

**WP 2012-16**  
**December 2012**



# Working Paper

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## **Economic and Nutritional Implications from Changes in U.S. Agricultural Promotion Efforts**

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### **Abstract**

Promotion programs that subsidize advertising for exported agricultural products continue to be employed in the United States and elsewhere despite much criticism that they are an inefficient use of taxpayer money. At the same time others have advocated for an increase in funds to support domestic advertising for fruits and vegetables; they see a role for public investment in such an effort given consumer trust in the government regarding messages about food choice and health. Because much of the U.S. trade promotion expenditures are applied to fruit and vegetable crops, we investigate the economic and health effects from changes in both export and domestic promotion expenditures for horticultural and non-horticultural commodities. Simulation results show that even modest decreases in trade promotion expenditures coupled with a corresponding increase in domestic promotion efforts have the capacity to influence domestic market conditions, caloric intake, and nutrient consumption.

*Keywords:* Advertising, Export promotion, Horticulture, Nutrient intake, Policy reform, Simulation model.

*JEL Classification:* Q13, Q17, Q18

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# **Economic and nutritional implications from changes in U.S. agricultural promotion efforts**

## **Introduction**

Since the inception of Targeted Export Assistance Program in 1985 and its replacement with the Market Promotion Program in 1990, the U.S. government has had a long tradition of subsidizing promotional efforts for agricultural products in export markets through research, trade shows, or advertising campaigns. Public funds are purportedly used for promotion to raise the market share of U.S. agricultural products in an increasingly competitive international marketplace. Since 2002, the Market Access Program (MAP) has served as the main program supporting promotion for high-value agricultural products (e.g., fruits, salmon, almonds, and wine) in foreign markets. In recent years, publicly funded promotion expenditures have grown from \$120 million in 1997 (U.S. GAO, 1999) to \$200 million dollars in 2011 (USDA-FAS, 2011). The Foreign Market Development (FMD) program has also provided promotion funds to expand long-term export markets for bulk products (e.g., soybean, cotton, grains, meat, wheat, and rice); the FMD program has had a budget of approximately \$35 million since 2006 (USDA-FAS, 2009). Table 1 outlines some recent expenditures under the MAP and the FMD program.

This article examines the linkage between agricultural subsidies applied to export promotions and the implications for domestic welfare and the associated domestic nutritional outcomes. Under the assumption that the government serves as a trusted and credible source of information that promotes the health benefits of fruit and vegetable consumption, we examine the economic and nutritional impacts from a redirection of export promotion expenditures towards domestic promotion efforts for horticultural commodities. The MAP is the focus of our analysis because it applies to high value specialty crops whereas the FMD program has traditionally been applied to bulk agricultural products. Our analysis extends the study by

Kinnucan and Cai (2011) that examined the impacts of non-price export promotions on domestic consumers and the study by Alston et al. (2009) that examines the dietary outcomes of proposed policy changes for healthy and unhealthy foods. We build on these earlier articles in two ways. First, we simulate the economic impacts of changes in government expenditures for export promotions of two commodity categories: horticultural products and non-horticultural products. Second, we use the simulated economic changes to calculate the corresponding changes in caloric consumption and intake of key nutrients, and discuss the implications.

### **Health Promotion, Food Choices, and Consumer Trust**

Our research is motivated, in part, by concerns over dietary health and the growing obesity epidemic in the United States over the past few decades (Zhang and Wang, 2004; Flegal et al., 2010). It is also motivated by the observation that the United States uses relatively little public funding to promote the consumption of fruits and vegetables domestically. Many other countries actively promote the health benefits of a diet rich in fruits and vegetables using large-scale advertisements. In Australia and the United Kingdom, publicly funded advertising programs for fruits and vegetables have shown to increase domestic consumption of fresh produce (Pollard et al., 2008; Capacci and Mazzocchi, 2011). There is some evidence that U.S. consumers might also respond to broad-based advertising efforts for fruits and vegetables (Rickard et al., 2011); however, in the United States, government support for domestic advertising of fruits and vegetables is negligible.

Health promotion efforts that effectively increase fruit and vegetable consumption have the capacity to be important nutritionally. Nutritionists see two primary health benefits of higher consumption rates of fruits and vegetables: higher intake of fiber and micronutrients (Godfrey and Richardson, 2002; Crujeiras et al., 2010), and the displacement of overall energy intake or

increased satiation (Rolls et al., 2004; Rodríguez-Rodríguez et al., 2010). Economic models that examine the effects of policy change typically report the price and quantity effects for selected commodities or food items, but do not address the implications for energy and nutrient intake. Therefore, we extend these traditional economic analyses here to consider how policy changes influence caloric consumption and nutrient intake.

In response to health concerns and social costs linked to obesity, the U.S. government may be able to play a larger role in the promotion of fruits and vegetables domestically. A campaign that helps to increase total fruit and vegetable consumption will influence micronutrient intake and dietary patterns more generally. Publicly funded campaigns used in countries outside of the United States that promote fruits and vegetables may have increased consumption because consumers trust health promotion messages from the government (Sheth and Parvatiyar, 1995; Coveney, 2008). Conversely, it is expected that consumers are less likely to trust promotional messages about food products from individual firms. Firm-level or even commodity-specific promotion efforts are unlikely to emphasize the health benefits of consuming fruits and vegetables collectively; they are more likely to develop promotional efforts that will increase sales of their product, and perhaps at the expense of other products in the fruit and vegetable category.

There is evidence that public policy initiatives have the capacity to impact fruit and vegetable consumption and nutrient intake (Cox et al., 1998; French and Stables, 2003; Glanz and Yaroch, 2004; Pomerleau et al., 2005; Capacci and Mazzocchi, 2011), and can enhance knowledge and overall awareness of healthier eating (Stables et al., 2002; Mangunkusumo et al., 2007). In this article we examine the economic and nutritional impacts from promotion of fruits and vegetables, and we study how the effects are influenced by the level of trust that consumers

place on health messages delivered by the government. Using a range of possible consumer response to domestic advertising efforts for fruits and vegetables, we shed some new light on the importance of consumer trust in the design of public policies to promote healthy food choices. By focusing on the role of government in the dissemination of promotional materials for fruits and vegetables, we build on earlier work that examines consumer trust of information provided by the government related to food safety (Hobbs, 2003), food quality (Jin et al., 2011), mandatory nutrition labeling (Caswell and Mojdzuska, 1996), and the health attributes of food (Williams, 2005; Coveney, 2008).

