# **Evaluation of Grower-Funded Marketing Activities by the**

# **United States Potato Board**

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# **Executive Summary**

- The U.S. potato market has been volatile over the past five years (CY 2007 CY 2011). According to USDA data, the per capita consumption of potatoes of all forms in the U.S. has changed dramatically over this period. Grower prices were largely responsible as prices peaked at \$23.66 / cwt in 2008 and fell to a little over \$6.00 / cwt only one year later. The recession and higher prices for all commodities presented a challenge for all commodity marketers over this period.
- In 2009, the U. S. Potato Board (USPB) began a media advertising program for the first time in several years. This study evaluates the effectiveness of not just advertising activities, but all forms of marketing investment, from retail category management programs to consumer publicity, innovation research and export market development.
- The objective of this study is to determine the return on investment to grower funds invested in USPB marketing activities. The relevant markets for U.S. potatoes are defined as the domestic retail market (frozen, refrigerated, chips, bagged fresh, bulk fresh and dehydrated potatoes), the domestic food service market (formed products, chips, frozen, whole, mashed, dehy), and export markets for seed, fresh, frozen and dehydrated potatoes.
- Econometric models are used to estimate the demand impact of USPB activities. Four models are created for this purpose: a domestic retail model, a domestic food service model, a domestic "best practices" model to estimate the effect of targeted category management programs, and an export market model.
- All models are estimated with data made available from USPB records and include retail scanner data from Nielsen Perishables Group, Inc., PotatoTrack survey data from NPD Group, and USDA export data gathered by the U.S. Department of Commerce. USPB records provide expenditure data on advertising investments, public relations activities, domestic food service and retail programs, domestic chip programs, research expenditures and spending on all export promotion activities.
- Benefit-cost ratios (BCR) are used as the measure of grower return on investment. Benefits are measured as the incremental producer surplus (a measure of industry profits) due to a simulated marginal increase in each program activity. Costs include all program expenditure in each targeted area. A BCR is interpreted as the dollars in incremental profit for an additional dollar of investment. For example, a BCR of 2.0 indicates that an additional dollar of investment can be expected to yield \$2.00 of incremental grower profit.
- All results are interpreted first in terms of their demand elasticity before calculating the resulting equilibrium BCR values. The elasticity of demand is defined as the percentage change in volume sales for a given percentage change in either price or or marketing

expenditure. For example, a price elasticity of -1.50 indicates that potato sales decline by 15.0% for every 10.0% increase in potato prices. Similarly, a marketing elasticity of 0.05 suggests that volume sales rise by 0.5% for every 10.0 increase in marketing expenditure.

- In the Domestic Retail market, the price elasticity of demand for all potato products, on average, was estimated to be -0.581 in the short run and -1.910 in the long run. Demand is thus inelastic in the short run and elastic in the long run. With respect to marketing investments, the estimated advertising elasticity of demand was 0.083 in the short run and 0.272 in the long run; the elasticity of demand with respect to consumer publicity was 0.034 in the short run and 0.113 in the long run, and the elasticity with respect to all other activities was 0.116 in the short run and 0.380 in the long run. These elasticities imply BCRs with respect to advertising of 1.073 in the short run and 3.539 in the long run; BCRs of 0.439 in the short run and 1.462 in the long run for consumer publicity, and 1.501 in the short run and 4.976 in the long run for all other investments.
- The estimated returns to marketing in the Food Service market are substantially higher than in the Domestic Retail market, at least in the short run. USPB advertising returns \$2.029 for the next checkoff dollar in the short run and \$2.981 in the long run. Consumer publicity returns \$4.252 for the next dollar in checkoff funds in the short run and fully \$6.223 per dollar in the long run. Food service marketing programs, which are marketing investments targeted specifically to the Food Service industry, produce a marginal BCR of 6.231 in the short run and 12.482 in the long run. Clearly, all of these investment returns are far better than growers' next-based investment vehicles.
  - Taken as a whole, domestic marketing efforts have been highly successful. Overall, Domestic Marketing programs earned an average BCR of 2.921 in the short run and 5.228 in the long run.

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- The Best Practices model, which comprises Best in Class, Best Practice Partner and Testand-Learn programs, was evaluated using a difference-in-difference approach. The incremental net revenue to growers (increase in farm gate revenue less production cost) from these partnership investments was estimated to be \$21.83 in profit for each dollar invested, assuming an 8% profit margin.
- International markets represent a major growth opportunity for US potato growers. Price elasticities of demand for dehy, fresh and frozen potatoes were -1.545, -1.026, and -0.968 in the short run and -1.782, -1.384, and -1.519 in the long run. Aggregating all USPB marketing activities into one spending category, the short-run response elasticity estimates were 0.062, 0.073, and 0.054, in the dehy, fresh and frozen markets respectively, and 0.072, 0.098, and 0.085 in the long-run. Each of these elasticities is relatively high and imply BCRs of 2.53, 4.90 and 6.39 under the most-likely supply elasticity assumption (elasticity = 1.5). The returns to seed promotion were evaluated in a separate model in which we found a price elasticity of -0.389 and a promotion elasticity of 0.186 (dynamic effects were not statistically significant). This promotion elasticity implies a return of \$2.89 for each dollar invested in the most-likely scenario. The overall

BCR in international markets was 4.93.

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On average, across all markets and type of investment, we found a BCR of 5.167 in the short run and 6.511 in the long run. Because these BCRs are estimated using econometric models, they are interpreted as returns on investment holding everything else constant, or the value of the USBP relative to a world absent USPB programming.

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#### Introduction

The U.S. potato market has been unusually volatile over the 2007 - 2011 period covered by this analysis. Record commodity prices in general, and the subsequent competition for scarce potato-growing land, is but one macro-development that has meant near-record high potato prices. With high prices, however, comes lower demand. At the same time, the worst economic conditions since the Great Depression have meant that some segments of the market, food service most notably, have faced a double-dose of economic pressures for lower sales. Nonetheless, because potatoes present a good value proposition for families, other segments of the potato market performed well throughout the economic malaise of the late 2000s. It is important to remember, therefore, that the analysis contained herein represents a description of what would have happened in the absence of Potato Board marketing activities. That is, we take both prices and the general level of economic activity into account in determining the return on investment to Board investments, independent of the other factors that may have influenced sales volumes in the potato market.

#### **Problem Statement**

s required by the Farm Security and Rural Investment Act of 2002, all federally sanctioned marketing orders must conduct an econometric assessment of the impact of their activities on grower profits. Therefore, this study presents an econometric evaluation of the demand impact of USPB marketing and public relations activities and a simulation model that estimates the return on growers' investment in USPB programs.<sup>1</sup> As promised, however, this report describes a set of models that will also help managers at the United States Potato Board (USPB) continue to make effective and efficient use of check-off funds. Specifically, the return on investment (ROI) models developed for the domestic retail, domestic food service and export markets can be used to help USPB better understand the relative returns to each of these programs.

<sup>&</sup>lt;sup>1</sup> Throughout this proposal, the terms "marketing" and "research" activities are used to describe in general terms the entire set of USPB activities, which are understood to be much broader in scope than traditional advertising and promotional efforts. Developing best practices, building public relations, industry outreach, opening export markets and supporting product research and other activities are assumed to fall within these broad definitions.

#### **Objectives of the Analysis**

he primary objective of this research is to estimate the long-run return on stakeholders' investment in each marketing activity over the CY 2007 - 2011 period. Our research will also generate a number of other outputs of interest to USPB stakeholders, including estimates of:

• the long-run impact of USPB marketing expenditures on the retail, food service and export demand for all potato products (frozen, refrigerated, chips, bagged fresh, bulk fresh, and dehydrated in the domestic retail market, skins, chips, formed products, hash browns, mashed, frozen french fries and whole potatoes in the domestic food service market, and fresh table stock, fresh chipping stock, frozen, dehydrated and seed potatoes in the export market) using appropriate econometric modeling techniques applied to retail scanner data, food service supplier survey data, and US Department of Commerce export data, respectively;

• the long-run impact of USPB marketing expenditures on prices paid to growers by retailers, food service buyers and foreign importers by developing and estimating econometric models of the supply chain for each potato product and market;

• the expected annual increment to grower profit, the net present value of all future profit (net of program costs) and, ultimately, the ROI (expressed as a benefit:cost ratio, or BCR) due specifically to USPB marketing activities.

We achieve these objectives using simulation models that are well-accepted in the academic literature on generic commodity promotion, and that are well-suited to adaption by USPB staff for their own use as prescriptive, managerial tools.

### The Theory of Promotion Evaluation

For promotion of any sort to be effective, it must increase the demand for the targeted commodity.<sup>2</sup> This increase in demand, moreover, must generate sufficient profits at the grower level to cover the cost of the investment. Any incremental gains above the amount invested represents a return on growers' investment. The simple logic behind this principle is illustrated by a supply and demand diagram.

In figure 1 (see appendix), demand shifts outward if the promotion program is effective in either generating new users or in increasing the consumption level of existing users. In the short-run, that is within a particular growing year, the supply of a crop is assumed to be fixed, or nearly so. To the extent that some potatoes are processed, however, suppliers have the ability to manage

<sup>&</sup>lt;sup>2</sup> For purposes of this study, marketing efforts are defined in the most general terms. That is, marketing includes traditional advertising, public relations, merchandising, price discounting and any other activity that is designed to influence consumer purchase decisions, either now or in the future.

inventory such that any rapid changes in demand can be absorbed by moving product from inventory or storage. Therefore, the elasticity of supply, or the slope of the supply curve in figure 3, is assumed to be relatively steep, but not perfectly vertical. A vertical supply curve reflects a supply that is fixed in absolute terms.<sup>3</sup> In the empirical analysis below, we assume the elasticity



Figure 1 Calculation of Return on Investment

of supply in the "base scenario" of 1.00, although we report BC results over a range of possible values. In this way, we demonstrate the impact of allowing the elasticity of supply to change on the value of potato marketing.

