years. Therefore, the resulting ROI is quite large.

How does the ROI estimated above compare to that for other promotion checkoff programs? Kaiser (2011) conducted a comprehensive literature review of 21 domestic checkoff programs and found that the median rate of return was 6.0. Hence, the 32.08 estimated here for the NWPB is substantially higher than the median for these selected studies.

To make allowances for the error inherent in any statistical estimation, a 99% confidence interval is calculated for the above ROI. The confidence interval provides a lower bound for the average BCR: one can be “confident” 99% of the time that the true average ROI lies above this limit. The lower bound of the 99% confidence interval for the NWPB ROI is 8.66. Since the lower bound of this 99% confidence interval is substantially higher than one we can be very confident that the true ROI for the NWPB is larger than one.

Promotion benefits a range of stakeholders beyond the growers that fund the promotion activities. For example, local input suppliers benefit from additional fertilizer or other input purchases, and local workers benefit from either higher wages, or more harvesting and post-harvest processing jobs. State and local governments also benefit from the incremental taxes associated with growers’ earnings. To examine this, an “input-output” model of the US macro-economy is used to simulate two scenarios: (1) NWPB program in effect, and (2) no NWPB in effect. In comparing the two scenarios, we calculate the implied increment in employment, labor income, value added, and GDP associated with the having the NWPB in effect. The result is a summary measure of the broader regional-macroeconomic impact of each type of promotion.

Using 2015 as a basis, total production of watermelons in 2015 was 3.51 billion pounds. Based on the 3.5-cent increase in price due to NWPB promotion, that means the watermelon checkoff program created \$122.9 million in incremental grower revenue in 2015. That is, the difference in grower total revenue due to the NWPB is \$122.9 million in 2015. This number is used as an input into the implied multipliers from the Kaiser, Richards, and Keeney (2016) analysis to obtain estimates of the broader effects of the NWPB on the general economy. The results indicate that the NWPB had substantial impacts on the general economy. The results indicate that spending on promotion by the NWPB increased employment in the nation by 2,650 jobs and increased labor income by \$87.6 million. It also increased value added to the nation by \$156.9 million. The total effect of NWPB spending increased economic output in the nation by \$200 million.

The main implications of this study are that the watermelon industry is getting a very high return from the domestic promotion efforts of the NWPB, and that these promotion programs have had a significant impact on the general economy. The estimated ROI indicates that it would be profitable, from an industry standpoint, to increase the level of domestic promotion of watermelons. Indeed, compared with other commodities, the returns to generic watermelon promotion are substantially higher than the median result.

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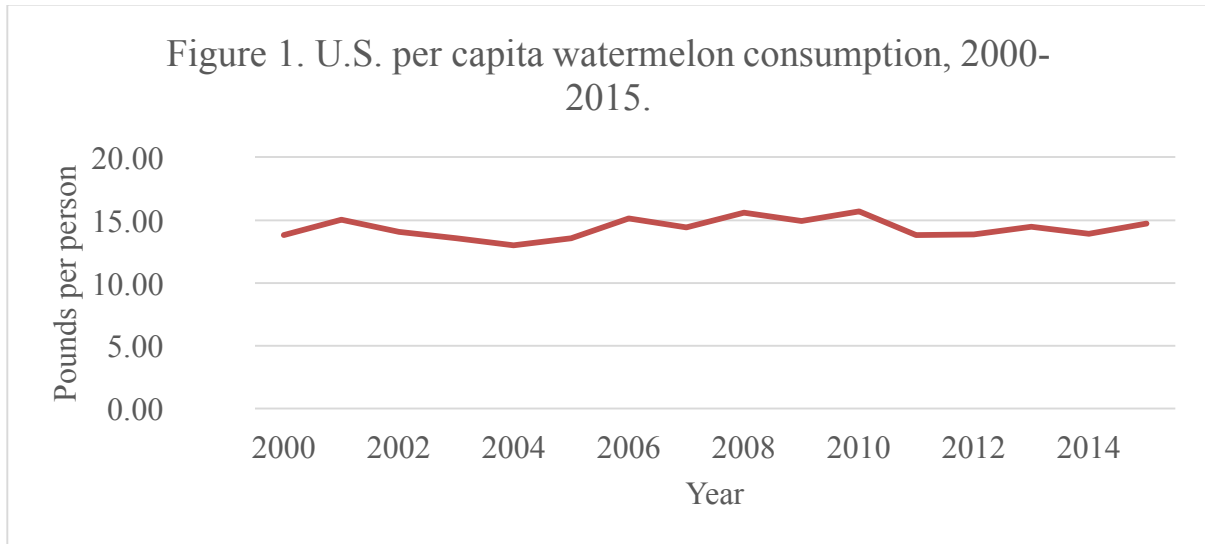
Since the 1996 Farm Bill, all federal checkoff promotion programs must be evaluated so that their return to investors can be determined. Accordingly, the purpose of this research study is threefold, to: (1) determine the domestic market impacts of the NWPB's demand enhancement programs, (2) compute a rate of return on investment (ROI) for the promotion activities conducted by the NWPB, and (3) measure the broader economic effects of the NWPB on employment, labor income, value added, and total economic output. The impacts of all factors affecting domestic watermelon demand for which data are available are measured statistically. In this way, we can net out the impacts of other important factors affecting watermelon demand over time. Then, the value of the incremental sales generated by the NWPB's marketing activities is estimated. These benefits to watermelon growers are compared with the costs associated with the NWPB to obtain an ROI for the program and used to estimate the broader economic impacts.