### **Simulation Model**

Our approach to understanding the economic effects of changes in promotional efforts for agricultural commodities can be illustrated graphically. In Figure 1 we show the effects of a reduction in export promotion efforts in the presence of domestic advertising. Panel A in Figure 1 outlines the likely effects of reducing government spending on agricultural trade promotions with no consumer response in domestic advertising; here we do not distinguish between horticultural and non-horticultural commodities, and instead focus on all commodities denoted as  $c$ . In this case we see a decrease in price, export demand falls, and an increase in domestic consumption. In Panel B, we assume that domestic consumers do respond to domestic advertising, and that there is an outward shift in domestic demand. Here the price again decreases, but to less of a degree than what is observed in Panel A. Due to the shift in export supply in this case, we see a larger decrease in the exported quantity; the increase in domestic demand also leads to a larger increase in domestic consumption. Since we illustrate the case of a reduction in export promotion, the price and quantity effects in Figure 1 are similar, but opposite to those outlined in Kinnucan and Cai (2011).

The framework introduced in Panel B in Figure 1 is extended in Figure 2. Here we outline the effects of reducing export promotion for horticultural commodities in a multi-market context with consumers responding to domestic promotion efforts. In Figure 2 we separate horticultural products from non-horticultural products, and therefore use superscripts  $h$  and  $n$  to differentiate these two commodity categories. Panel A in Figure 2 describes the domestic market and export market for horticultural commodities; Panel B describes markets for non-horticultural commodities. The two commodity categories are modeled as substitutes in consumption in the domestic market. Here we observe that a decrease in export promotion applied to horticultural commodities leads to similar results presented in the Panel B in Figure 1; the price of horticultural commodities falls and consumption increases at home. Due to the substitutability between two products, we assume an inward-shift in domestic demand for non-horticultural commodities in Panel B. This, in turn, leads to an increase in the export supply of non-horticultural commodities. Overall, the market price and domestic consumption of non-horticultural commodities are shown to fall in Figure 2. Given the magnitude of the shifts in domestic demand and export supply for non-horticultural commodities, it is possible to observe either an increase or a decrease in the domestic consumption of non-horticultural commodities.

Next we develop a multi-market partial-equilibrium model used to simulate the effects of reductions in export promotion subsidies following a framework outlined by Alston et al. (1995), among others. The model is a system of supply, demand, and market clearing conditions for two commodity groups. Solutions to the logarithmic transformation hinge on the parameters that describe supply, demand and promotional elasticities as well as various quantity and promotional shares. The results from the simulation model are subsequently used to calculate changes in welfare, caloric consumption and intake of selected nutrients.



$$Q_d^h = H_d(P^h, P^n, A_d^h) \quad (1a)$$

$$Q_d^n = N_d(P^h, P^n, A_d^n) \quad (1b)$$

$$Q_x^h = H_x(P^h, \tilde{A}_x^h) \quad (1c)$$

$$Q_x^n = N_x(P^n, \tilde{A}_x^n) \quad (1d)$$

$$A_d^h + A_x^h = A_I^h \quad (1e)$$

$$A_d^n + A_x^n = A_I^n \quad (1f)$$

$$A_I^h = T^h \cdot Q_s^h \quad (1g)$$

$$A_I^n = T^n \cdot Q_s^n \quad (1h)$$

$$\tilde{A}_x^h = A_x^h + A_G^h \quad (1i)$$

$$\tilde{A}_x^n = A_x^n + A_G^n \quad (1j)$$

$$\tilde{A}_x^h = f(A_G^h) \quad (1k)$$

$$\tilde{A}_x^n = f(A_G^n) \quad (1l)$$

$$Q_s^h = H_s(P_s^h) \quad (1m)$$

$$Q_s^n = H_s(P_s^n) \quad (1n)$$

$$P_s^h = P^h - T^h \quad (1o)$$

$$P_s^n = P^n - T^n \quad (1p)$$

$$Q_s^h = Q_d^h + Q_x^h \quad (1q)$$

$$Q_s^n = Q_d^n + Q_x^n \quad (1r)$$

In the equations above we use superscripts  $h$  and  $n$  to denote horticultural and non-horticultural products; subscripts  $d$  and  $x$  to denote domestic and export markets; and subscripts  $I$  and  $G$  to represent the source of promotion funding ( $I$  for industry and  $G$  for government). Endogenous market-level variables include quantities consumed domestically,  $Q_d$ , quantities exported,  $Q_x$ , domestic production,  $Q_s$ , supply price,  $P_s$  (exclusive of the per unit marketing fee,  $T$ ), and demand price,  $P$  (inclusive of marketing fee). Other endogenous variables include the funds for promotion generated by a marketing fee,  $A_I$ , industry expenditures on domestic promotions,  $A_d$ , expenditures for export market promotion exclusive of the subsidy,  $A_x$ , and total expenditures for the export market promotion inclusive of the subsidy,  $\tilde{A}_x$ . Exogenous demand shifts due to changes in government-funded export promotion are specified in the

model;  $A_G^h$  is used to describe such a shift for horticultural products and  $A_G^n$  is used for non-horticultural products.

Equations (1a), (1b), (1c) and (1d) describe the demand for horticultural and non-horticultural products in domestic and export markets where cross-price effects are considered only in the domestic market. For each commodity category, equations (1e) and (1f) show the domestic and export promotion expenditures by industry sources. Equations (1g) and (1h) outline the mechanism for how industry funds are raised from marketing fees. Equations (1i) and (1j) show that total export promotional expenditures are composed of government funding and industry investment; government subsidies for export promotion efforts are captured in equations (1k) and (1l). Equation (1m) and (1n) represent the supply equations for horticultural and non-horticultural products. Market-clearing conditions for price, quantities consumed and total subsidy allocated between horticultural and non-horticultural products are presented in equations (1o), (1p), (1q) and (1r). We substitute equation (1i) into equation (1e) to eliminate  $A_x^h$  and equation (1j) is substituted into (1f) to eliminate  $A_x^n$ . A logarithmic transformation is applied to this set of equations to develop the following model that will be used to simulate the economic effects from specific changes in promotional efforts.