Marketing activities must raise the price of the commodity in order to generate incremental value. This concept is easily demonstrated through figure 1. At an initial equilibrium market

price (that is, before any marketing is conducted) of  $P_0$ , consumers receive a "surplus" on each unit purchased because they are willing to pay (indicated by the height of the demand curve) more than what the market requires them to. The total of this consumer surplus is the area below the demand curve ( $D_0$ ) and above the market price. Producers, on the other hand, receive a surplus on each unit sold to the extent that the market price is greater than their marginal cost of production (indicated by the height of the supply curve,  $S_0$ ). The total amount of producer surplus is given by the area bounded by the points "abc" that lies below the market price and above the supply curve.

Effective marketing causes the demand curve to shift from  $D_0$  to  $D_1$ . There are two ways to interpret this "shift" in demand. Either each consumer is willing to pay more for each unit that he or she purchases, or there are simply more consumers buying the good at each price. The benefit to potato marketers from this shift in demand comes from a rise in producer surplus, or profit. In figure 1, producer surplus rises from the triangle "abc" to the larger triangle "aed." The difference, or "bcde" represents the incremental return to the marketing program. The BCR, therefore, is calculated as the ratio of "bcde" to the amount invested in the program.

<sup>&</sup>lt;sup>3</sup> Beyond inventories, imports also respond to changes in the market price. If the quantity traded in figure 1 represents the aggregate of domestic and import production, then supply is more elastic than if only domestic supplies are considered.

Notice that the price must rise in order to create additional producer surplus. From figure 1, it is apparent that a necessary condition for this to occur is that the supply curve must be upward sloping, and the increment to producer surplus depends critically on the slope of the supply curve, as will be apparent in the empirical results discussed below.

While the measure of producer surplus described in figure 1 refers to the entire potato marketing channel, growers are interested only in their share. Promotion that adds value only to processors or retailers is of no value to growers. Consequently, it is necessary to estimate the retail-farm price transmission elasticity, or the extent of price pass-through from the retail to the grower level. We show how the price-transmission elasticity is estimated in the appendix, but the concept is straightforward. When retail prices rise, sellers do not necessarily pass this price increase directly to suppliers for two reasons. First, retailers do not see a one-for-one change in revenue because when they raise the price, they sell a lower quantity. Because they are selling fewer units, their demand on the input market is less. This causes input prices to fall. On the other hand, the incremental value of each input is higher, so sellers are willing to pay more for each unit that is brought to market. The net effect is, therefore, an empirical question. The method outlined in the appendix shows how we resolve this question and determine how much of any demand increase is passed through to growers in terms of higher prices.

Of course, however, this simple, static diagram does not nearly reflect the complex nature of commodity promotion in the "real world." In particular, funds allocated toward a particular program or strategy are more appropriately viewed as investments in a stock of awareness, goodwill or a cohort of potato consumers. As a capital stock, promotion investments are necessarily long-lived, lasting for many months, quarters or years beyond the period of initial expenditure. In this study, we incorporate this logic by allowing monthly expenditures in a particular area to accumulate over time, depreciating at a rate that is commonly accepted, and widely tested, in the promotion literature (Clark, 1976; Kaiser, et al., 2005). In this way, grower funds allocated for a particular purpose in the current month are assumed to have impacts that last nearly a year. Because we allow for both short- and long-run effects, the BCRs reported below consist of short- and long-run returns. Clearly, long-run returns are more relevant for growers with significant capital invested in growing and marketing potatoes.

#### **Research Methods and Econometric Models**

#### Overview

We estimate four models: (1) a Domestic Retail model (bulk fresh, bagged fresh, refrigerated, frozen, chips and dehy), (2) a Domestic Food Service model (skins, chips, formed, mashed, frozen fries, hash browns, whole potatoes, and miscellaneous products), (3) a Best Practices model (bulk fresh), and (4) an Export Market model (frozen potato products, fresh potatoes (table stock and chipping stock), dehy and seed). The components of each model consist of: (1) a demand model, (2) a model of the retail-farm price linkage and (3) an investment return, or ROI model. In the following sections, we describe each phase of the econometric modeling strategy in general terms, with more detail provided in the technical appendices.

#### Stage I: Econometric Analysis of Demand

The critical outputs of each econometric model are "elasticity" estimates that show the percentage change in demand for a percentage change in each explanatory variable – prices, demographic factors or indicators of marketing effort. The mathematical details of the model used in the Retail and Food Service evaluations are provided in appendix A, so we only summarize the structure of the estimated model and the assumptions that are made in its implementation. Demand models for all markets and products are similar in form, so the description applies equally to all components of the Domestic Retail, and Food Service models.

The logit model described in the appendix is becoming an increasingly popular means of estimating the demand for differentiated products. Because the dependent variable in the logit model is each product's share of the entire retail category (eg., bulk fresh potato sales as a share of all retail potato and potato product sales, also referred to as the "marginal share") it is necessarily a model of how consumers allocate their potato dollar among imperfectly substitutable products. By including an "outside option" or some part of the total demand for potatoes that is not included in the model, we also allow for aggregate category expansion over time. Given that this is the goal of all USPB programming, the logit model is well-suited to the purposes at hand. Logit models have been found to produce far more reliable, accurate and consistent estimates of demand elasticities relative to traditional demand systems.

The logit demand model also includes a number of factors that demand theory suggests are likely to cause demand to change over time, or to vary across regions. Clearly, price is the most important of these factors. As a share model, the logit implicitly takes into account the response of each product to changes in other product prices. We also include an aggregate measure of consumer disposable income, because consumers change both the amount and types of products they buy as they become more wealthy. Third, the overall population is a critical component of a model that seeks to explain the national demand for a widely consumed consumer product. Fourth, USPB marketing activities are included as investments in potato marketing equity. Finally, we include a number of regional and quarterly indicator variables in the Domestic Retail and Food Service models in order to account for unmeasurable demand factors that may vary by time or by place. Details on how each of these variables is constructed are provided in the Data Description section below.

The Export Market model, on the other hand, is a "log-log" model in which the regression model is specified in linear form after taking the natural log of all variables. In the estimated model, the dependent variable is therefore, the log of the volume of a particular product form (fresh, dehy, frozen, etc.) exported to a specific market during each time period. The right-side, or explanatory variables, include prices, income, exchange rates, and export promotion variables. Log-log models are convenient because each estimated coefficient is an elasticity without conversion or

further calculation. Such log-log models are commonly used for evaluation purposes and are standard in the literature.

In a competitive industry, higher returns due to demand expansion will invite entry, a higher supply and, ultimately, lower prices. Consequently, econometric models that account for long-run changes in demand must also allow for grower supply response. We account for changes in potato supply by estimating a simultaneous demand-and-supply system. Rather than formally estimate a model of supply, however, we estimate the demand model using an instrumental variables approach where the instruments are chose in order to adequately account for supply variability. Suitable instruments include input prices for potato production (seed, fertilizer, energy), wages paid to agricultural workers and annual potato yields – a proxy for technological improvements in potato production.

The Best Practices Model is fundamentally different from the other three due to the nature of the data gathered by the USPB and The Perishables Group. Due to the intensive data gathering activities of the USPB, evaluating the Best Practices program on its own represents an opportunity to drill down into specific aspects of the USPB domestic marketing program, but is not a formal requirement of the USDA evaluation mandate. It should be noted that the investments required to implement the Best Practices program are included in the Domestic Retail and Foodservice models above, so this section of the report should be regarded as complementary to the analysis above and not a separate evaluation.

In order to take advantage of the data generated by the Best-in-Class experiment, we employ a difference-in-difference method of analyzing the data. Essentially, the difference-in-difference approach uses a simple linear regression model to estimate the impact on category sales due only to the intervention by comparing the change in sales before and after the beginning of the program between intervention and control stores. In terms of a regression model, the difference-in-difference-in

$$S_{jt} = \beta_0 + \beta_1 T P_{jt} + \beta_2 B P_{jt} + \beta_3 B P_{jt} * T P_{jt},$$

where  $S_{jt}$  is the dollar sales by chain *j* in month *t*,  $TP_{jt}$  is a binary variable that equals 1 during the period in which the Best-in-Class program is implemented and 0 prior to that period,  $BP_{jt}$  is a binary variable that equals 1 for the chain that implements the program and 0 for the "control chain," and  $TP_{jt} * BP_{jt}$  is the product of the two binary variables. Because the method of least squares used to estimate this equation implicitly uses the difference of each variable from its own mean, it perfectly reflects the experimental difference-in-difference intuition described above. By including the  $TP_{jt}$  and  $BP_{jt}$  variables, we account for the fact that sales may differ during the sample period simply because they are trending upward and also may be higher for the test chain for reasons unrelated to USPB activities. The parameter on  $TP_{jt} * BP_{jt}$ , therefore, is interpreted as the effect that is due entirely and specifically to the Best-in-Class program. Further, because this

model explains the difference between monthly sales of control and test store, the coefficient is interpreted directly as the incremental monthly revenue due only to Best-in-Class.

The difference-in-difference approach used here to evaluate the Best Practices program in an entirely different way from the methods used to evaluate the other programs. That is, instead of estimating demand elasticities and simulating the implied welfare changes, the difference-in-difference method is based on the counterfactual experiment that directly estimates the incremental retail value generated by following the set of category management practices recommended by the USPB. When interpreting these results, it is important to remember that we are not calculating incremental grower profit as in the cases above as we do not know the grower cost of the additional potatoes sold through the program. Recall that there are three types of Best in Practice programs included in this analysis: Best-in-Class, Best Practice Partners, and Test & Learn programs.