Researcher's Credentials

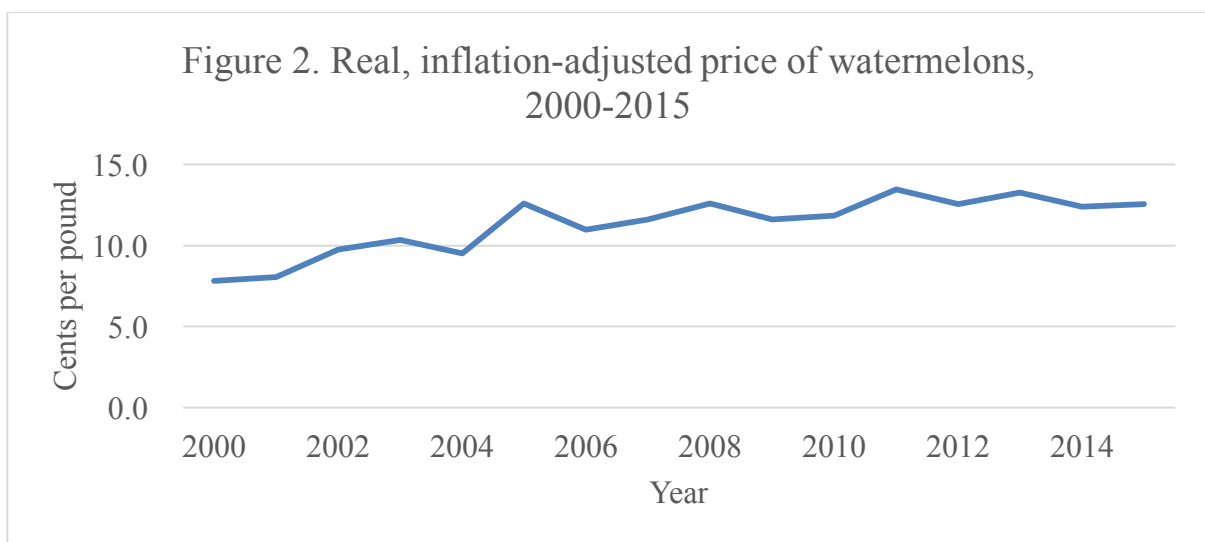
This independent evaluation is carried out by Dr. Harry M. Kaiser, who is the Gellert Family Professor and Associate Dean for Academic Affairs in the Charles H. Dyson School of Applied Economics and Management at Cornell University. Dr. Kaiser has been involved in commodity promotion research for 31 years, and is one of (if not the) the leading experts on this topic in the world. He has written 150 refereed journal articles, five books, 17 book chapters, and over 150 research bulletins. Dr. Kaiser has conducted over 130 economic evaluation studies of domestic and international checkoff programs in the United States, Canada, and Europe on such commodities as fluid milk, cheese, butter, salmon, peanuts, red meat, pork, raisins, walnuts, blueberries, potatoes, beef, wheat, watermelons, high-valued-agricultural commodities, and bulk agricultural commodities. In 2005, Kaiser was the lead author of a book on all commodity checkoff programs in California. In 2006, 2010, and 2015, Dr. Kaiser was a principal (or co-principal) investigator on three comprehensive economic studies investigating the overall benefits and costs of all FAS programs to cooperators and the general economy. Dr. Kaiser received the Distinguished Member Award from the Northeastern Association of Agricultural and Resource Economics in 2002 and then again in 2009. In 2006, Professor Kaiser received the highest award given to alumni of the University of Wisconsin-Eau Claire—the Alumni Distinguished Achievement Award. In 2009, Professor Kaiser received the Outstanding Achievement Award from the Board of Regents of the University of Minnesota, which is the highest award conferred by the university to an alumnus. Professor Kaiser received the Outstanding Alumni Award from the Department of Applied Economics, University of Minnesota, in 2009. In 2017, Kaiser was selected as a Fellow of the Agricultural and Applied Economics Association, which is their highest honor.

Trends in the Watermelon Consumption

Both per capita watermelon consumption and watermelon prices have generally increased over the past 15 years. For instance, Figure 1 shows a small positive trend in consumption since 2000. Per capita consumption has increased from 13.8 pounds in 2000 to 14.7 pounds in 2015,

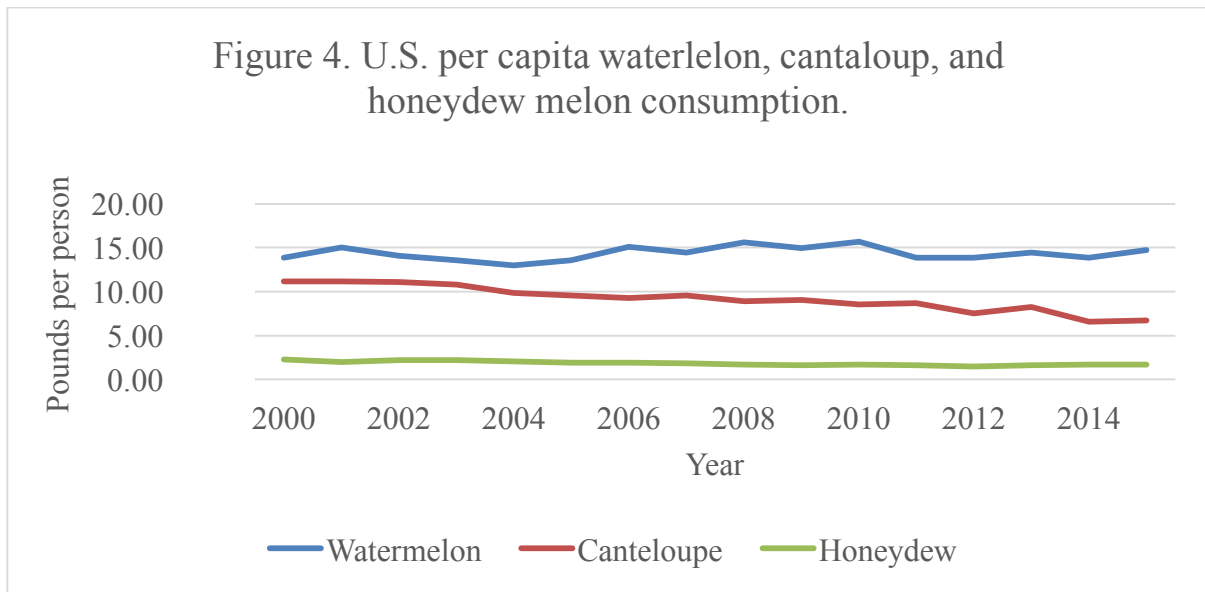


which represents a 6.5% increase. At the same time, grower and retail watermelons prices have increased as reflected in Figures 2 and 3. Real inflation adjusted grower prices have grown by



60.8% since 2000 (Figure 2), while retail prices have increased by 39.3% since 2003 (Figure 3),