$$d \ln Q_d^h = \eta_d^{hh} d \ln P^h + \eta_d^{hn} d \ln P^n + \psi_d^h \alpha_d^h d \ln A_d^h \quad (2a)$$

$$d \ln Q_d^n = \eta_d^{nn} d \ln P^n + \eta_d^{nh} d \ln P^h + \psi_d^n \alpha_d^n d \ln A_d^n \quad (2b)$$

$$d \ln Q_x^h = \eta_x^h d \ln P^h + \beta_A^h d \ln \tilde{A}_x^h \quad (2c)$$

$$d \ln Q_x^n = \eta_x^n d \ln P^n + \beta_A^n d \ln \tilde{A}_x^n \quad (2d)$$

$$\theta_d^h d \ln A_d^h + \theta_x^h d \ln \tilde{A}_x^h = \theta_I^h d \ln A_I^h + \theta_G^h d \ln A_G^h \quad (2e)$$

$$\theta_d^n d \ln A_d^n + \theta_x^n d \ln \tilde{A}_x^n = \theta_I^n d \ln A_I^n + \theta_G^n d \ln A_G^n \quad (2f)$$

$$d \ln A_I^h = d \ln T^h + d \ln Q_s^h \quad (2g)$$

$$d \ln A_I^n = d \ln T^n + d \ln Q_s^n \quad (2h)$$

$$d \ln \tilde{A}_x^h = \varphi_x^h d \ln A_G^h \quad (2k)$$

$$d \ln \tilde{A}_x^n = \varphi_x^n d \ln A_G^n \quad (2l)$$

$$d \ln Q_s^h = \varepsilon^h d \ln P_s^h \quad (2m)$$

$$d \ln Q_s^n = \varepsilon^n d \ln P_s^n \quad (2n)$$

$$d \ln P^h = (1 - \tau^h) d \ln P_s^h + \tau^h d \ln T \quad (2o)$$

$$d \ln P^n = (1 - \tau^n) d \ln P_s^n + \tau^n d \ln T \quad (2p)$$

$$d \ln Q_s^h = k_d^h d \ln Q_d^h + k_x^h d \ln Q_x^h \quad (2q)$$

$$d \ln Q_s^n = k_d^n d \ln Q_d^n + k_x^n d \ln Q_x^n \quad (2r)$$

In equations (2a) to (2r), we use  $d \ln Z$  to indicate a relative change in variable  $Z$ .

Solutions from the model are functions of exogenous shocks related to promotion efforts and the following parameters: index of consumer trust in domestic promotion efforts denoted as  $\psi$ , promotion elasticities in the domestic denoted as  $\alpha$ , promotion elasticities in the export market denoted as  $\beta$ , supply elasticities denoted as  $\varepsilon$ , own and cross-price demand elasticities denoted as  $\eta$ , consumption shares of domestic production in domestic and export markets denoted as  $k = Q/Q_s$ , and the marketing fee expressed as a fraction of the demand price denoted as  $\tau$ . Share identities, denoted as  $\theta$ , represent the promotional shares for  $h$  and  $n$  products derived from different sources. The elasticity indicating the sensitivity of total spending on export promotion is denoted as  $\varphi_x^c$ ; we follow Kinnucan and Cai (2011) and refer to this as the budget-diversion elasticity.

### **Parameterization of the Model**

We estimate export price and promotional elasticities for both horticultural and non-horticultural products using data between 1975 and 2004. Long-run export promotional elasticities for both commodity categories are estimated following the econometric framework employed by Kinnucan and Cai (2011). Equation (3a) outlines the model used to estimate the U.S. export value share for horticultural commodities and equation (3b) outlines the model used to estimate the U.S. export value share for non-horticultural commodities.

$$\begin{aligned} \ln(X_t^h / X_t^{Wgdp}) = & \beta_0^h + \beta_P^h \ln(P_t^h / DEFL_t) + \beta_{PS}^h \ln(P_t^{C,h}) + \beta_{XR} \ln(XR_t) \\ & + \beta_Y \ln(X_t^{Wgdp} / DEFL_t) + \beta_A^h \ln(GW_t^h) + \beta_{LAG}^h \ln(X_{t-1}^h / X_{t-1}^{Wgdp}) + \mu_t^h \end{aligned} \quad (3a)$$

$$\begin{aligned} \ln(X_t^n / X_t^{Wgdp}) = & \beta_0^n + \beta_P^n \ln(P_t^n / DEFL_t) + \beta_{PS}^n \ln(P_t^{C,n}) + \beta_{XR} \ln(XR_t) \\ & + \beta_Y \ln(X_t^{Wgdp} / DEFL_t) + \beta_A^n \ln(GW_t^n) + \beta_{LAG}^n \ln(X_{t-1}^n / X_{t-1}^{Wgdp}) + \mu_t^n \end{aligned} \quad (3b)$$

In the above specifications,  $X_t$  represents the nominal value for U.S. agricultural exports in year  $t$  in U.S. dollars;  $X_t^{Wgdp}$  is the nominal per capita GDP for countries outside of the United States in year  $t$  in U.S. dollars;  $P_t^h$  is the unit-value of U.S. horticultural exports in U.S. dollars per metric ton in year  $t$ , representing the market price;  $P_t^n$  is the unit value of U.S. poultry exports in year  $t$  (serving as a proxy for the market price of U.S. non-horticultural products);  $P_t^{C,h}$  is the real trade-weighted exchange rates for U.S. competitors' horticultural exports in year  $t$  (serving as a proxy for the price of substitutes for U.S. horticultural products);  $P_t^{C,n}$  is the real trade-weighted exchange rates for U.S. competitors' high-value processed products in year  $t$  (serving as a proxy for the price of the substitute for U.S. non-horticultural products); and  $X_{t-1} / X_{t-1}^{Wgdp}$  represents the lagged dependent variable for the share of foreign income spent on U.S. agricultural exports. The term  $DEFL_t$  is the GNP deflator for countries outside of the United States in year  $t$ ;  $XR_t$  is the world U.S. agricultural trade-weighted real exchange rate; and  $\mu_t$  is a random disturbance term.