### Stage II: Retail-Farm Price Linkage

Higher demand does not necessarily translate dollar-for-dollar into grower revenue. In fact, promotion impacts are necessarily estimated at the retail level, while growers are more interested in incremental revenue at the farm gate. Market power by both buyers and sellers, marketing methods, distribution costs, contracting arrangements and other institutional features determine the share of each incremental retail dollar that ultimately finds it way into growers' hands.

To account for the potentially imperfect pass-through of changes in retail demand to the grower level, the econometric procedure includes an econometric model of price relationships in the potato industry. With this model, we estimate the extent to which retail and food service demand is passed through to higher grower income. The details on the mathematical form of the estimated price-linkage model is provided in appendix B.

### Stage III: Net Present Value of Incremental Profit Calculation

Once the retail-farm pass-through of the shift in demand created by USPB marketing activities is estimated, we are able to calculate the increment to profit that this implies. Profit is calculated for each different product form and summed to arrive a net change in producer surplus (in terms of the theory developed in figure 1). We then calculate the net present value by multiplying the resulting change in profit by a term that reflect the time value of money over a five-year time horizon and a reasonable estimate of stakeholders opportunity cost of capital (5.0%). A benefit:cost ratio is then calculated by dividing the net present value by the average monthly investment over the sample period.

### **Data Description**

Overview

In this section, we describe the data that were used to estimate the demand impact of USPB activities targeted toward the retail, foodservice and export markets. In each case, the data sets are currently maintained by either the USPB or by the U.S. government so the results described herein are readily replicable by any interested researchers. For each model (domestic retail, domestic foodservice, domestic "best practices," and export markets) we describe the basic demand data – product price and quantity movement – as well as data on all other factors that are expected to drive potato demand. These factors include a number of USPB activity metrics in addition to external variables such as personal income, prices for substitute products, the size of the consuming population and a number of others.

### Time Period

The same period used for this analysis includes the 2007 - 2011 marketing years (July 2006 - June 2011). Because USPB records were only available for the calendar years 2007 - 2011, however, the sample was changed to represent the available data. This period represents an ideal opportunity to evaluate USPB effectiveness, because a consumer advertising program was initiated in 2009 after many years of zero-investment. The resulting data series represents a nearly ideal "natural experiment" in the effectiveness of generic advertising in that the sample period consists naturally of a control period during which no advertising takes place, and an "intervention" period in which significant advertising investments were made.

### Data and Variable Description

### Domestic Retail Model

The data for the Domestic Retail Model were obtained from Nielsen Perishables, Inc., which is a syndicated (retail scanner) data provider based in Chicago, IL. Nielsen Perishables data describes movement of all branded and non-branded potato products (bagged fresh, bulk fresh, chips, frozen, refrigerated and dehydrated) through all vendors with \$2.0 million (and above) in annual sales. We include in this analysis results for the entire sample period for "traditional" scanner data that includes all supermarkets, and results for the last three years that includes club stores and superstores as well. Estimating these two models separately was necessary because superstores and club stores only recently began to participate in Nielsen's data syndication program, and only made data available for the last three years.

In each product category, we aggregated over individual UPCs (where relevant) and weeks in order to express the retail movement data on a frequency similar to the USPB budget data, which is recorded monthly. All retail data are recorded using Nielsen's nine-region classification of geographies: East North Central, West North Central, New England, Mid Atlantic, Mountain, Pacific, East South Central, West South Central and South Atlantic. With these nine regions, we estimate the model with a total of 5 years \* 12 months \* 9 regions = 540 observations for each product.

Estimating retail demand required that we control for variation in macroeconomic conditions more generally, and account for likely variation in potato supply over the sample time period. Data on gross domestic product (GDP) growth, unemployment rates, interest rates, and women's participation rate in the workforce, were obtained from the Federal Reserve Board of the United States. Each of these variables was tested for statistical significance in the econometric model and any that were clearly not significant were not included in the final model. We instrumented for variation in potato supply by estimating the model with two-stage least squares (2SLS). Our instruments included a number of variables likely to influence the cost of producing and marketing potatoes, and variation in potato yield: retail wages, agricultural production wages, fertilizer cost, fuel cost, utility cost, an index of finance, insurance and real estate prices, and an index of rainfall in Idaho. These instruments proved highly effective in controlling for endogenous variation in potato prices. A summary of all variables used in the retail model is provided in table 1 in the appendix.

A common set of USPB marketing investment variables were used for both the Retail and Food Service models (with obvious differences for Best Practice Program investments and the food service program). Based on consultations with USPB marketing officials, we categorized each budget item into one of eleven different investment classes: (1) advertising, (2) chip program, (3) consumer publicity (relations), (4) food service, (5) innovation, (6) issues management, (7) nutrition, (8) partnerships, (9) research, (10) retail, and (11) fry program. Estimating the econometric models described below with only a limited number of observations, however, means that we had to aggregate several of the above categories into one "other investments" category in order to uncover the independent effect of investments in the most important areas. For each of the retail and food service models, this left three categories of investment, two of which appear in both models: advertising and consumer relations. Some of the eleven types of investment that are not intended to shift demand within the time frame of the sample period (research, chip program, innovation, and fry program, to be specific) were excluded from the analysis.

### Domestic Food Service Model

The data for the Food Service Model are from the PotatoTrac service provided by NPD, Inc. Unlike the retail scanner data provided by Nielsen Perishables, which measures items that are actually purchased, the PotatoTrac data are instead gathered via a survey of food service suppliers. As a survey, the PotatoTrac data are likely to contain significant measurement and sampling error, but we have no basis upon which to judge whether this error is likely to bias our estimates upward or downward. Moreover, it is unknown whether this supplier survey is any more or less accurate than the buyer census data covered by the Perishables scanner data. The variables measured by the PotatoTrac data are similar to those covered by the retail data, but for a slightly different set of product categories. We define food service categories that include diced products, formed products, frozen french fries, hash browns, mashed potatoes, whole potatoes, potato skins, and a miscellaneous category that captures everything else. The data set includes volume sales and dollar sales, from which we impute unit value indices (prices) for each product. Importantly, the PotatoTrac data are available only on a quarterly basis, so for estimation purposes we aggregate the USPB budget data up to the quarter-level and estimate the model with a total of 20 quarters for each product. Because this represents a very low number of observations, we pool the data over all products for the logit model in order to create a data set amenable to estimation.

# Best Practices Model

The data used for the Best Practices model are provided by the Nielsen Perishables Group, and include the Best-in-Class, Best Practice Partners, and Test & Learn programs. All three programs are aggregated together so that the overall effect of all three are being measured in the model. The following describes each of the three programs, along with the participating retailers and the time period that the programs were implemented.

The Best in Class (BIC) Program is a partnership between USPB, suppliers and retailers to innovate and grow retailer potato categories via proven best practices: assortment, merchandising, pricing and promotion. The retailer implements recommendations chain-wide and we use the ROM (rest-of-market) to assess performance. The goal is to increase sales through:

- a. Product mix that meets consumer needs
- b. Tiered pricing
- c. Effective promotions
- d. Consumer education
- e. Merchandise how consumers shop the category

Two retail chains are featured in the BIC Program: Meijer and Seattle Safeway. The Meijer BIC Program started January 2009 and ended September 2012. Nielsen Perishables provided monthly potato sales per store data (dollars per \$MM/ACV) for Meijer beginning in the pre-program period of September 2008 and ending in the post-program period of June 2012. In addition, the model also includes monthly per store potato sales for Meijer rest-of-market (ROM) as well as Meijer market to compare the treated store with. The Seattle Safeway BIC program began in January 2010 and ended in December 2012 and the monthly data for the treated and control stores begins in January 2009 and ends in June 2012. The control stores include Seattle Safeway market and ROM.

The Best Practice Partner (BPP) is a shorter-term program that allows retailers to choose and focus on one best practice to meet their organization's strategies and goals. The participating retailers in this program include Price Chopper, Save-a-Lot, and Walmart, however, due to data availability only Price Chopper is included in the model. The program period is for November 2009 to June 2011, and the monthly potato per store data for Price Chopper, Price Chopper market, and Price Chopper ROM begins in January 2009 and ends in June 2012.

The Test and Learn (TAL) program provides an opportunity to evaluate the effectiveness of potential new best practices to expand USPB resources and offerings. The TAL participating retailers include Stater Brothers, Seattle Safeway, Giant, Eagle, Vons, and Meijer. The Stater Brothers TAL program was from November to January 2010; Seattle Safeway from July 2009 to March 2010; Giant Eagle from May to July 2011; Vons from October to December 2011; and Miejer from April to May 2012. Monthly per store potato sales data are included for both a pre, during, and post period as well as for control stores.

#### Export / International Market Model

The international market model consists of four separate import demand equations for US potatoes: (1) fresh potatoes, (2) frozen potatoes, (3) dehydrated potatoes, and (4) seed potatoes. To estimate the impact of USPB research and marketing activities, we use annual potato trade data obtained from the Foreign Agricultural Trade of the United States (FATUS) database assembled from the US Department of Commerce data by the Foreign Agricultural Service (USDA). USPB export activity data come from the USPB and include both USDA/MAP and private expenditures on foreign market development activities. All expenditures are aggregated together into a single foreign market activity for each country/region.<sup>4</sup> For the fresh, frozen, and dehydrated import demand models, the following countries/regions are used: Japan, South Korea, China, Taiwan, Mexico, ASEAN and the Rest of the World (ROW). The seed model includes a different set of countries since the USPB focuses on different markets for this product: Honduras, Uruguay, the Dominican Republic, Nicaragua, Brazil, Panama and ROW.