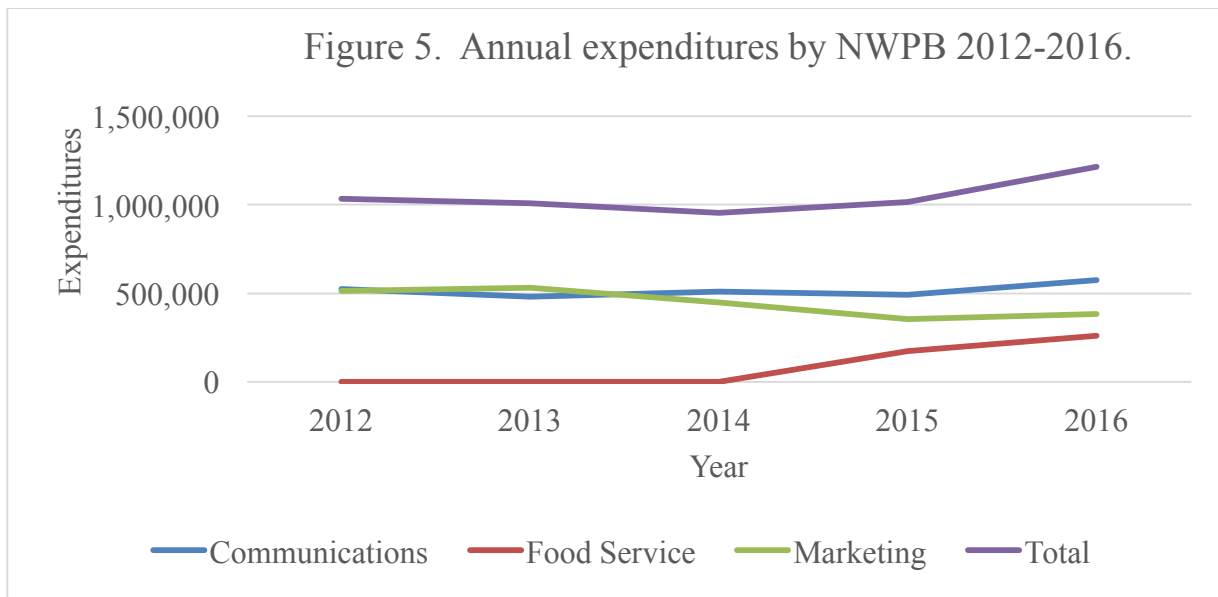
which is the most recent year of data in this report. This increase in watermelon demand (as reflected in both quantity and price) is critical to the health and vitality of the watermelon industry.



Two of the most important substitutes for watermelons are cantaloupes and honeydew melons. Figure 4 displays per capita consumption of watermelons, cantaloupes, and honeydew melons since 2000. Over the past 15 years, the increase in per capita consumption of

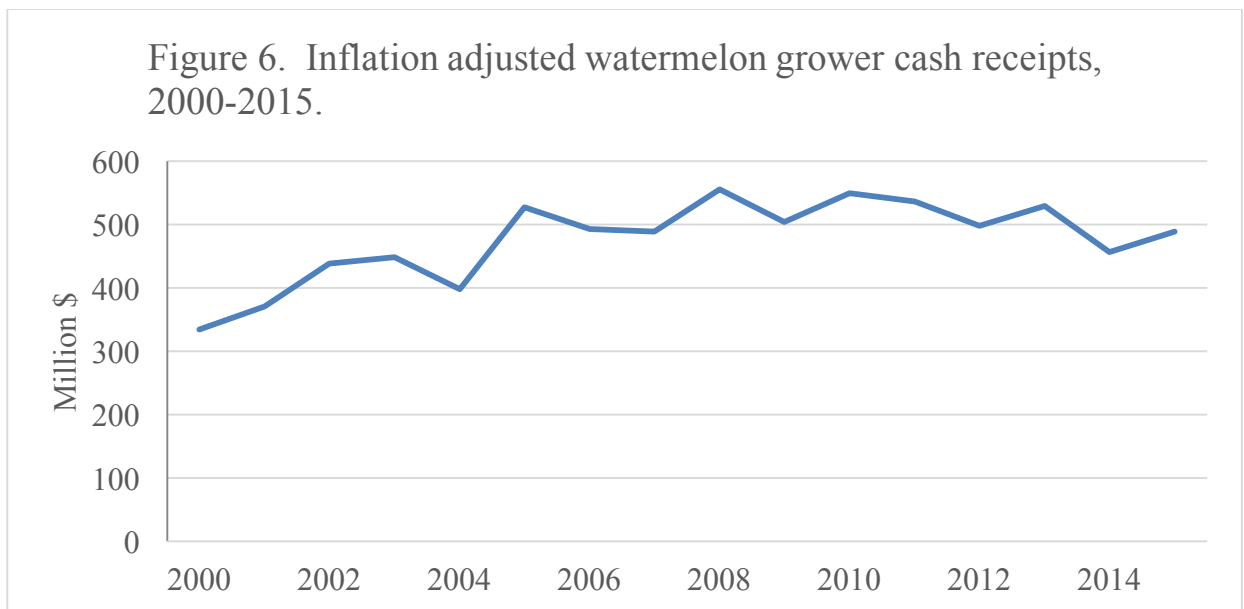
watermelons has come at the expense of these two commodities. While watermelon consumption increased 6.5% over this period, cantaloupe consumption fell 39.4% while honeydew melons decreased 26%.

One factor that has likely contributed to growth in per capita consumption of watermelons is the promotion efforts of the NWPB. Figure 5 shows domestic marketing expenditures on generic watermelon promotion since 2012 separated by major NWPB activity (communications, marketing, foodservice, and total). The total budget for promotion activities by the NWPB increased by 17.5% from 2012 to 2016.



The growth in per capita consumption since 2000 is crucial to the overall health and viability of the U.S watermelon industry. Growth in demand usually means increases in prices and grower revenues. This is evident in Figure 6, which displays real watermelon grower total revenue (in 2017 dollars) from 2000 through 2015. The increase in per capita consumption that has occurred since 2000 has been accompanied by a positive trend in grower revenue. In 2000,

total grower revenue was \$334 million. In 2015, total revenue grew to \$489 million, an increase of 46.3%. Clearly, it behooves the industry to market watermelons effectively, since growth in consumption is so beneficial to grower revenues. To disentangle the impact of domestic marketing by the NWPB from other demand factors, we need to turn to more sophisticated statistical models from a field of economics called econometrics, which is the focus of the next section of this report.