The goodwill variable for the horticultural and non-horticulture commodity categories, denoted as  $GW$ , is generated using data describing export promotion expenditures. Following Nerlove and Arrow (1962) and Kinnucan and Cai (2011), the goodwill variable for commodity category  $c$  is defined as  $GW_t^c = AD_t^c + \delta AD_{t-1}^c + \delta^2 AD_{t-2}^c + \delta^3 AD_{t-3}^c$ , where

$AD_t^c = \tilde{A}_{x,t}^c \cdot SDR_t^c / DEFL_t$  is the real total U.S. promotional expenditures for commodity

category  $c$  exports in year  $t$ .<sup>1</sup> The coefficient on the goodwill variable, denoted as  $\beta_A^c$ , is the parameter of interest as it will be used directly in the simulation model to describe the response to export promotion efforts for the two commodity groups. Following the calculations outlined in Kinnucan and Cai (2011), the long-run promotional elasticity for horticultural products is 0.282 and it is 0.12 for non-horticultural products.<sup>2</sup>

All other parameters used in the model are taken from the literature, or based on information from industry and government sources. The baseline values for model parameters and the relevant data sources are listed in Table 2 for horticultural products, and in Table 3 for non-horticultural products. We borrow parameters on export promotional expenditures, marketing fees, and supply elasticities from Kinnucan and Cai (2011), use estimates from Huang and Lin (2000) to define demand elasticities, and collect other baseline parameter values from industry and government sources. Initial equilibrium values for price, quantity and promotion expenditures are set equal to their average value during the period between 2000 and 2004. Budget share parameters for both products are derived from available data describing U.S. government expenditures for export promotion, total U.S. expenditures for export promotion, and industry investments in promotion. Quantity shares are derived from data detailing average gross values of U.S. farm production for horticultural and non-horticultural commodities, and average export values for these two commodity categories. Marketing fees for both commodity categories, expressed as a fraction of demand price, are set to 0.004 to calculate the respective industry expenditures for promotions.

Baseline supply elasticities for both commodity categories are set equal to 0.6 in an effort to capture production response over a longer time horizon. Domestic demand elasticities estimated by Huang and Lin (2000) for fruit (-0.72) and poultry (-0.64) are employed here to

represent the domestic demand elasticities for horticultural and non-horticultural products, respectively. A range of values for the cross-price elasticity between the commodity categories are considered in our analysis; the baseline value was set at 0.05 and in the final simulation we set the value equal to 0.25 to better understand how sensitive our results are to this parameter.

Kinnucan and Cai (2011) model consumer response to domestic promotion efforts using a range of domestic promotion elasticities between 0 and 0.1. Here we extend the calculation of consumer response to domestic promotion efforts to include the domestic promotion elasticity (denoted as  $\alpha_d^c$ ) and an index parameter (between 0 and 1) that indicates the level of consumer trust in such efforts (denoted as  $\psi_d^c$ ). To be consistent with Kinnucan and Cai (2011), in our baseline simulations we consider elasticities that range between 0 and 0.2 and set the consumer trust parameter equal to 0.5. In a subsequent simulation we examine the effects when the consumer trust parameter for domestic promotion efforts increases to 1.0 for horticultural commodities.

Next we develop a link between our simulated changes in consumption and the corresponding changes in caloric consumption and nutrient intake. This is done to provide a quantitative examination of the dietary impacts for domestic consumers given changes in export and domestic promotion efforts. We use data describing food availability and food consumption to define the caloric consumption levels contributed from horticultural and non-horticultural commodity categories.<sup>3</sup> We also use data describing the nutrient content found in various commodities to calculate the nutrient density for our horticultural and non-horticultural commodity categories. These calculations are done for six selected nutrients: cholesterol, fiber, vitamin A, vitamin C, calcium, and iron.<sup>4</sup> Combining the percent changes in consumption simulated in our economic model with the nutrient density information, we calculate the annual

changes in caloric consumption and changes in intake of the selected nutrients. Results are provided across a range of simulation experiments and presented separately for the horticultural and non-horticultural commodity categories.

## **Results**

Four simulations are considered in our analysis that models the effects of a 10% decrease in government expenditures for export promotions coupled with a corresponding increase in expenditures for domestic promotion efforts under various market conditions. The first simulation examines the economic and nutritional effects from changes in government expenditures on promotion of both horticultural and non-horticultural products. The second examines the effects when the changes in government expenditures for promotion are applied only to horticultural products. The third and fourth simulations repeat the exercise from the second simulation with additional assumptions. In the third simulation we examine the effects from greater consumer trust in domestic promotion efforts for horticultural commodities relative to non-horticultural commodities. In this case we assume that the government is involved in the promotion campaign for fruits and vegetables and that consumers place greater trust in such a program. The fourth simulation assumes a stronger level of substitution between horticultural and non-horticultural commodities. For all simulations we show results across a range of domestic promotion elasticity parameters.

Our results are summarized in Table 4 and Table 5. Here we show the effects on prices and consumption simulated from our model, and the welfare measures derived following Wohlgenant (1993) for the horticulture and non-horticulture commodity categories. In addition, we use the simulated changes in quantities to calculate annual changes in caloric consumption and annual changes in the intake of selected nutrients; all of these changes are reported in the

tables of results. We are interested in the net changes in nutrient intake, and therefore we combine the effects across the commodity categories when we report changes in nutrient intake. Although an increase of 3500 calories per year is considered to add one pound of body weight in a steady state (Hall et al., 2011), we report separate caloric changes for horticultural and non-horticultural commodity categories. We do this as there is evidence that an increase in caloric consumption from foods derived from horticultural commodities, compared to non-horticultural commodities, are associated with very small (or even negative) impacts on body weight (Ludwig, 2002; Ledikwe et al., 2006; Mozaffarian et al., 2011).

Table 4 shows results from two simulations that model the effects of a 10% decrease in government support for export promotions with a redirection of these funds to domestic promotion efforts. The first simulation considers changes in promotional support for all commodities, and the second examines the effects when the changes apply only to promotional support for horticultural commodities. For both simulations we examine four levels of response to domestic promotion activities. When export promotion decreases (and domestic promotion increases) for both commodity categories, we see producer surplus fall, consumer surplus increase, and an increase in net social surplus.

Depending on the level of consumer response to domestic advertising, caloric consumption increases by between 1486 and 9305 calories annually, and annual intake of all the selected nutrients increases. Using the daily recommendations for nutrient intake<sup>5</sup>, we see that the simulated changes in intake of the selected nutrients are non-trivial; they range between an increase of 1% to 3%. When we simulate a 10% decrease in export promotion for horticultural commodities only (thereby diverting the funds to domestic promotion for horticultural commodities) we see larger welfare effects in horticultural markets, but smaller welfare effects



overall. In the second simulation we find larger changes in caloric consumption in the horticultural commodity category, but negative changes in caloric consumption in the non-horticultural commodity category. Furthermore, compared to the results from the first simulation, we see a decrease in intake of cholesterol and much larger increases in fiber and the selected micronutrients. In particular, intake of vitamin A increases by 2.1% and vitamin C increases by 6.7%.