Macroeconomic data for each market and region are obtained from the USDA/ERS international macroeconomic database. The variables collected for each country/region include real Gross Domestic Product, agricultural adjusted exchange rates, and Consumer Price Indices. As with the other models, the potential long-term impact of market development expenditures is estimated using a flexible, geometric lag specification.

The four import demand equations for U.S. potatoes are estimated with (1) imports of U.S. potatoes (fresh, frozen, dehydrated, and seed) as the dependent variable. These variables are measured on a volume basis (in metric tons) for each calendar year. The following import demand determinants are included to ascertain their impacts on annual import demand for U.S. potatoes:

- 1. Unit value (price) of potato (fresh, frozen, dehydrated, and seed) imports from the U.S. in dollars per metric ton,
- 2. Quantity of annual potato (fresh, frozen, dehydrated, and seed) imports from the US in the proceeding year,

<sup>&</sup>lt;sup>4</sup> This aggregation was done for two reasons. First, we were unable to adequately divide the expenditures into categories focusing on "consumer" vs. "trade," which was done in the last report by Richards and Patterson. Second, since the private and public sources of the expenditures have the same marketing goals, it made sense to simply combine them into one activity to preserve degrees of freedom in the econometric model.

- 3. Average annual real (inflation-adjusted) GDP for each importing country/region,
- 4. Average annual agricultural adjusted exchange rate (ER) of each importing country/region's currency per US dollar,
- 5. Total annual USPB plus USDA/MAP foreign market development expenditures.

Imports in the previous year are included to capture dynamic effects of international trade rigidities, i.e., imports from the US last year should be highly correlated with imports from the US this year. The US potato price for the four products are computed as the total value of imports divided by the total quantity of imports. Hence, US price is computed as a unit value measure and reflects the overall category for fresh, frozen, dehydrated, and seed. The US price is expected to be negatively related to the volume of imports from the US in each country, i.e., a lower price results in higher US import quantity demanded reflecting the law of demand. The relationship between GDP and the demand for US potatoes is expected to be positive, i.e., as countries become wealthier, the demand for US potatoes should increase. The exchange rate (ER) has been shown to be an important determinant of the demand for US imports. The relationship between ER and the import demand for US potatoes is expected to be negative. As the US dollar becomes cheaper, US potatoes become relatively cheaper and hence import demand increases. Potato export promotion expenditures are deflated by the Consumer Price Index (CPI) in each importing region.

Unlike the three other models which were estimated in double logarithmic form, the import demand model for seed potatoes is estimated as a tobit model in linear form because there are many years that some of the importing countries had zero US imports. In addition, lagged imports is not significant in the seed potato model and is therefore omitted as an explanatory variable in the final model. Finally, a time trend variable is also included in the seed model to capture other factors not included in the explanatory variables.

# ROI Simulation Model and Grower Demand

A number of variables are also required for the ROI simulation model. Among these, the "farm share of the retail dollar" is used to estimate the change in farm price for a given change in the retail price. This value varies considerably from year to year, and BCRs measured at the farm level are critically dependent upon its value. Therefore, we calculate BCRs over a range of farm shares, centered on the long-term average value of 23.5% (Stewart, 2006). Second, the elasticity of supply for non-farm inputs was assumed to be 1.50, because there are no estimates of this value in the public domain. Third, the substitution elasticity between marketing and farm inputs is assumed to be 1.0. This assumption is standard in the literature and does not materially impact the resulting ROI estimates. Details on how the retail-farm price linkage model are estimated are provided in appendix B.

### **Results and Discussion**

Overview

In this section, we summarize the results obtained from estimating each demand model, and the implied ROI values to each type of Board investment. Our estimates are first presented in the form of response elasticities (see definition above) in order to provide an intuitive measure of the extent to which each program "shifts out" the demand curve. We next present ROI estimates in terms of BCRs for both short- and long-run perspectives. Because the parameter estimates from the logit model are essentially meaningless in themselves (they are interpreted as the marginal utility obtained by an incremental change in each variable), our discussion focuses on statistical significance and the elasticities implied by the estimates in each model.

### Domestic Retail Model

From the estimates presented in table 2 (see appendix), it is evident that nearly all of the explanatory variables are statistically significant (indicated by a t-ratio greater than 1.96). Among the most important in this regard are the lagged share of each product, and the ratio of GDP to population (per capita GDP growth). The estimated coefficient on the lagged share variable (0.696) is critical in determining the difference between short-run and long-run returns as it suggests that nearly 70% of the adjustment to the long-run equilibrium occurs within one year. As a result, the short-run and long-run demand impact of each marketing investment are not likely to differ much. Interestingly, the parameter estimate for per capita GDP growth is negative, which implies that lower income growth causes potato demand to rise, and vice versa. This result is confirmation that potatoes are seen as a good value by consumers, and tend to sell well during economic downturns. Most importantly, the parameter estimates for advertising, consumer publicity and "other marketing," which is an aggregation of marketing investments in all the other categories defined above, are all positive and significant. The intuition or interpretation of these parameter estimates, however, is more meaningful if expressed in terms of elasticities.

All price and marketing elasticities are shown in table 3 in the appendix. Recall that an elasticity is defined as the percentage change in a response variable (volume sales in this case) in response to a percentage change in a causal variable, price or investment in this case. For example, the short-run price elasticity of -0.581 in table 3 means that if the price of retail potatoes rises by 10%, then the quantity demanded can be expected to fall by 5.8%, on average, across all retail potato products. Because the price elasticity is less than 1.0 (in absolute value, or ignoring the negative sign), we refer to this value as "inelastic" as the quantity demanded is relatively non-responsive to changes in price. On the other hand, the long-run price elasticity of -1.91 is greater than 1.0 in absolute value so we refer to this estimate as elastic, or relatively responsive to changes in price. In the long run, consumers can be expected to reduced their quantity demanded by 19.1% for every 10% rise in price. Clearly, the assumption that the price elasticity of demand is the same for all potato products is a strong assumption, but because estimating price response is not the focus of this study, it is immaterial to our primary results.

Our main focus is, of course, on estimating the response of demand to variation in marketing investment. The elasticities in table 3 show that "other" investments have the strongest impact

on potato demand, followed closely by media advertising. This result shows that USPB investments have been effective overall. Finding a strong response to advertising in particular is an important result because this type of activity is relatively new for the Board and shows that funds allocated for this purpose have been highly effective in increasing demand.

To determine whether investments in each category have earned a positive rate of return, however, we use the elasticity estimates in table 3 to calculate rates of return, expressed as BCRs. The returns to advertising investments are shown in table 4 in the appendix. Because the "farmers' share of the retail dollar" and the elasticity of supply are important parameters in calculating the return to potato advertising, and are not known with certainty, we calculate BCRs over a range of share and elasticity values. For each category of investment, however, our "benchmark" or most likely scenario estimate is found in the middle of the table at a share value of 23.5% and a supply elasticity of 1.00. For advertising, this most-likely scenario shows a BCR of 1.073 in the short run and 3.539 in the long run. In other words, the next dollar invested in advertising can be expected to return \$1.073 in incremental grower profit in the short run, and fully \$3.539 in the long run. Therefore, while USPB advertising investments in the short run earn rates of return that are roughly comparable to returns on other investments growers may have available, the long-run rates of return are likely far higher than any other they are likely to make.<sup>5</sup>

Next, we examine returns to consumer publicity in the retail potato market (table 5 in the appendix). In the short run, we find that investments in consumer publicity do not cover the initial capital costs, in present value terms, as the BCR is 0.439, which is clearly below 1.0. In the long run, however, consumer publicity yields a BCR of 1.462. Although this return is lower than the return to advertising, it is still well above the returns to other investments.

The returns to all other investments, which is defined as an aggregation of spending on retail programs, partnerships, issues management and nutrition, are considerably higher than returns to either the advertising or consumer publicity. As the results in table 6 (see appendix) show, the BCR for other investments in the "most likely" parameter scenario are \$1.501 in incremental profit for each dollar invested in the short run and \$4.976 for each dollar in the long run. Clearly, these rates of return are highly attractive.

#### Food Service Model

The data used to estimate the Food Service model are summarized in table 7 in the appendix, while the parameter estimates from this model are shown in table 8, also in the appendix. Because there were fewer observations available to estimate the Food Service model, due to the fact that PotatoTrac only reports quarterly survey results, the explanatory ability of the Food Service model was significantly lower than that reported in the Retail model (a coefficient of determination of 37.7% suggests that only 37.7% of the variation in potato product sales is

<sup>&</sup>lt;sup>5</sup> For comparison purposes, a BCR of 1.100 implies a percentage rate of return of 10.0%. If the current market rate of return on government bonds is 3.0%, the BCR implied by holding a bond for one year is 1.03.

explained by variation in prices, quarterly indicator variables, lagged market shares and marketing investments. Income and population were included in initial specifications of this model, but were not significantly different from zero so were dropped from the final model. Nonetheless, the effects of the remaining variables were statistically different from zero with the expected signs in each case. The coefficient on the lagged dependent variable, 0.325, suggests that sales in the Food Service model are slower to move to their new equilibrium if subjected to some shock to demand, so we can expect the short and long-run results to differ significantly in this case. As in the Retail Model, however, the price-estimate of -1.520 is not particularly meaningful in itself, but it does imply that prices are an important determinant of the quantity sold each month.