Methodology

This study quantifies the relationship between the promotion efforts of the NWPB and the domestic demand for watermelons. The export market is ignored since the focus is solely on the NWPB, which devotes most of its services to the domestic market. The model is based on the economic theory of consumer demand. In theory, one expects promotion activities to be beneficial to watermelon growers and handlers because they increase watermelon demand, resulting in higher prices and revenues. However, there are also other factors that affect domestic demand.

In order to distinguish the impact of the NWPB's promotion activities on watermelon demand from the impacts of other factors influencing demand, an econometric framework is adopted.

The econometric approach quantifies economic relationships using economic theory and statistical procedures with data. It enables one to simultaneously account for the impact of a variety of factors affecting demand for a commodity. Since watermelons are perishable and have seasonal production, the demand model is estimated using the retail price as being dependent on quantity of watermelons available. In addition to quantity of watermelons available, other demand factors affecting the retail watermelon price include available quantities of two important related commodities, cantaloupes and honeydew melons, and generic promotion expenditures. By casting the economic evaluation in this type of framework, one can filter out the effect of other factors and, hence, quantify directly the net impact of the NWPB's promotion activities on retail watermelon demand.

In this study, monthly retail scanner data on watermelon prices and volume sold, and cantaloupe and honeydew melon volume sold are combined with monthly NWPB marketing, communications, and foodservice expenditure data to estimate the price-dependent demand function. The time frame for the econometric model is 1997.01-2016.12. Similar to Ward's 2008 study and Kaiser's 2012 study, these data are further decomposed on a U.S. regional basis to look at cross sectional variation as well as changes over time. Specifically, the data are divided into eight separate regions including: California (CA), Great Lakes (GL), Mid South (MS), Northeast (NE), Plains (PL), South Central (SC), Southeast (SE), and West (W).

The econometric model uses statistical methods with these time series and cross sectional data to measure how strongly various retail watermelon demand factors are correlated with retail watermelon prices in the U.S. For example, with this approach one can measure how important

a change in quantity of watermelons is on impacting the retail watermelon price relative to a change in NWPB promotion in affecting retail watermelon price.

As mentioned above, the retail price of watermelons is used as the dependent variable in the econometric model, and the following factors are included to ascertain the extent, if any, of their impact on watermelon demand in the United States.

1. Quantity of watermelons sold. Reflecting the so-called law of demand, we expect there to be a negative relationship between quantity demanded and price. Higher quantity available in the market results in a lower retail price.
2. Quantity of cantaloupe sold. This variable may be either negatively or positively related to watermelon price, depending upon whether cantaloupe and watermelons are substitute (-) or complimentary (+) products. If they are substitutes, then an increase in demand for cantaloupes results in a decrease in price for watermelons. If they are compliments, then an increase in demand for cantaloupes results in an increase in price for watermelons.
3. Quantity of honeydew sold. This variable may be either negatively or positively related to watermelon price, depending upon whether honeydew melons and watermelons are substitute (-) or complimentary (+) products.
4. Current and lagged expenditures by the NWPB on marketing, communications, and foodservice activities. Since promotion activities have a residual effect, we expect that both current and lagged values of these expenditures will have a positive impact on the watermelon price.
5. Regional indicator variables for the eight regions specified above. These variables are included to capture demographic differences in each of the region and their impact on the retail watermelon price.

6. Seasonal dummy variable equal to one for May through September and zero otherwise.

This variable is expected to be negative indicating that retail watermelon prices are significantly lower from May to September when supply is higher than the rest of the year.

To compare the relative importance of each factor on disappearance, the results from the statistical (econometric) model are converted into price “flexibilities.” A price flexibility coefficient measures the percentage change in the retail watermelon price given a 1 percent change in a specific demand factor, holding all other factors constant. For example, a price flexibility coefficient of -0.75 means that a 1% increase in quantity available would decrease the retail price by 0.75% when holding all other demand factors constant. Determining the statistical significance of this variable is therefore of crucial importance in the analysis that follows.

The retail demand model for watermelons can be expressed mathematically as:

$$PW_{it}/CPI_t = \beta_0 + \beta_1 QWAT_{it} + \beta_2 QHDEW_{it} + \beta_3 QCANT_{it} + \beta_4 SEASDUM_t + \beta_5 (\ln(NWPB_{it-n}/CPI_t)) + \sum_{j=1}^7 \beta_j REGDUM_j$$

where: PW_{it} is the retail watermelon price in region i in month t , CPI_t is the Consumer Price Index for all items in month t , $QWAT_{it}$ is quantity of watermelons sold in region i in month t , $QHDEW_{it}$ is quantity of honeydew melons sold in region i in month t , $QCANT_{it}$ is quantity of cantaloupes sold in region i in month t , $SEASDUM_t$ is a seasonal indicator variable equal to 1 for May through September and zero otherwise, $NWPB_{it-n}$ are expenditures on marketing, communications, and foodservice by the NWPB in month $t-n$, \ln is the natural logarithm operator, and $REGDUM_j$ are regional indicator variables for the seven regions of the U.S.

To account for inflation over time, the retail watermelon price is deflated by the Consumer Price Index for all items. Hence, the dependent variable in the demand equation is the real, inflation-adjusted, retail price of watermelons. The seasonal indicator variable is included as it is expected that the retail price to be lower during the spring/summer season for watermelons, from May through September. The regional indicator variables are included to control for differences in demographics. The model includes all but one regional indicator variable, the South Central, and therefore the estimated coefficients indicate the difference in retail prices of each region relative to the South Central.

Real, inflation-adjusted domestic promotion expenditures are used as a measure of the NWPB marketing, communications, and foodservice efforts. It is well documented in the literature that promotion programs have a “carry-over” or residual effect on demand, i.e., past, as well as current promotion has an effect on current demand. To capture this residual effect, current and various lagged generic watermelon marketing, communications, and foodservice expenditures are included in several specifications of the model and the lag-length that provides the best statistical fit is chosen for the final model. A final model is then chosen based on the best statistical fit. To model the well-known concept of “diminishing returns to promotion,” the promotion expenditures are transformed by taking the natural logarithm, which has the property reflecting diminishing returns.