In Table 5 we provide results from two additional simulations that test the impact of greater trust in domestic promotion efforts for the horticultural commodity category and the effect of increased substitutability (in consumption) between the horticultural and non-horticultural commodity categories. Both of these simulations were designed as a way to better understand the upper limit in changes to caloric consumption and nutrient intake given a 10% decrease in export promotion for horticultural commodities. In both of these cases the results will be compared to those from the second simulation in Table 4. In the case with greater consumer trust in domestic promotion efforts for horticultural commodities (by setting the consumer trust parameter equal to one for the horticultural commodity category), we see larger increases in caloric consumption of horticultural commodities and smaller decreases in caloric consumption of non-horticultural commodities. This, in turn, leads to a smaller decrease in cholesterol and larger increases in fiber and the selected micronutrients. Simulation results from the model that considered increased substitutability between commodity categories shows little difference in the change in caloric consumption from horticultural commodities, but a much larger decrease in caloric consumption of non-horticultural commodities. As a result, we see a bigger decrease in the intake of cholesterol and smaller increases in the intake of fiber and micronutrients.

Overall, our simulation results indicate that a modest decrease in export promotion expenditures (and a budget-neutral reinvestment of those funds in domestic promotion efforts) for horticultural commodities has economic and nutritional implications. The results are particularly sensitive to the level of consumer trust in domestic promotion efforts. The nutritional implications are greatest in the simulation that assumes full consumer trust in government-sponsored promotion efforts for the horticultural commodity category. Results here show that fiber and vitamin A intake would increase by approximately 3.5% and that vitamin C intake would increase by 12.3%. Our findings suggest that there would be economic and nutritional gains from redirecting export promotion funds for horticultural commodities to the domestic market, and that the nutritional impacts would be greatest in the presence of a domestic promotion program that is trusted by consumers.

### **Summary and Policy Implications**

The positive effects of government-supported export promotion programs for exporting producers of agricultural commodities have been well documented. There is also some evidence that these programs reduce domestic consumer welfare. In this article we extend research in this arena by considering both the economic and health consequences from changes in both export and domestic promotion efforts for agricultural commodities. A simulation model is developed to consider the effects in two commodity categories—horticultural and non-horticultural commodities—and much of our analysis focuses on the implications of decreasing government expenditures on export promotion of horticultural commodities and redirecting the funds to increase domestic promotion efforts for the same commodities. More specifically, we are interested in the impact of government-supported activities that promote the consumption of horticultural commodities in the domestic markets (e.g., 5-A-Day programs). It is expected that

consumers will place greater trust in government-sponsored promotional messages that highlight the health benefits of consuming horticultural commodities, and we explore the economic and nutritional implications of consumer trust in such campaigns.

A series of simulations were conducted to examine the effects of a decrease in government expenditures for export promotion coupled with a corresponding increase in domestic promotion for agricultural commodities. We consider the impacts from changes applied to all agricultural commodities and from changes that apply only to horticultural commodities. We also explore how sensitive our baseline results are to the level of consumer trust in such promotion campaigns and to the level of substitution between the two commodity categories. Our results indicate that this redirection of promotion expenditures would increase net social welfare (largely from increases in consumer surplus due to lower prices). When we focus on changes in promotional efforts for horticultural commodities, the net gain in social surplus for horticultural commodities increases as the level of substitution between the commodity categories increases, and it increases notably as consumer trust in domestic promotion increases. We also provide results to highlight the resulting changes in caloric consumption and nutrient intake from changes in promotional activities. Here we find that decreasing export promotion and increasing domestic promotion for horticultural commodities would lead to a very small decrease in caloric consumption from non-horticultural commodities. However, we would also see an increase in caloric consumption from horticultural commodities which may have positive dietary effects, and important increases in the intake of fiber and selected micronutrients. These positive effects are largest when we consider an increased level of consumer trust in government-supported promotional efforts for horticultural commodities in the domestic market.

This research was motivated by the observation that the U.S. government supports the promotion of horticultural commodities in foreign markets, but does little to support similar promotion efforts in the domestic market. There is also evidence that publically funded promotion programs for fruits and vegetables have influenced consumption patterns in other countries. The purpose of our analysis is to understand both the economic and nutritional implications from a decrease in export promotion efforts and an increase in domestic promotion efforts for fruits and vegetables. We extend previous work in this arena by examining how such changes in promotion expenditures would influence the markets and dietary patterns for two commodity categories, horticultural and non-horticultural products, in the United States. Our analysis sheds new light on the impacts of a government-funded domestic advertising program for fruits and vegetables, and the role of consumer trust in this type of initiative.

## Footnotes

<sup>1</sup> The retention parameter,  $\delta$ , is set equal to 0.33 (following Kinnucan and Cai, 2011) for both commodity categories.

<sup>2</sup> These estimates indicate that foreign markets are more responsive to promotion efforts for U.S. horticultural exports compared to promotion efforts for all U.S. agricultural exports; the long-run elasticity estimated by Kinnucan and Cai (2011) was 0.189.

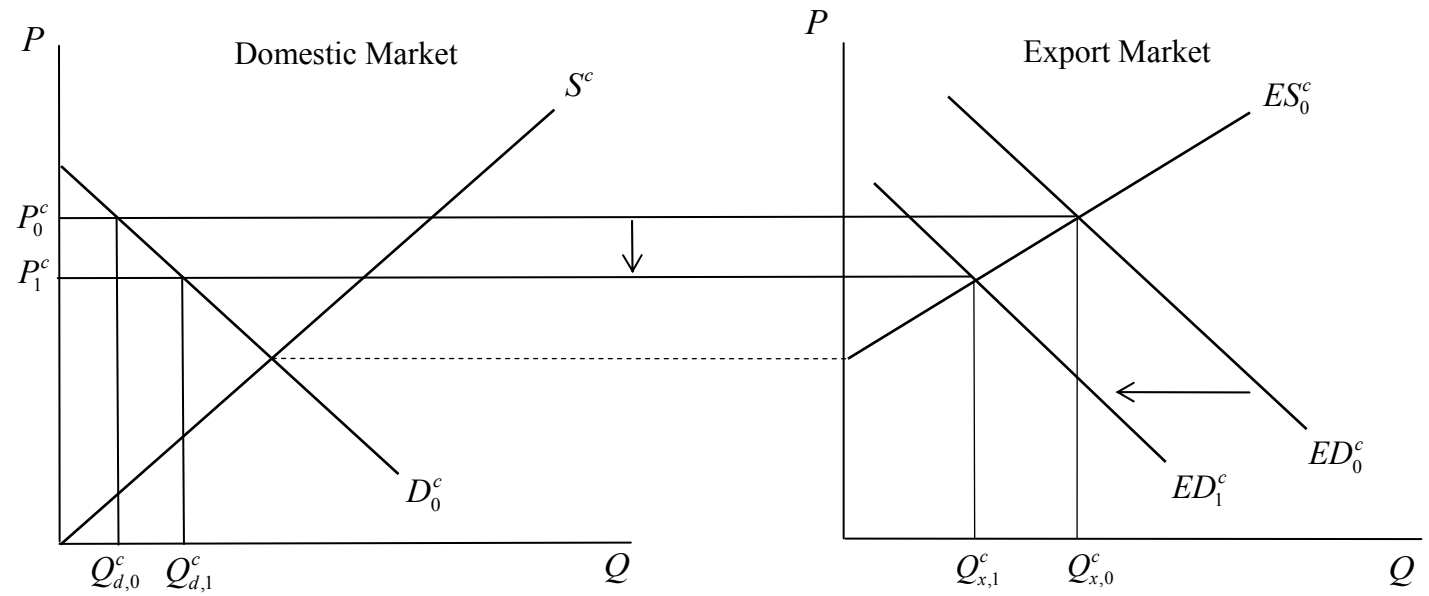
<sup>3</sup> Because the caloric content for food consumed from different commodity categories is not available, we use the caloric content from data describing food supply (USDA-ERS: Food Availability Data System, 2012) to generate shares of caloric intake in the two commodity categories. Based on these data and total daily caloric consumption of 2067 calories per day per adult, we set total calories from horticultural commodities to 214 and total calories from non-horticultural commodities to 1853.