Elasticities with respect to price and marketing investments are, however, both relevant and can be compared to elasticities from the Retail model in a meaningful way. These elasticities are shown in table 9 in the appendix. With respect to prices, the average price elasticity of demand across all different product forms is -1.128 in the short run and -1.671 in the long run. Food service operators, therefore, appear to be relatively responsive to changes in wholesale prices in both the short- and long-runs as these elasticities are both in the elastic portion of the demand curve. Because demand is elastic, sellers cannot increase their revenue simply by limiting supply to the market and allowing prices to rise. Each category of marketing investment – Advertising, Consumer Publicity and the Food Service program – has a statistically-significant effect on demand and the response to the food service program. These elasticities are likely to generate strong demand responses in food service demand, all else held constant.

Table 10 in the appendix shows this to be the case with respect to advertising investments, while table 11 (see appendix) shows the returns to consumer publicity and table 12 (see appendix) the returns to expenditure in the food service program.<sup>6</sup> Advertising is expected to have significant effects on both retail and food service demand because the ads are designed to reach potato consumers of all types, or at least can be expected to have spillover effects from one target market to another. Because the demand from food service suppliers is a direct reflection of the demand from consumers, anything that changes consumer behavior can be expected to have some effect on the equilibrium price paid to potato growers. Returns to advertising tend to be high relative to those calculated for the retail market, but significantly below returns to either consumer publicity or the food service program. BCRs for advertising are 2.029 in the short run and 2.981 in the long run. Recall that our results are estimated holding all other factors in the food service market over much of this period, profits would have been much worse if it were not for USPB advertising programs.

In table 11, we show that returns to consumer publicity are even higher at 4.252 in the short run and 6.223 in the long run. Because investments in the food service program are directed

<sup>&</sup>lt;sup>6</sup> Note that Advertising and Consumer Publicity are targeted to consumers, while expenditures in the Food Service program are targeted specifically to food service buyers.

specifically to food service buyers, we expect returns to this program to be higher yet. Our expectations are borne out by the simulation results. In the short run, the return to investments targeted toward the food service market generate fully \$6.230 in incremental profit for the next dollar invested, while the marginal return in the long run is \$12.482 per USPB dollar. These findings suggest that funds targeted toward mass adverting are likely to be highly profitable, as are those directed specifically toward food service buyers.

### Best Practices Model

Estimation results for the Best Practices difference-in-difference model are in table 13 in the appendix. The results indicate that the Best Practices Program had a positive and statistically significant impact on potato sales in the participating retail stores. Specifically, average monthly potato sales per chain were \$3.366 million per month higher from the chains that participated in the three Best Practice programs than chains that did not participate. In other words, the incremental sales in the chains that participated in the three Best Practice programs were 49% higher than those that did not participate, meaning that participation in the Best Practices program, relative to control stores that did not participate, provides a sales gain of nearly 50%. The regression results also indicate that three of the retail chains had statistically different total potato sales than the other chains. On average, Stater Brothers has \$2.2 million less, while Vons and Seattle Safeway had \$1.2 million and \$8.3 million more than the other chains in the sample.

To the extent that growers' interests are aligned with potato retailers, this represents a significant growth in value to the industry as a whole. Extrapolating this result to the entire market implies a total retail value to the program of approximately \$283 million in annual retail revenue. Multiplying this value by the assumed farm share of 22.0% yields an incremental gross revenue at the farm gate of \$62.2 million. If the net profitability margin, on average, for potato growers is assumed to be 8%, i.e., every \$1 received in gross revenue translates into 8 cents in farm profits, then the Best Practice program returned almost \$5 million in total farm profits. Based on an estimated annual cost of \$229,000, the benefit cost ratio for the Best Practice program returned \$21.83 in industry profit. If the assumed net profitability margin is only 1% instead of 8%, the benefit-cost ratio of this program is still 2.72, which is above 1.0 indicating net benefits to potato growers.

### Export Promotion Model

The import demand models for fresh, frozen, and dehydrated potatoes are estimated in logarithmic form with annual data from 2007 through 2011 for the seven importing regions mentioned earlier in this report. The elasticities are summarized in Table 14 in the appendix. The R-squared indicate that all equations explained at least 97% of the variations in import demand for US potatoes. The elasticity signs are consistent with economic theory and the majority of estimated coefficients are statistically significant at better than the 1% significance levels.

The estimated import demand equations indicate that imports in the previous year are a significant determinant of imports of US potatoes in the current year for two models. The results indicate that US fresh and frozen potato imports in the previous year had an elasticity or partial adjustment coefficient of 0.259 and 0.362, respectively. That is, a 10% increase in imports of US fresh and frozen potatoes in the previous year would increase imports in the current year by 2.59% and 3.62%, respectively, holding all other factors constant. The estimate for dehydrated potatoes is also positive, but smaller and not statistically significant at the 10% level.

The value of the US dollar, as reflected by the exchange rate (ER) variable, has the most important impact on import demand for all three products. The short-run exchange-rate elasticities are -2.173, -2.249 and -1.166 for dehydrated, fresh, and frozen potatoes, respectively. That is, a 10% increase in the value of the US dollar decreases imports of US potatoes by 21.73%, 22.49%, and 11.66%, respectively, in the short-run (one-year), holding all other demand determinants constant. The long-run elasticities for ER are -2.505, -3.276, and -1.829 for dehydrated, fresh, and frozen potatoes.

The price of US potatoes is also a significant factor in explaining annual variations in imports of US potatoes. The estimated short-run own-price elasticities for dehydrated, fresh, and frozen potatoes are -1.545, -1.026, and -0.968, respectively, indicating that a 10% increase in the US price would decrease imports by 15.45%, 10.26%, and 9.68% in the short-run, holding all other demand determinants constant. The long-run own price elasticities for these three products are -1.782, -1.384, and -1.519, respectively.

GDP in importing countries is positive and statistically significant for dehydrated potatoes, but is not statistically significant for fresh and frozen potatoes. The short- and long-run elasticities of GDP for dehydrated potatoes are 0.558 and 0.643, respectively. In other words, holding all other demand factors constant, a 10% increase in GDP in an importing region results in a 5.58% increase in imports of US dehydrated potatoes in the short-run, and a 6.43% increase in the long-run.

The statistical evidence supports the notion that U.S potato export promotion programs, which are funded by public-private contributions, have the effect of increasing the import demand for US potatoes. The estimated short-run export promotion elasticities for dehydrated, fresh, and frozen potatoes are 0.062, 0.073, and 0.054, respectively. That is, holding all other demand factors constant, a 10% increase in US potato export promotion expenditures would result in a 0.62%, 0.73%, and 0.54% increase in imports of US dehydrated, fresh, and frozen potatoes in the short-run. The long-run export promotion elasticities for these three products are: 0.072, 0.098, and 0.085, respectively.

Annual data from 2007 through 2011 are also used with the seven importing regions mentioned earlier in this report to estimate the seed potato model. In the initial estimation of the model, lagged seed potato imports is not significant and hence is deleted from the final model. All remaining variables have elasticity signs are consistent with economic theory and are statistically

significant at better than the 1% significance levels. The estimated elasticities are summarized in Table 15 in the appendix.

The price of US seed potatoes is a significant factor in explaining annual variations in imports. The estimated own-price elasticity is -0.389, indicating that a 10% increase in the US price would decrease imports by 3.89%, holding all other demand determinants constant. This price elasticity is much smaller than those estimated for fresh, frozen, and dehydrated potatoes, which indicates that countries importing US seed potatoes are not as price sensitive as other US potatoes.

The most important demand determinant for seed potatoes is the GDP of the importing country. The estimated elasticity is 0.932, i.e., a 10% increase in GDP increases US imports by 9.32% holding all other factors constant. The trend term is also positive and statistically significant indicating that US seed potato imports have increased over time.

Like the three other products, U.S potato export promotion programs have the effect of increasing the import demand for US seed potatoes. The estimated export promotion elasticity is 0.186 indicating a 10% increase in US seed export promotion expenditures increase seed potato imports by 1.86% holding other factors constant. This is significantly higher than that for the other three potato products.

While these results indicate a positive impact of USPB foreign market development programs on import demand for US potatoes, what remains a key concern is these export promotion programs on industry profits compared with marketing costs. To model these impacts, an own price elasticity of supply is incorporated using a constant elasticity form, and sensitivity analysis is conducted on a range of assumed own price supply elasticity values, including 0.5. The simulation procedure begins on the demand side, where predicted quantities of import demand are estimated from the estimated import demand equation. Then, supply is defined in constant elasticity form and equated with the predicted demand quantities. Changes in import demand due to the USPB then affect the level of production and the resulting grower price.

The model is simulated based on two scenarios: (1) export promotion expenditures are set equal to historical levels for each importing region from 2007-11, and (2) export promotion expenditures are set to 99% of historical levels for each importing region from 2007-11. A "marginal" benefit-cost ratio (BCR) is then computed by taking the ratio of the change in profits between the two scenarios divided by the change in export promotion costs. The resulting BCRs for dehydrated, fresh, frozen, and seed potato export promotion by assumed supply elasticity are presented in Table 16 in the appendix.

For all assumed supply elasticities, the BCRs are larger than 1.0 indicating that the benefits of export promotion are larger than the costs. For example, based on a supply elasticity of 1.5, which is probably the most plausible estimate for potato exports, the BCRs for dehydrated, fresh, frozen, and seed potato export promotion are 2.53, 4.90, 6.39, and 2.89, respectively. In other words, the benefits of export promotion in terms of an incremental dollar investment returned

\$2.53, \$4.90, \$6.39, and \$2.89 in profits. The overall BCR for all four programs is 4.93 based on the supply elasticity of 1.5. Based on these marginal BCRs, it appears that frozen potato export promotion offered the highest return on investment followed by fresh potato, then seed potato, and finally dehydrated potato export promotion.