Econometric Results

Two versions of the demand model are estimated. Version 1 aggregates all NWPB activities into one variable, while Version 2 splits the NWPB activities into three categories: (1) marketing, (2) communications, and (3) foodservice. The results of both versions are very similar. The retail

watermelon demand models are estimated in logarithmic functional form with monthly data from 2007.01 through 2016.12 and the eight regions of the United States. The models are estimated using ordinary least squares. In addition to the demand factors described above, both models include regional dummy variables for the eight regions and the seasonal dummy variable described above. The results indicate that four regions (Southeast, Great Lakes, Northeast, and Plains) had significant differences in the retail watermelon price from the rest of the regions, and they were left in the final models. Similar to the 2012 report, the seasonal dummy variable is negative and statistically significant indicating that retail watermelon prices are significantly lower from May to September than the rest of the year.

The econometric results are presented in Tables 1 and 2. The R-squared indicates that the

Table 1. Econometric Results for Model 1.

Dependent Variable: LOG(PWAT/CPI)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.510680	0.191856	-13.08629	0.0000
LOG(QWAT)	-0.313919	0.008635	-36.35525	0.0000
LOG(QHONEY)	0.112991	0.014901	7.582868	0.0000
DUMSEAS	-0.092239	0.016121	-5.721708	0.0000
LOG((MKTING(-8)+COM(-2)+FOODSERV(-1))/CPI)	0.042112	0.010578	3.981111	0.0001
DUMSE	0.380928	0.032034	11.89128	0.0000
DUMGL	-0.077096	0.031586	-2.440790	0.0149
DUMNE	0.164887	0.033187	4.968397	0.0000
DUMPL	-0.115342	0.032702	-3.527002	0.0004
AR(1)	0.612274	0.027539	22.23279	0.0000
R-squared	0.937131	Mean dependent var		-5.791098
Adjusted R-squared	0.936486	S.D. dependent var		0.456926
S.E. of regression	0.115154	Akaike info criterion		-1.473891
Sum squared resid	11.64272	Schwarz criterion		-1.419961
Log likelihood	664.4077	Hannan-Quinn criter.		-1.453276
F-statistic	1454.163	Durbin-Watson stat		2.030191
Prob(F-statistic)	0.000000			

explanatory variables explain about 93% of the variations in the retail watermelon price over

time for these regions for both versions of the model. The estimated coefficients are consistent with economic theory and all estimated coefficients are statistically significant at conventional significance levels except for the quantity of cantaloupes in the market, which is statistically insignificant and therefore omitted from the model. An auto-regressive AR(1) process is used in estimating the models to correct for auto-correlation. Several econometric diagnostic tests performed indicate no statistical problems with either model.

Table 2. Econometric Results for Model 2.

Dependent Variable: LOG(PWAT/CPI)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.392036	0.287063	-8.332801	0.0000
LOG(QWAT)	-0.315589	0.013267	-23.78767	0.0000
LOG(QHONEY)	0.110156	0.019606	5.618431	0.0000
DUMSEAS	-0.095788	0.029758	-3.218918	0.0013
LOG(MKTING(-8)/CPI(-8))	0.027444	0.013491	2.034239	0.0422
LOG(COM(-2)/CPI(-2))	0.018662	0.011790	1.582881	0.1138
LOG(FOODSERV(-1)/CPI(-1))	0.011647	0.003683	3.162498	0.0016
DUMSE	0.383221	0.032563	11.76851	0.0000
DUMGL	-0.076424	0.035687	-2.141495	0.0325
DUMNE	0.167940	0.022929	7.324286	0.0000
DUMPL	-0.118421	0.014443	-8.198962	0.0000
AR(1)	0.563136	0.042057	13.38997	0.0000
R-squared	0.939238	Mean dependent var		-5.791098
Adjusted R-squared	0.938475	S.D. dependent var		0.456926
S.E. of regression	0.113337	Akaike info criterion		-1.503489
Sum squared resid	11.25237	Schwarz criterion		-1.438773
Log likelihood	679.5491	Hannan-Quinn criter.		-1.478751
F-statistic	1231.002	Durbin-Watson stat		1.988660
Prob(F-statistic)	0.000000			

The estimated price flexibilities are presented in Tables 3 (Version 1) and 4 (Version 2). Recall that a price flexibility gives the percentage change in the retail watermelon price given a 1% change in an explanatory variable, holding all other explanatory variables constant. In Version 1, the results show that the quantity of watermelons sold in the market is negatively related with the

retail watermelon price. Specifically, a 10% increase in the quantity of watermelons available in the market results in a 3.52% decrease in the retail price of watermelons, holding all other demand factors constant. This inverse relationship between price and quantity reflects the law of demand, i.e., people buy more when the price decreases, and less when the price increases.

Table 3. Price Flexibility Coefficients for Model Version 1.

Retail watermelon price with respect to:	Coefficient
Watermelon quantity	-0.352
Honeydew melon quantity	0.126
NWPB combined activities	0.056

Honeydew melons are a compliment for watermelons. The price flexibility coefficients show that a 10% increase in the quantity of honeydew melons increases the retail price of watermelons by 1.26% when all other demand factors are held constant. This result is different from the 2012 report that found both cantaloupes and honeydew melons to be substitutes for watermelons.

The statistical results indicate that NWPB activities¹ have a positive and statistically significant impact on increasing retail watermelon demand. The combined generic watermelon demand enhancing activities by the NWPB has a flexibility coefficient of 0.056. That is, a 10% increase in NWPB promotion results in an increase in retail watermelon price of 0.56% when

¹ In this version of the model, NWPB marketing, communications, and foodservice activities are combined into one single variable. However, each is found to have a different lagged effect on the retail watermelon price. Specifically, marketing has an 8-month lagged effect meaning marketing activities 8 months ago impact the current retail price. Communications has a shorter lagged effect of 2-months, while foodservice has the shortest lagged effect of 1-month.

holding constant all other demand factors.² Ward (2008) found a one-month residual effect and a cumulative price flexibility of 0.173 using similar data over the period 2003.1-2007.6. Kaiser (2012) found a five-month residual effect on the retail watermelon price with a cumulative price flexibility coefficient of 0.098. The current result is in between these two previous studies.

Table 4. Price Flexibility Coefficients for Model Version 2.