<sup>4</sup> We use loss-adjusted food availability data to describe the average nutrient intake in the consumption of horticultural and non-horticultural products (USDA-ERS: Food Availability Data System, 2012). Following this approach, the average intake of cholesterol, fiber, vitamin A, vitamin C, calcium and iron contributed from horticultural products is 0 milligrams (mg), 6.2 grams (g), 154.7 micrograms ( $\mu\text{g}$ ), 52.3 mg, 66.1 mg, and 2.3 mg respectively. For non-horticultural products, the average intake is 364.9 mg, 6.5  $\mu\text{g}$ , 398.0 mg, 6.5 mg, 427.1 mg, and 9.7 mg for cholesterol, fiber, vitamin A, vitamin C, calcium and iron, respectively.

<sup>5</sup> Daily Dietary Reference Intakes for the selected nutrients are available from USDA-FNIC (2012). Based on a recommended intake of 2000 calories per day, the recommended intake for cholesterol is 300 mg per day, for fiber is 25 g per day, for vitamin A is 550  $\mu\text{g}$  per day, for vitamin C is 60 mg per day, for calcium is 1000 mg per day, and for iron is 18 mg per day.

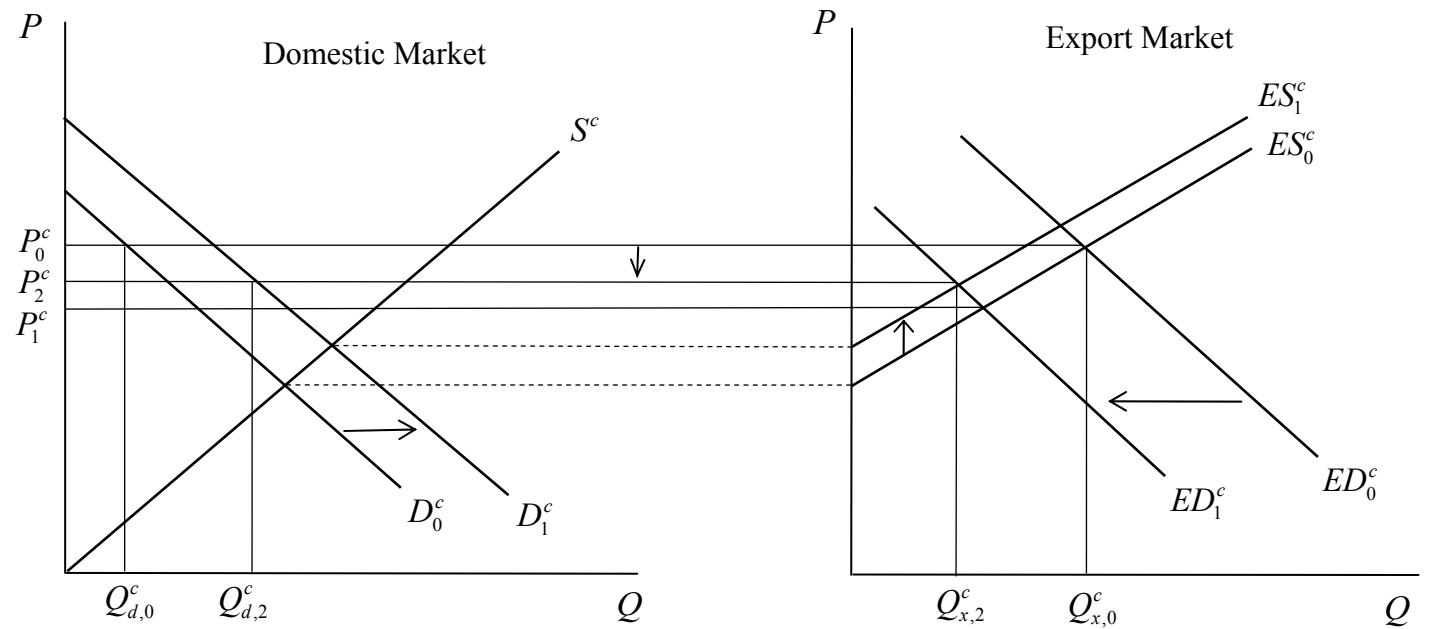
**Panel A.**

No consumer response to domestic promotion



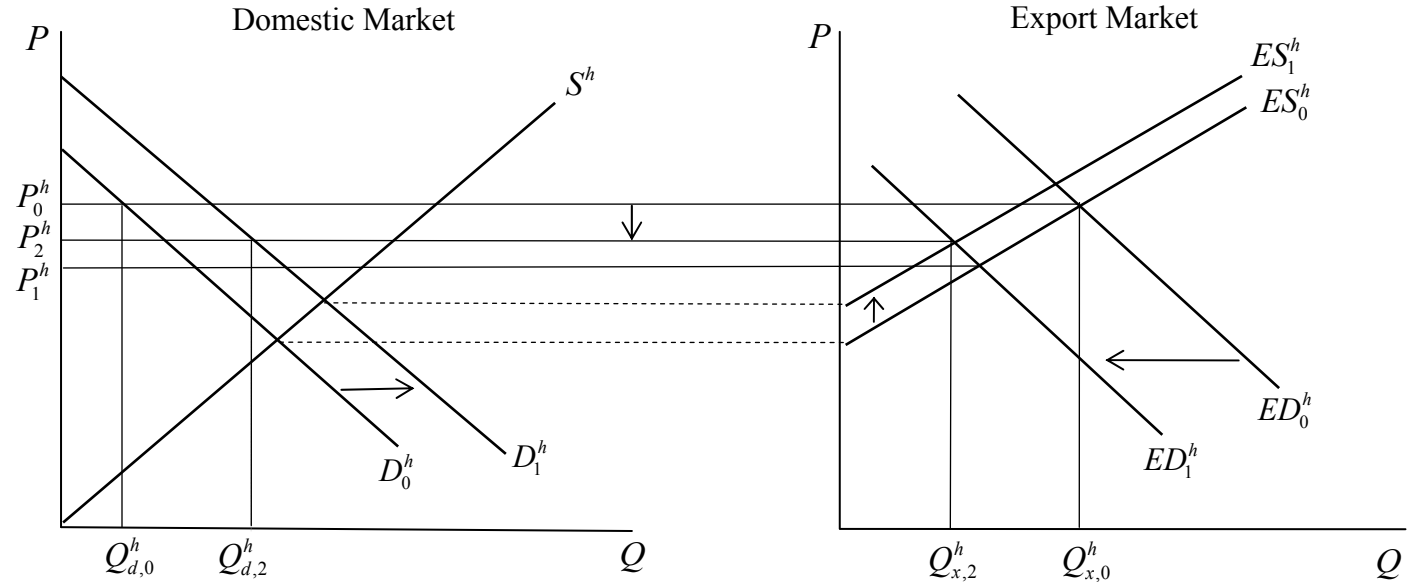
**Panel B.**

Some consumer response to domestic promotion

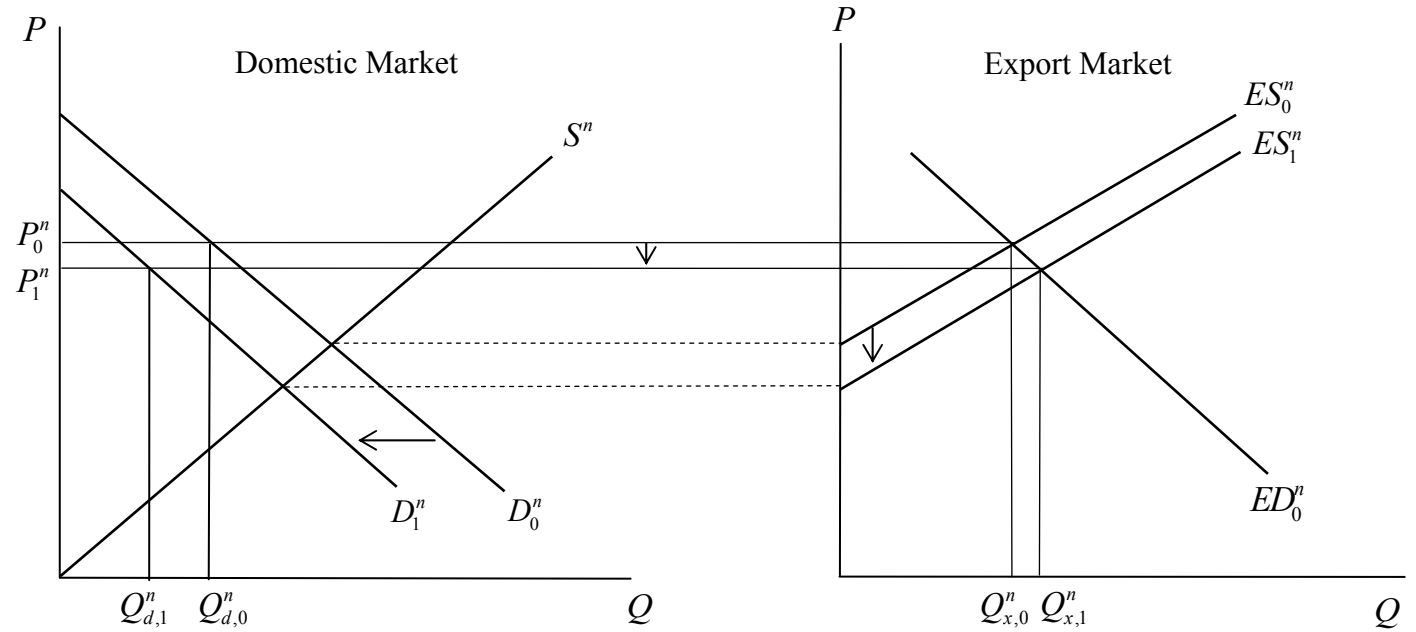


**Figure 1.** Potential Effects from Changes in Export Promotion Efforts

**Panel A.**  
Horticultural Products



**Panel B.**  
Non-Horticultural Products



**Figure 2.** Multi-Market Response to Changes in Government-Funded Export Promotions for Horticultural Products

Table 1. Export Promotion Expenditures for Horticultural and Non-Horticultural Products, FY 2011