### Summary of Results

In summary, we found evidence of positive returns to every category of USPB expenditure, and even some cases in which the returns were very high (table 17 in the appendix). On average, across all markets and type of investment, we found a BCR of 5.167 in the short run and 6.511 in the long run. Domestic investments, which include both the retail and food service programs, return 2.922 and 5.227 dollars per dollar of investment in the short and long runs, respectively. International programs yield a return of 4.93 per dollar invested. The Best Practice Program, which was evaluated separately, returns 21.83 per dollar of investment. Clearly, these rates of return are very attractive for USPB stakeholders and reflect well of the performance of the programs. As emphasized at the outset of this report, it is important to put these findings in context: Namely, they represent estimates of where the industry is now in terms of retail, food service and export sales, relative to where it would be in the absence of the USPB. Our estimates, therefore, represent measures of the incremental benefit to US potato growers of funding the USPB at current levels.

### Caveats

As with any fact-based evaluation, the statistical results presented herein are only as good as the data used to estimate them. To the extent that the Nielsen, NPD and USDA data sources are not representative of actual market movements, then our estimates will be in error. Second, statistical modeling always involves a choice among many appropriate models. In the analysis reported herein, we have gone to great lengths to test the specification used against others to ensure that the results are as robust as possible. Third, marketing expenditures are always an approximation of actual marketing effort. To the extent that investment dollars do not accurately reflect the amount of effort expended in marketing US potatoes each period, our results will again be biased accordingly. Finally, the precision of statistical estimation always improves with the amount and quality of data. Therefore, it is hoped that the USPB will continue to maintain high standards in data acquisition and recording so that the next evaluation will be improved through the availability of a deeper database of potato sales and marketing activity.

#### **Appendix A. Econometric Models**

This appendix describes in more detail the specific econometric models that are used in estimating the impact of USPB marketing, public relations, and research activities on the demand for potatoes and potato products in the domestic retail, domestic foodservice and international markets. For this analysis, it is assumed that the market segments are independent so we estimate separate models for each.

In this appendix, we use the domestic fresh market model (estimated using Nielsen Perishables data) as an example. Implicitly, by using this model we assume retail potatoes are differentiated by variety, size, or product type. As such, an individual consumer is assumed to choose only one product (ie., a 3 lb. bag of Safeway potatoes) from all other substitutable products available to them on that particular trip to the store. Consequently, we represent the demand for retail potatoes with a discrete choice model of differentiated product demand (Anderson, dePalma and Thisse 1992; Berry 1994; Berry, Levinsohn and Pakes 1995; Nevo 2000). We begin by defining a random utility representation of individual household demand, and then aggregate over the distribution of consumer heterogeneity to arrive at a consistent aggregate demand for potatoes and potato products in the market as a whole. We write the utility for household h as:

$$u_{hj} = v_{hj} + \varepsilon_{hj} = \beta_{0j} + \sum_{k} \beta_{1k} x_{jk} + \sum_{l} \gamma_{l} f(A_{l}) - \alpha p_{j} + \xi_{j} + \varepsilon_{hj}, \qquad (2)$$

where  $v_{hj}$  is the deterministic component of utility,  $\beta_{0j}$  is the maximum willingness to pay for potato products of type or variety *j*, *p*<sub>j</sub> is the retail price of product *j*, *x*<sub>j</sub> is a set of other explanatory variables, including personal income, a time trend or qualitative indicators to account for other non-quantifiable factors that may affect potato product sales, *f*(*A*<sub>*i*</sub>) is the stock of marketing capital created by investments in marketing activity *l* by the USPB,  $\xi_j$  is an unobservable (to the econometrician) error term and  $\varepsilon_{hj}$  is a random error, assumed to be iid extreme value distributed. Household *h* will choose the product of type *j* if the utility from this choice is greater than the utility from all other alternatives. In other words, the probability that household *h* chooses *j* over all others is governed by the distribution of  $\varepsilon_{hj}$  because:

$$Pr(j = 1) = Pr(v_{hj} + \varepsilon_{hj} > v_{hi} + \varepsilon_{hi}) = Pr(v_{hj} - v_{hi} + \varepsilon_{hj} > \varepsilon_{hi}).$$
(3)

As is well understood, if  $\varepsilon_{hj}$  is distributed extreme value, the random utility model in (1) implies share functions for each product of type j = 1, 2, ... J of:

$$S_{j} = \frac{\exp\left(\beta_{0j} + \sum_{k} \beta_{k} x_{kj} + \sum_{l} \gamma_{l} f(A_{l}) - \alpha p_{j} + \xi_{j}\right)}{1 + \sum_{i=1}^{J} \exp\left(\beta_{0i} + \sum_{k} \beta_{k} x_{ki} + \sum_{l} \gamma_{l} f(A_{l}) - \alpha p_{i} + \xi_{i}\right)},$$
(4)

where  $S_j$  is the market share of product type *j*. This expression yields the multinomial logit (MNL) model of discrete choice used by Berry (1994), Nevo (2001) and many others to study the structure of demand for differentiated products. Although the simple MNL model in (4) suffers from the proportionate draw problem (also called the "independence of irrelevant alternatives, or IIA problem), meaning that the cross-elasticities for all alternatives are equal, the IIA problem is of little consequence in this application. Promotion effectiveness depends on the own-price and marketing-elasticity and, to a much lesser extent, on the cross-price elasticity. Consequently, the degree of error caused by the IIA simplification is likely to be very low.

Our primary interest in estimating (4) lies in obtaining price and marketing elasticities. Elasticities are derived from the MNL model by finding the derivative of the share function in price (marketing) and multiplying by the ratio of price (marketing capital) to the mean share. The resulting expressions are given by:

$$\varepsilon_{p_j} = (\partial S_j / \partial p_j) (p_j / S_j) = \alpha \overline{p_j} (1 - S_j),$$
(5)

in price, and:

$$\varepsilon_{A_{jl}} = (\partial S_j / \partial A_l) (\overline{A_l} / \overline{S_j}) = \gamma_l \overline{A_l} (1 - \overline{S_j}), \qquad (6)$$

in marketing capital. Evaluating each elasticity specific to each product type provides valuable information on the differential effect of price changes and marketing investments on sales of each type of potato product. These response parameters form the key input to the profit calculation model described below.

#### **Appendix B. Retail-Farm Price Linkage Model**

This appendix shows how we estimate the price transmission elasticity, or the extent to which higher retail prices are passed through to the farm level. An expression for the price transmission elasticity is derived from the first-order conditions for profit maximization for a representative retailer (or processor). In the simplest terms, grower prices  $(p_g)$  for each product *j* represent a cost to a representative retailer while retail prices determine their revenue  $(p_r)$ . Retailers face variable costs of selling  $(C_i)$  that depend on both the amount of sales and a vector of input prices specific to retailers  $(w_r)$ , as well as fixed costs of operation  $(F_i)$ . Product sales for the *i*th retailer  $(Q_i)$  depend upon the retail price and the amount of marketing services  $(A_i)$ , whether by the retailer itself or by the USPB. Expressing this logic more formally, the profit-maximization problem for a representative retailer is written as:

$$\max_{\mathbf{p}_{r}} \pi_{i} = (p_{r} - p_{g})Q_{i}(p_{r},A_{i}) - C_{i}(Q_{i},w_{r}) - F_{i},$$
(7)

where we assume single-period profit maximization for simplicity sake. Taking the first-order condition for the problem written in (6), aggregating over all firms in the industry and expressing in terms of the price-elasticity of demand yields an estimable equation for the equilibrium retail-farm margin:

$$p_r = (p_g + c_i) \theta \left( \frac{\varepsilon_D}{1 + \varepsilon_D} \right), \qquad (8)$$

where  $\varepsilon_{\rm D}$  is the price-elasticity of demand, marginal cost,  $c_i$ , is estimated as a linear function of the vector of retailing-input prices, and  $\theta$  represents the extent of departure from the differentiated-product equilibrium assumption that underlies the derivation of (7). Our estimate of the price-transmission elasticity, therefore, is given by the estimate of  $\theta \varepsilon_D / (1 + \varepsilon_D)$  multiplied by the ratio of grower to retail prices.

#### **Appendix C. Grower Profit Model**

This appendix describes the way in which we will calculate the increment to total grower profit given the impact parameters estimated in equation (2) above. This model is similar to one used in Richards and Patterson and was originally developed by Kinnucan et al. To calculate profit, the analysis takes into account: (1) the activity impact on demand quantity (retail, food service and imports), (2) the impact on price, (3) the feedback effect of higher prices on market supply, and (4) the transmission of retail prices to the grower level. Although the final solution consists of a single equation, the model requires separate components for each element (1) to (4). Again in mathematical terms, this model, written in terms of the change in the log of each variable value, appears as:

Market Demand:	$d\ln Q_r = N_r d\ln P + G d\ln Z_r + B_1 d\ln A_1 + B_2 d\ln A_2;$	
Import Demand:	$d\ln Q_m = N_m d\ln P + H d\ln Z_m;$	
Farm Supply:	$d\ln X = E_s d\ln W;$	(9)
Price Transmission:	$d\ln W = \bar{T} d\ln P;$	
Market Equilibrium:	$w_m d\ln Q_m + w_r d\ln Q_r = d\ln X.$	

Each equation is then substituted into market equilibrium to solve for the resulting price impact of the marketing program:

$$d\ln P = M^{-1}Gd\ln Z_r + M^{-1}Hd\ln Z_m + M^{-1}B_1d\ln A_1 + M^{-1}B_2d\ln A_2, \qquad (10)$$

Given this change in prices, the addition to profit is then calculated as:

$$d\pi = \sum_{i} S_{i}^{f} P_{i} Q_{i} d\ln W_{i} (1 + 0.5 d\ln X_{i}).$$
(11)

where the subscript indicating activity *l* has been suppressed for clarity. Each of the variables and parameter values are defined as follows:

W = variables representing FOB (grower) prices for each product;

X = variables representing supplies of each product;

**P** = variables representing market prices (assuming export and retail prices are equal);

 $Q_r$  = variables representing retail and food service quantities;

- $Q_x$  =variables representing import quantities;
- $w_r$  = share of market in retail or food service;
- $w_x$  = share of market in import;

 $S_i^f$  = grower's share of the retail dollar for the i<sup>th</sup> product type;

 $Z_r$  and  $Z_x$  = factors affecting demand in retail, food service and import markets,

 $A_1$  = indicator variable for marketing activity 1;

 $A_2$  = indicator variable for marketing or research activity 2;

 $N_r$  and  $N_x$  = groups of retail and import demand price-response terms;

 $B_k$  = response measures for the k<sup>th</sup> type of activity;

T = price-transmission elasticities (% of price going to grower);

G = demand elasticities with respect to exogenous retail factors,

H = elasticities with respect to exogenous import demand shifters;

 $E_s$  = supply response elasticities;

$$\boldsymbol{M} = \boldsymbol{E}_{\boldsymbol{x}}\boldsymbol{T} - \boldsymbol{w}_{\boldsymbol{r}}\boldsymbol{N}_{\boldsymbol{r}} - \boldsymbol{w}_{\boldsymbol{x}}\boldsymbol{N}_{\boldsymbol{x}}$$

= solution for the change in price variable.

This model, while appearing quite complicated, is easily implemented with any spread sheet or data base software. Based on the incremental profit calculated in (8), the net present value of investment in activity l is calculated as:

$$NPV_{l} = \sum_{t=1}^{10} e^{-rt} d\pi_{l} - c_{l}, \qquad (12)$$

where  $e^{-rt}$  is the "present value factor" that is used to calculate the present value of incremental operating in year t at time 0 at a discount rate r,  $c_l$  is the amount of expenditure on activity l and summing over a ten year period reflects the assumed long-range planning horizon of the USPB. If  $NPV_l$  is greater than zero at an interest rate that reflects USPB members' opportunity cost of capital, then investments in activity l are economically viable.

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Variable	Units	Ν	Mean	Std. Dev.	Min	Max
Bag Fresh	\$/lb	3348	0.543	0.104	0.286	0.909
Bag Fresh	M lbs.	3348	2.599	1.269	0.746	6.579
Bag Fresh	%	3348	0.073	0.036	0.020	0.182
Bulk Fresh	\$/lb	3348	0.992	0.121	0.701	1.391
Bulk Fresh	M lbs.	3348	0.478	0.314	0.078	1.574
Bulk Fresh	%	3348	0.013	0.009	0.002	0.043
Chips	\$/1b	3348	3.979	0.405	3.135	4.749
Chips	M lbs.	3348	0.686	0.312	0.322	1.321
Chips	%	3348	0.019	0.009	0.009	0.037
Frozen	\$/lb	3348	1.430	0.141	1.089	1.677
Frozen	M lbs.	3348	0.688	0.315	0.269	1.379
Frozen	%	3348	0.019	0.009	0.008	0.040
Refrigerated	\$/1b	3348	2.094	0.197	1.766	2.630
Refrigerated	M lbs.	3348	0.117	0.084	0.040	0.326
Refrigerated	%	3348	0.003	0.002	0.001	0.009
Dehy	\$/lb	3348	3.386	0.353	2.770	4.196
Dehy	M lbs.	3348	0.090	0.048	0.028	0.226
Dehy	%	3348	0.003	0.001	0.001	0.006
Advertising	\$ 00,000	3348	5.329	10.281	-7.847	39.753
Chip Program	\$ 00,000	3348	4.122	8.340	-27.780	32.071
Consumer Publicity	\$ 00,000	3348	6.664	9.526	0.000	59.603
Food Service	\$ 00,000	3348	4.735	4.532	-5.367	17.422
Innovation	\$ 00,000	3348	1.835	2.631	-0.914	13.407
Issues Management	\$ 00,000	3348	1.155	1.504	0.000	6.483
Nutrition	\$ 00,000	3348	2.186	3.069	-0.002	12.300
Partnerships	\$ 00,000	3348	0.288	0.598	-1.224	2.690
Research	\$ 00,000	3348	3.250	2.606	0.000	9.936
Retail	\$ 00,000	3348	8.967	8.132	0.040	34.846
Fry Program	\$ 00,000	3348	0.659	3.996	-4.000	27.261
Retail Wages	Index	3348	4.201	0.163	4.000	4.560
Food Mfg. Wages	Index	3348	7.524	0.356	7.090	8.500

 Table 1. Summary of Data used for Retail Model

Potato PPI	Index	3348	1.703	0.381	1.204	2.678
Fuel Price	Index	3348	1.879	0.273	1.441	2.456
Electricity Rates	Index	3348	1.779	0.080	1.617	1.922
Processing Wages	Index	3348	8.584	0.527	7.580	9.560
Per Cap. Consumption	Index	3348	1.163	0.050	1.099	1.244
Finance and Real Estate	Index	3348	1.086	0.027	1.046	1.143
Restaurant Wages	Index	3348	1.069	0.025	1.022	1.114
Consumer Price Index	Index	3348	2.149	0.053	2.038	2.255
Population (US)	Ten M.	3348	30.655	0.335	30.080	31.162
GDP Growth	Index	3348	1.428	0.033	1.376	1.500
Interest	%	3348	3.659	0.623	2.740	4.850
Unemployment Rate	Index	3348	15.377	0.086	15.201	15.540
Gasoline Price	\$ / gal	3348	2.942	0.521	1.940	3.910
Disposable Income	\$ 0,000	3348	3.559	0.083	3.406	3.708
Labor Force Part.	%	3348	0.654	0.007	0.642	0.663

Sources: Nielsen Perishables Group, Inc.; NASS-USDA; Federal Reserve Board of the US.

Variable	Estimate	t-ratio
Lagged Share	0.6958*	70.8000
Bagged Fresh	-0.0081*	-5.0450
Bulk Fresh	-0.0324*	-16.8900
Chips	-0.0200*	-4.6490
Frozen	-0.0303*	-14.9600
Refrigerated	-0.0334*	-12.9500
Dehy	-0.0296*	-7.8740
Quarter 1	-0.0049*	-6.7920
Quarter 2	-0.0043*	-5.8880
Quarter 3	-0.0042*	-5.5060
East North Central	0.0114*	5.1980
East South Central	-0.0027	-1.3870
Mid Atlantic	0.0057*	3.1860
Mountain	-0.0014	-0.8513
New England	-0.0028	-1.9520
Pacific	0.0062*	4.6800
South Atlantic	0.0111*	9.2200
West North Central	-0.0042*	-3.8650
GDP/Capita	-3.6399*	-29.4400
Price	-0.3228*	-2.7400
Advertising	0.0011*	6.9400
Consumer Relations	0.0003*	3.5620
Other	0.0022*	5.7650
$\mathbb{R}^2$	0.9294	
DW	1.7220	

 Table 2. Retail Potato Demand Estimation Results: Logit Model

Note: A single asterisk indicates significance at a 5% level.

	Elasticity					
	Price	Advertising	Consumer Relations	Other		
Short Run	-0.581	0.083	0.034	0.116		
t-ratio	-2.740	6.940	3.562	5.765		
Long Run	-1.910	0.272	0.113	0.380		
t-ratio	-2.738	7.057	3.553	5.803		

 Table 3. Retail Elasticity Matrix: Price and Marketing Activities

Note: t-ratio is value in row below elasticity estimate

			Farm Shar	re of the Retail	Dollar	
				Short Run		
	_	0.255	0.245	0.235	0.225	0.215
	0.250	3.544	3.441	3.335	3.227	3.117
Supply	0.500	2.104	2.032	1.959	1.885	1.810
Elasticity	0.750	1.496	1.442	1.386	1.331	1.275
	1.000	1.161	1.117	1.073	1.029	0.984
	1.250	0.948	0.912	0.875	0.838	0.801
	1.500	0.802	0.770	0.739	0.707	0.676
				Long Run		
	_	0.255	0.245	0.235	0.225	0.215
	0.250	11.674	11.333	10.986	10.631	10.268
Supply	0.500	6.937	6.698	6.457	6.213	5.967
Elasticity	0.750	4.935	4.754	4.572	4.389	4.205
	1.000	3.830	3.685	3.539	3.393	3.247
	1.250	3.129	3.008	2.887	2.765	2.644
	1.500	2.645	2.541	2.437	2.334	2.334

# Table 4. Benefit:Cost Ratios for Advertising - Retail Model

		Farm Share of the Retail Dollar				
				Short-Run		
		0.255	0.245	0.235	0.225	0.215
	0.250	1.450	1.408	1.364	1.320	1.275
Supply	0.500	0.861	0.831	0.801	0.771	0.740
Elasticity	0.750	0.612	0.590	0.567	0.544	0.521
	1.000	0.475	0.457	0.439	0.421	0.402
	1.250	0.388	0.373	0.358	0.343	0.328
	1.500	0.328	0.315	0.302	0.289	0.276
				Long Run		
		0.255	0.245	0.235	0.225	0.215
	0.250	4.829	4.688	4.544	4.397	4.247
Supply	0.500	2.868	2.769	2.669	2.568	2.466
Elasticity	0.750	2.039	1.965	1.889	1.814	1.738
	1.000	1.582	1.522	1.462	1.402	1.341
	1.250	1.293	1.243	1.193	1.142	1.092
	1.500	1.093	1.050	1.007	0.964	0.921