Retail watermelon price with respect to:	Coefficient
Watermelon quantity	-0.316
Honeydew melon quantity	0.110
NWPB marketing	0.028
NWPB communications	0.019
NWPB foodservice	0.012

The price flexibility coefficients for Version 2 of the model are presented in Table 4. This version of the model has almost identical results to Version 1. Again, the results show that the quantity of watermelons sold in the market is negatively related with the retail watermelon price. Specifically, a 10% increase in the quantity of watermelons available in the market results in a 3.16% decrease in the retail price of watermelons, holding all other demand factors constant. A 10% increase in the retail price of honeydew melons increases the retail price of watermelons by 1.1% when all other demand factors are held constant.

The disaggregated demand enhancing activities by the NWPB all have a positive and statistically significant impact on retail watermelon prices. Generic watermelon marketing by

² Because there is error inherent in any statistical model, a 99% confidence interval is computed for the combined NWPB activities. This interval can be interpreted as the range of possible values where one can be confident that the true population price flexibility coefficient could be expected to fall 99% of the time. The 99% confidence interval (lower bound, upper bound) for the NWPB activities price flexibility coefficients is (0.015, 0.100). Since the lower bound of this confidence is still above zero, this adds credence to the notion that the NWPB is positively impacting retail watermelon demand.

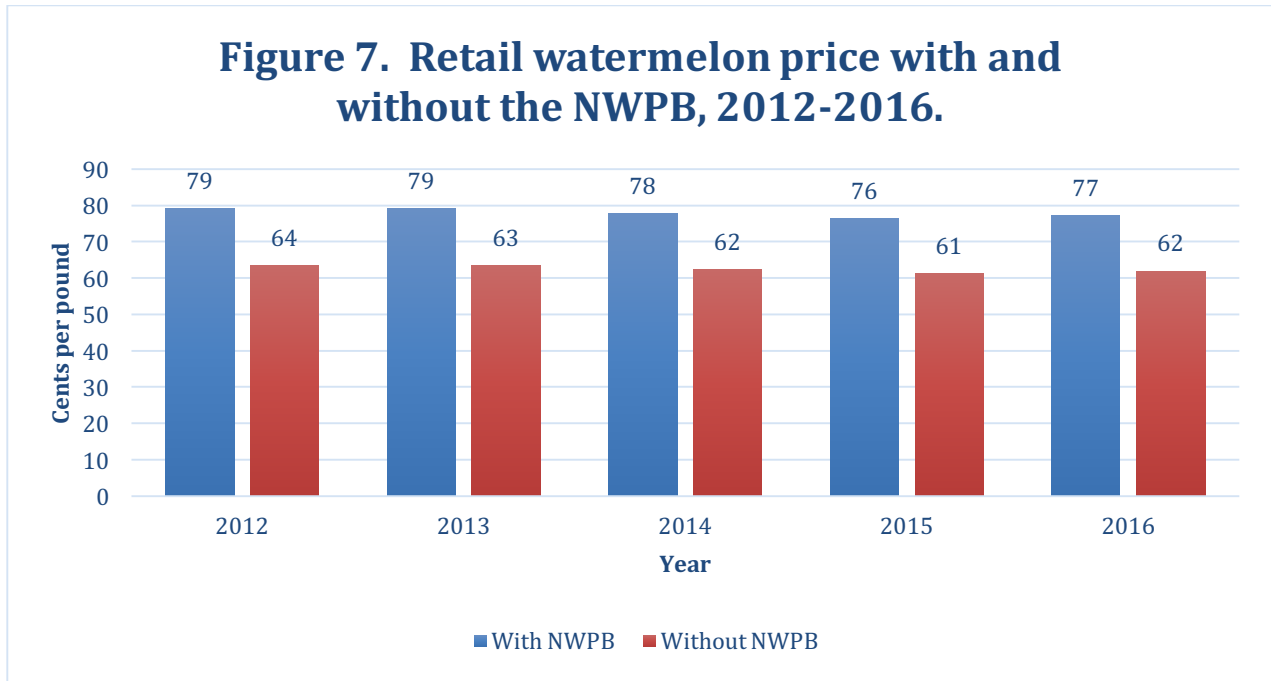
the NWPB has a flexibility coefficient of 0.028. That is, a 10% increase in NWPB marketing results is an increase in retail watermelon price of 0.28% when holding constant all other demand factors. NWPB communications have a price flexibility coefficient of 0.019, i.e., a 10% increase in communications increases the retail watermelon price by 0.19%, holding all other demand factors constant. Finally, NWPB foodservice activities has a price flexibility coefficient of 0.012.³

Simulation Analysis

The estimated retail demand model is used to simulate market conditions with and without the NWPB. Specifically, two scenarios are simulated over the time period 2012.1 – 2016.12: (1) baseline scenario, where the retail watermelon price is simulated based on all explanatory variables set to their historical levels, and (2) no-NWPB scenario, which is the same as the baseline except NWPB promotion expenditures are set to 1% of the historical levels. A comparison of the simulated retail watermelon prices between these two scenarios provides a measure of the impact of the NWPB's impact on retail prices over this five-year time period. In addition, using the price spreads between historical retail and farm watermelon prices, one can estimate the impact of NWPB promotion efforts on the farm price. Using this information, similar to the report by Ward (2006) and Kaiser (2012), one can estimate a rate of return on investment.

Over the period 2012 through 2016, the combined NWPB expenditures on marketing, communications, and foodservice totaled \$7.842 million. Figure 7 presents the estimated impact of those expenditures on the retail watermelon price for 2012 through 2016. In Figure 7, the