<b>Market Access Program (MAP)<sup>a</sup></b>				<b>Foreign Market Development (FMD) Program<sup>b</sup></b>	
<b>Horticultural Products</b>		<b>Non-Horticultural Products</b>		<b>Non-Horticultural Products</b>	
<i>Organization</i>	<i>Allocation</i>	<i>Organization</i>	<i>Allocation</i>	<i>Organization</i>	<i>Allocation</i>
Washington Apple Commission	\$5,199,788	U.S. Meat Export Federation	\$16,261,732	American Soybean Association	\$6,648,054
Florida Department of Citrus	\$4,937,966	Food Export Association of the Midwest USA	\$10,919,428	U.S. Wheat Associates	\$5,033,535
National Potato Promotion Board	\$4,870,824	Western United States Agricultural Trade Association	\$10,859,171	U.S. Grains Council	\$4,386,866
California Walnut Commission	\$4,614,261	U.S. Grains Council	\$8,621,582	U.S. Meat Export Federation	\$1,612,357
Pear Bureau Northwest	\$3,632,830	Food Export USA Northeast	\$8,152,605	USA Rice Federation	\$1,457,865
California Table Grape Commission	\$3,494,622	U.S. Wheat Associates	\$6,798,051	USA Poultry and Egg Export Council	\$1,262,021
California Prune Board	\$3,339,658	Southern United States Trade Association	\$5,831,384	National Renderers Association	\$837,791
Sunkist Growers, Inc.	\$3,107,359	Wine Institute	\$5,585,230	American Peanut Council	\$628,631
Others	\$17,916,743	Others	\$38,178,950	Others	\$1,293,773
<b>Total</b>	<b>\$51,114,051</b>		<b>\$111,208,133</b>		<b>\$23,160,893</b>

Source: USDA: FAS, 2011. Total Available FY 2011 Funding for Market Access Program and Foreign Market Development Program.