# Table 5. Benefit:Cost Ratios for Consumer Relations - Retail Model

			Farm Sha	are of the Retai	Dollar		
	_	Short Run					
	_	0.255	0.245	0.235	0.225	0.215	
	0.250	4.958	4.813	4.665	4.515	4.360	
	0.500	2.944	2.843	2.740	2.637	2.532	
Supply	0.750	2.094	2.017	1.940	1.862	1.784	
Elasticity	1.000	1.624	1.563	1.501	1.439	1.377	
	1.250	1.327	1.276	1.224	1.173	1.121	
	1.500	1.122	1.078	1.034	0.990	0.946	
				Long Run			
	_	0.255	0.245	0.235	0.225	0.215	
	0.250	16.399	15.921	15.433	14.935	14.426	
	0.500	9.751	9.415	9.076	8.733	8.387	
Supply	0.750	6.938	6.683	6.428	6.170	5.912	
Elasticity	1.000	5.385	5.181	4.976	4.771	4.565	
	1.250	4.400	4.229	4.059	3.889	3.718	
	1.500	3.719	3.573	3.428	3.282	3.136	

### Table 6. Benefit:Cost Ratios for Other Marketing Investments - Retail Model

Product	Variable	Units	Ν	Mean	Std. Dev.	Min	Max
Diced	Price	\$/lb	72	0.5961	0.0297	0.5402	0.6401
Diced	Volume	0,000 lbs	72	3.3337	0.2453	2.8402	3.8182
Diced	Share	%	72	0.0168	0.0212	0.0157	0.0170
Formed	Price	\$/lb	72	0.5299	0.0282	0.4744	0.5748
Formed	Volume	0,000 lbs	72	16.3270	0.9902	14.5630	18.3690
Formed	Share	%	72	0.0825	0.0921	0.0786	0.0825
Fries	Price	\$/lb	72	0.4627	0.0267	0.4096	0.4924
Fries	Volume	0,000 lbs	72	173.7800	8.7071	164.8100	195.5400
Fries	Share	%	72	0.8777	0.8506	0.8843	0.8761
Hash Browns	Price	\$/lb	72	0.5423	0.0387	0.4631	0.5996
Hash Browns	Volume	0,000 lbs	72	3.3998	0.2087	3.0623	3.8844
Hash Browns	Share	%	72	0.0172	0.0176	0.0165	0.0171
Mashed	Price	\$/lb	72	0.7803	0.0291	0.7198	0.8287
Mashed	Volume	0,000 lbs	72	0.7974	0.1251	0.6289	1.0575
Mashed	Share	%	72	0.0040	0.0113	0.0034	0.0047
Skins	Price	\$/lb	72	1.3543	0.0428	1.2557	1.4240
Skins	Volume	0,000 lbs	72	0.3125	0.0376	0.2757	0.4018
Skins	Share	%	72	0.0016	0.0033	0.0015	0.0018
Whole	Price	\$/lb	72	0.9887	0.5848	0.1660	1.5418
Whole	Volume	0,000 lbs	72	0.0101	0.0218	0.0000	0.0743
Whole	Share	%	72	0.0001	0.0019	0.0000	0.0003
Misc	Price	\$/lb	72	0.7253	0.1938	0.4111	1.0405
Misc	Volume	0,000 lbs	72	0.0392	0.0211	0.0006	0.0838
Misc	Share	%	72	0.0002	0.0018	0.0000	0.0004

 Table 7. Food Service Data Summary

Source: PotatoTrac.

Variable	Estimate	t-ratio
Lagged Share	0.325*	15.290
Quarter 1	-0.454*	-32.451
Quarter 2	-0.449*	-31.250
Quarter 3	-0.452*	-31.690
Quarter 4	-0.449*	-31.270
Price	-1.520*	-6.836
Advertising	0.001*	2.195
Consumer Relations	0.001*	2.211
Food Service	0.002*	2.258
R <sup>2</sup>	0.377	

**Table 8. Food Service Demand Model Estimates** 

	Price	Advertising	Cons. Relations	Food Service
Elasticity	-1.128	0.032	0.067	0.099
t-ratio	-6.836	2.195	2.211	2.258
Elasticity	-1.671	0.047	0.100	0.146
t-ratio	-7.007	2.190	2.200	2.248

**Table 9. Food Service Elasticities** 

Note: t-ratio is value below estimate.

			Sł	nort Run				
		Farm Share of Retail Dollar						
		0.255	0.245	0.235	0.225	0.215		
	0.250	5.696	5.558	5.415	5.267	5.115		
Supply	0.500	3.715	3.598	3.479	3.358	3.236		
Elasticity	0.750	2.757	2.660	2.563	2.465	2.366		
	1.000	2.191	2.110	2.029	1.947	1.865		
	1.250	1.818	1.749	1.679	1.609	1.539		
	1.500	1.554	1.493	1.432	1.371	1.310		
		Long Run						
		0.255	0.245	0.235	0.225	0.215		
	0.250	8.368	8.165	7.955	7.738	7.514		
Supply	0.500	5.459	5.287	5.112	4.934	4.754		
Elasticity	0.750	4.050	3.909	3.766	3.622	3.477		
	1.000	3.220	3.101	2.981	2.861	2.740		
	1.250	2.672	2.569	2.467	2.364	2.261		
	1.500	2.283	2.194	2.104	2.014	1.925		

# Table 10. Benefit:Cost Ratios for Advertising - Food Service Model

				Short Run		
			Farm S	hare of Retail	Dollar	
	_	0.255	0.245	0.235	0.225	0.215
	0.250	11.933	11.643	11.343	11.034	10.715
Supply	0.500	7.784	7.539	7.290	7.037	6.779
Elasticity	0.750	5.776	5.574	5.371	5.165	4.958
	1.000	4.592	4.422	4.252	4.080	3.908
	1.250	3.810	3.665	3.518	3.372	3.225
	1.500	3.256	3.129	3.001	2.873	2.745
				Long Run		
	_	0.255	0.245	0.235	0.225	0.215
	0.250	17.462	17.038	16.600	16.148	15.681
Supply	0.500	11.393	11.034	10.670	10.299	9.922
Elasticity	0.750	8.455	8.159	7.861	7.561	7.257
	1.000	6.721	6.473	6.223	5.973	5.721
	1.250	5.578	5.364	5.150	4.936	4.721
	1.500	4.767	4.580	4.393	4.206	4.019

#### Table 11. Benefit:Cost Ratios for Consumer Relations - Food Service Model

		Short Run				
			Farm S	hare of Retail D	ollar	
		0.255	0.245	0.235	0.225	0.215
	0.250	17.480	17.055	16.617	16.164	15.697
Supply	0.500	11.405	11.046	10.681	10.310	9.933
Elasticity	0.750	8.463	8.168	7.869	7.568	7.265
	1.000	6.728	6.479	6.230	5.979	5.727
	1.250	5.583	5.370	5.155	4.941	4.726
	1.500	4.771	4.584	4.397	4.210	4.023
				Long Run		
	_	0.255	0.245	0.235	0.225	0.215
	0.250	34.995	34.145	33.268	32.363	31.428
Supply	0.500	22.843	22.123	21.393	20.650	19.895
Elasticity	0.750	16.955	16.363	15.765	15.162	14.554
	1.000	13.480	12.982	12.482	11.979	11.474
	1.250	11.188	10.759	10.330	9.900	9.470
	1.500	9.561	9.186	8.811	8.437	8.062

# Table 12. Benefit:Cost Ratios for Food Service Program - Food Service Model

Variable	Estimate	t-ratio
Intercept	6,877,323*	11.26
Best Practice	-5,504,732*	-12.53
Control Stores	-2,537,385*	-3.42
Best Practice*Control Stores	3,366,390*	3.94
Stater Bros.	-2,239,779*	-2.46
Vons	1,245,227*	1.90
Seattle Safeway	8,248,389*	12.83
R <sup>2</sup>	0.62	
Benefit:Cost Ratio	21.83	

 Table 13. Best Practice Program Difference-in-Difference Estimation Results

Note: A single asterisk indicates significance at a 5.0% level.

	Dehydrated	Fresh	Frozen
Variable	Elasticity	Elasticity	Elasticity
		Short Run	
Price	-1.545	-1.026	-0.968
Exchange rate	-2.173	-2.429	-1.166
GDP	0.558	-0.375	-0.156
Export Promotion	0.062	0.073	0.054
		Long Run	
Price	-1.782	-1.384	-1.517
Exchange Rate	-2.506	-3.278	-1.827
GDP	0.643	-0.506	-0.245
Export Promotion	0.716	0.098	0.085
$\overline{\mathbb{R}^2}$	0.960	0.976	0.988
DW	2.353	1.405	2.345

Table 14. Estimated Elasticities for Import Demand Models

	Seed		
Variable	Elasticity		
Price	-0.389		
GDP	0.932		
Export promotion	0.186		
Trend	0.271		

Table 15. Estimated Elasticities for Seed Import Demand Model

	Elasticity of Supply					
	0.50	1.00	1.50	2.00	2.50	3.00
Dehydrated export promotion	7.59	3.80	2.53	1.90	1.52	1.27
Fresh export promotion	14.69	7.35	4.90	3.68	2.94	2.45
Frozen export promotion	19.17	9.59	6.39	4.79	3.83	3.20
Seed export promotion	8.73	4.34	2.89	2.16	1.73	1.44
Overall export promotion	14.80	7.41	4.93	3.70	2.96	2.47

# Table 16. Benefit:Cost Ratios for USPB Export Promotion Programs

# Table 17. Summary of BCR Results

	Short Run	Long Run
Domestic Programs	2.922	5.228
International Programs	4.930	4.930
Best Practice Program	21.830	21.830
Overall USPB Program	5.167	6.512