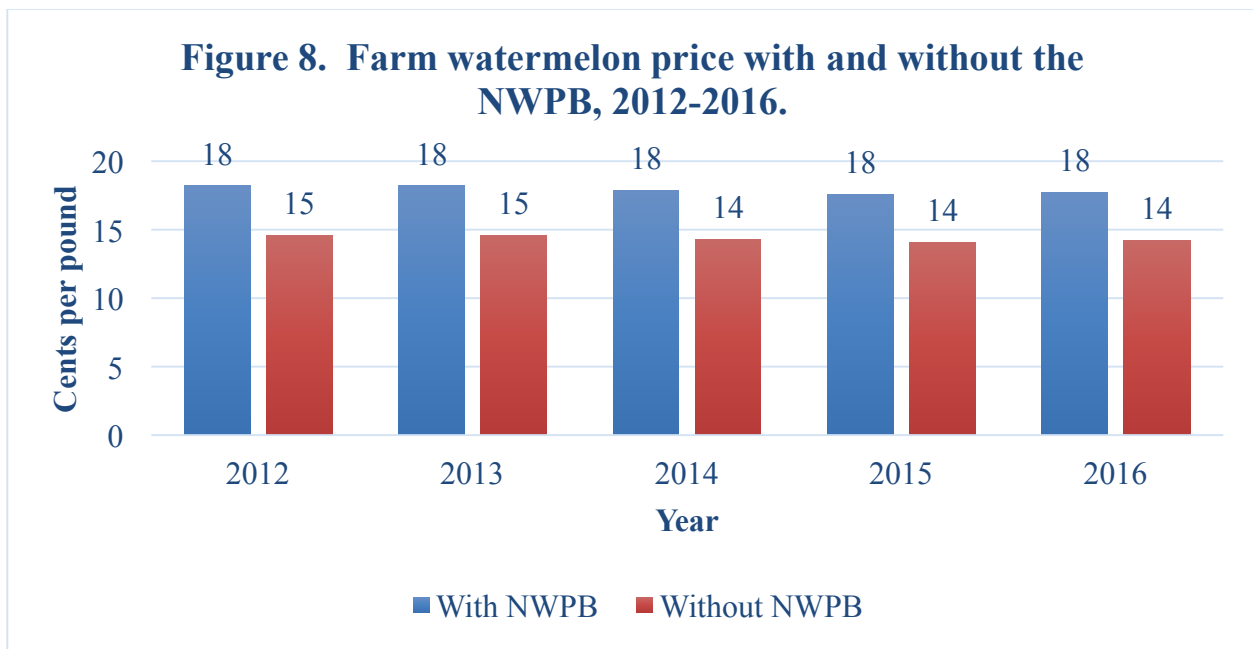
³ Again, a confidence interval is computed for each of the three NWPB promotion expenditures. Unlike the result before, the lower bound on both marketing and communications is zero. However, as the confidence interval on the aggregate activities of the NWPB previously indicated, we can be confident that the true population price flexibility coefficient for combined NWPB activities are positive 99% of the time.



retail prices under both scenarios are averaged over the entire year for each year and for all eight regions. In the graph, the blue bar represents the retail price with the promotion programs of the NWPB and the red bar is the average price without the promotion programs. Over the entire period, the retail price averaged 77.9 cents per pound with the NWPB and 62.5 cents per pound without the NWPB. In other words, had there not been any promotion by the NWPB over the last five years, the average retail price of watermelons would have been 15.4 cents per pound lower than it actually was. That is, the NWPB had the impact of increasing the retail watermelon price by 19.8%. This result is slightly higher than the 17.9% impact that Ward (2006) found on retail watermelon prices in his previous study of the NWPB, and almost identical to the 20% impact Kaiser (2012) found. Hence, retailers of watermelons clearly benefited from the NWPB's promotion efforts over the past five years.

A more important question is how do the stakeholders of the NWPB benefit from these promotions? Ideally, one could model the linkage between the farm and retail watermelon

prices, but unfortunately the historical data on retail prices that provide an adequate series for such a model are unavailable. Instead, the same procedure that Ward (2006) and Kaiser (2012) used in their studies that link the price spreads between FOB and retail prices is used. Both of these studies used the farm share of the retail value of watermelons. The farm share of the retail price for the period 2012-16 is around 23%, which is used here. Figure 8 shows the grower price with and without the NWPB over this period.



From 2012-16, the farm price averaged 17.9 cents per pound with the NWPB and 14.4 cents per pound without the NWPB. In other words, had there not been any promotion by the NWPB over the last five years, the average farm price of watermelons would have been 3.5 cents per pound lower than it actually was. This 19.8% increase in the farm price due to NWPB promotion programs is slightly higher than the 17.9% impact that Ward (2006) found and almost

identical to the 20% impact Kaiser (2012) found on farm watermelon prices in his previous study of the NWPB.

If we assume that the retail and farm pounds of watermelon are equivalent, as Ward (2006) and Kaiser (2012) did, one can multiply the increase in the farm price due to the promotions by the NWPB by retail U.S. sales (14.84 billion pounds from 2012-2016) to derive the gain in total dollar sales at the farm-level. Over the five-year period, the results indicate that the NWPB promotion effort resulted in an increase in total farm sales of watermelons of \$519.4 million. Based on these increased farm sales and the total budget of the NWPB over this period (\$15.7 million), the rate of return on investment (ROI) from the NWPB promotion is equal to:

$$\text{ROI} = (519.4 - 15.7) / 15.7 = 32.08.$$

In other words, each dollar invested in NWPB promotion returned \$32.08 in net farm revenue to the U.S. watermelon industry. The lower bound of a 99% confidence interval for this ROI estimate is 8.66, which is still much larger than 1.0 indicating positive net benefits of NWPB promotion programs.

This estimate is substantially larger than the 10.6 estimate by Ward. It is also slightly larger than the Kaiser (2012) study of the NWPB of 27.73.

Questions often arise about the accuracy of such estimates of ROIs in economic evaluations of commodity promotion programs. The resulting ROIs are generally large because promotion expenditures are exceedingly small relative to product value so only a small demand effect is needed to generate large positive returns. For example, average NWPB promotion expenditures in 2016 were less than 0.5% of the farm value of watermelon. Still, this relatively small investment in watermelon promotion increased net revenue by almost \$104 million per year over the past five years. Therefore, the resulting ROI is quite large.

How does the ROI estimated above compare to that for other promotion checkoff programs? Kaiser (2011) conducted a comprehensive literature review of 21 domestic checkoff programs and found that the median rate of return was 6.0. Hence, the 32.08 estimated here for the NWPB is substantially higher than the median for these selected studies.

Broader Economy-wide Impacts

Promotion benefits a range of stakeholders beyond the growers that fund the promotion activities. For example, local input suppliers benefit from additional fertilizer or pesticide purchases, and local workers benefit from either higher wages, or more harvesting and post-harvest processing jobs. State and local governments also benefit from the incremental taxes associated with growers' earnings.

The magnitude of each of these spillover, or "multiplier," effects depends upon how the fruit in question is produced and sold. If a particular fruit is machine-harvested, for example, the labor input will be very low, but the local capital expenditure, mechanic employment, and software investment will be greater than otherwise. Each of these relationships can be summarized in an "input-output model" that contains data on the technical relationships between each input supply industry, the outputs for the industry in question (total crop revenue), and broader macroeconomic outputs such as employment, labor income, value-added, and gross domestic product (GDP). A previous study by Kaiser, Richards, and Keeney (2016) of fresh fruit promotion used a particular input-output model called IMPLAN (IMpact analysis for PLANning, Mig, Inc.), which consists of a large-scale input-output database representing nearly every industry in the U.S. at the ZIP code, county, and state level. The implied multipliers of

that study for Florida citrus are used here to estimate the broader economy-wide effects of watermelon promotion.

More specifically, the difference between grower revenue with and without NWPB promotion is used as the basis for the input-output model to compute the broader economy-wide effects. Two scenarios are simulated and compared: (1) NWPB program in effect, and (2) no NWPB in effect. In comparing the two scenarios, we calculate the implied increment in employment, labor income, value added, and GDP associated with the having the NWPB in effect. The result is a summary measure of the broader regional-macroeconomic impact of each type of promotion.

Using 2015 as a basis, total production of watermelons in 2015 was 3.51 billion pounds. Based on the 3.5-cent increase in price due to NWPB promotion, that means the watermelon checkoff program created \$122.9 million in incremental grower revenue in 2015. That is, the difference in grower total revenue due to the NWPB is \$122.9 million in 2015. This number is used as an input into the implied multipliers from the Kaiser, Richards, and Keeney (2016) analysis to obtain estimates of the broader effects of the NWPB on the general economy.

The results are displayed in Table 5. The NWPB had substantial impacts on the general economy as illustrated in Table 5. This table displays the long-run regional impacts of NWPB promotion on employment numbers, employment income, value added (an approximate measure of the incremental profit generated not only for watermelon growers, but for input suppliers, packers, and wage-earners as well), and total economic output. The direct effects mean the effects directly attributable to the NWPB. The indirect effects measure the part of the multiplier associated with increase input purchases due to higher demand by the local sector, e.g., nursery

stock, pesticide, or fertilizer. The induced effects are the second-order effects created by labor income spending in the regional economy.

The results indicate that spending on promotion by the NWPB increased employment in the industry by 2,650 jobs and increased labor income by \$87.6 million. It also increased value added to the nation by \$156.9 million. The total effect of NWPB spending increased economic output in the nation by \$200 million.

Table 5. Broader impacts of NWPB on general economy, 2015.

	Employment (number)	Labor income (mil \$)	Value added (mil \$)	Economic Output (mil \$)
Direct Effect	2,034.4	61.5	111.1	121.6
Indirect Effect	149.0	5.2	9.2	13.1
Induced Effect	466.8	19.6	36.6	64.1
Total Effect	2,650.2	87.6	156.9	200.0

Conclusions and Implications

The purpose of this research study was threefold, to: (1) determine the domestic market impacts of the NWPB's demand enhancement programs, (2) compute a rate of return on investment for the promotion activities conducted by the NWPB, and (3) measure the broader economic effects of the NWPB on employment, labor income, value added, and total economic output. Monthly retail scanner data on watermelon prices and volume sold, and cantaloupe and honeydew melon volume sold since 2007 were combined with monthly promotional expenditure data to estimate a retail watermelon price-inverse demand function. Similar to Ward's 2008 study and Kaiser's 2012 study, these data were further decomposed on a U.S. regional basis to

look at cross-sectional variation in eight separate regions: California (CA), Great Lakes (GL), Mid South (MS), Northeast (NE), Plains (PL), South Central (SC), Southeast (SE), and West (W). Based on this retail demand model, several conclusions were evident on the impacts of the NWPB generic promotion programs:

- NWPB's domestic promotion programs had a positive and statistically significant impact on watermelon demand. Combined generic watermelon promotion (marketing + communications + foodservice) had a cumulative price flexibility coefficient of 0.056. That is, a 10% increase in NWPB promotion resulted in an increase in the retail watermelon price by 0.56% when holding constant all other demand factors.

- In terms of individual promotion programs, watermelon marketing by the NWPB had a flexibility coefficient of 0.028. That is, a 10% increase in NWPB marketing resulted in an increase in retail watermelon price of 0.28% when holding constant all other demand factors. NWPB communications had a price flexibility coefficient of 0.019, i.e., a 10% increase in communications increased the retail watermelon price by 0.19%, holding all other demand factors constant. Finally, NWPB foodservice activities has a price flexibility coefficient of 0.012.

- Generic watermelon promotion had a significant impact on retail watermelon prices. From 2012 through 2016, the retail price averaged 77.9 cents per pound with the NWPB and 62.5 cents per pound without the NWPB. In other words, had there not been any promotion by the NWPB over the last five years, the average retail price of watermelons would have been 15.4 cents per pound lower than it actually was. That is, the NWPB had the impact of increasing the retail

watermelon price by almost 20%.

- The farm price averaged 17.9 cents per pound with the NWPB and 14.4 cents per pound without the NWPB. In other words, had there not been any promotion by the NWPB over the last five years, the average farm price of watermelons would have been 3.5 cents per pound lower than it actually was.
- Over the five-year period 2012-2016, the NWPB promotion effort resulted in an increase in total farm sales of watermelons of \$519.4 million or \$103.9 million per year.
- The estimated ROI from these activities was 32.08:1. In other words, each dollar invested in NWPB promotion returned \$32.08 in net farm revenue to the U.S. watermelon industry.
- NWPB promotion programs also had sizable impacts on the general economy. The analysis indicated that the NWPB increased employment by 2,650 jobs, added \$87.6 million in labor income, added \$156.9 million in valued added, and \$200 million in total economic output to the general economy.

The main implications of this study are that the watermelon industry is getting a very high return from the domestic promotion efforts of the NWPB, and that these promotion programs have had a significant impact on the general economy. The estimated ROI indicates that it would be profitable, from an industry standpoint, to increase the level of domestic promotion of watermelons. Indeed, compared with other commodities, the returns to generic

watermelon promotion are substantially higher than the median result.

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