<sup>a</sup> Total available funding for MAP in FY 2011 was \$200 million; this includes approximately \$32 million in expenditures for other (non-food) agricultural and forestry products and approximately \$5.6 million in reserves that are not shown here.

<sup>b</sup> Total available funding for FMP was \$34.5 million in FY 2011; this includes approximately \$8.5 million for other agricultural and forestry products and \$2.8 million in reserves that are not shown here.



Table 2. Baseline Parameter Values for the Horticultural Commodity Category

Parameter	Definition	Value	Source
$A_G^h$	Government expenditures for export promotion of horticultural products (million \$)	26	Kinnucan and Cai (2011) USDA-FAS: GATS (2012)
$\tilde{A}_x^h$	Total expenditures for export promotion of horticultural products (million \$)	76	Kinnucan and Cai (2011)
$A_I^h$	Total industry spending on promotion of horticultural products (million \$)	99	Calculated
$A_d^h$	Domestic promotional expenditures for horticultural products (million \$)	49	Calculated
$A^h$	Total promotional expenditures for horticultural exports (million \$)	125	Calculated
$\theta_G^h$	Government share of total horticultural promotion expenditures	0.21	Calculated
$\theta_I^h$	Industry share of total horticultural promotion expenditures	0.79	Calculated
$\theta_d^h$	Share of total horticultural promotion expenditures spent in the domestic market	0.39	Calculated
$\theta_x^h$	Share of total horticultural promotion expenditures spent in the export market	0.61	Calculated
$P^h Q_s^h$	Gross farm value of U.S. production for horticultural products (million \$)	24,636	USDA-ERS (2012)
$P_s^h Q_s^h$	Net farm value of U.S. production for horticultural products (million \$)	24,537	Calculated
$P^h Q_x^h$	Value of U.S. farm exports in horticultural products (million \$)	12,082	USDA-FAS: GATS (2012)
$P^h Q_d^h$	Value of domestic consumption in horticultural products (million \$)	12,554	Calculated
$\tau^h$	Industry marketing fees for horticultural products	0.004	Kinnucan and Cai (2011)
$k_d^h$	Quantity share of horticultural supply consumed in the domestic market	0.51	Calculated
$k_x^h$	Quantity share of horticultural supply consumed in the export market	0.49	Calculated
$\varepsilon^h$	Domestic supply elasticity for horticultural products	0.6	Kinnucan and Cai (2011)
$\eta_d^{hh}$	Domestic own-price demand elasticity for horticultural products	-0.72	Huang and Lin (2000)
$\eta_x^h$	Export demand elasticity for horticultural products	-3.46	Estimated
$\eta_d^{hn} = \eta_d^{nh}$	Domestic cross-price demand elasticity between horticultural and non-horticultural products	(0.05, 0.25)	Assumed
$\beta_A^h$	Export promotion elasticity for horticultural products	0.282	Estimated
$\psi_d^h$	Index of consumer trust in domestic advertising for horticultural products	(0.5, 1.0)	Assumed
$\alpha_d^h$	Domestic promotion elasticity for horticultural products	(0, 0.1, 0.2)	Assumed
$\varphi_x^h$	Budget diversion elasticity for horticultural products	0.887	Estimated

Table 3. Baseline Parameter Values for the Non-Horticultural Commodity Category

Parameter	Definition	Value	Source
$A_G^n$	Government expenditures for export promotion of non-horticultural products (million \$)	36	Kinnucan and Cai (2011) USDA-FAS: GATS (2012)
$\tilde{A}_x^n$	Total expenditures for export promotion of non-horticultural products (million \$)	108	Kinnucan and Cai (2011)
$A_I^n$	Total industry spending on promotion of non-horticultural products (million \$)	632	Calculated
$A_d^n$	Domestic promotional expenditures for non-horticultural products (million \$)	560	Calculated
$A^n$	Total promotional expenditures for non-horticultural exports (million \$)	668	Calculated
$\theta_G^n$	Government share of total non-horticultural promotion expenditures	0.05	Calculated
$\theta_I^n$	Industry share of total non-horticultural promotion expenditures	0.95	Calculated
$\theta_d^n$	Share of total non-horticultural promotion expenditures spent in the domestic market	0.84	Calculated
$\theta_x^n$	Share of total non-horticultural promotion expenditures spent in the export market	0.16	Calculated
$P_s^n Q_s^n$	Gross farm value of U.S. production for non-horticultural products (million \$)	155,887	USDA-ERS (2012)
$P_s^n Q_s^n$	Net farm value of U.S. production for non-horticultural products (million \$)	157,255	Calculated
$P_x^n Q_x^n$	Value of U.S. farm exports in non-horticultural products (million \$)	37,603	USDA-FAS: GATS (2012)
$P_d^n Q_d^n$	Value of domestic consumption in non-horticultural products (million \$)	120,284	Calculated
$\tau^n$	Industry marketing fees for non-horticultural products	0.004	Calculated
$k_d^n$	Quantity share of non-horticultural supply consumed in the domestic market	0.76	Calculated
$k_x^n$	Quantity share of non-horticultural supply consumed in the export market	0.24	Calculated
$\varepsilon^n$	Domestic supply elasticity for non-horticultural products	0.6	Kinnucan and Cai (2011)
$\eta_d^{nn}$	Domestic own-price demand elasticity for non-horticultural products	-0.64	Huang and Lin (2000)
$\eta_x^n$	Export demand elasticity for non-horticultural products	-2.48	Estimated
$\eta_d^{hn} = \eta_d^{nh}$	Domestic cross-price demand elasticity between horticultural and non-horticultural products	(0.05, 0.25)	Assumed
$\beta_A^n$	Export promotion elasticity for non-horticultural products	0.12	Estimated
$\psi_d^n$	Index of consumer trust in domestic advertising for non-horticultural products	0.5	Assumed
$\alpha_d^n$	Domestic promotion elasticity for non-horticultural products	(0, 0.1, 0.2)	Assumed
$\varphi_x^n$	Budget diversion elasticity for non-horticultural products	0.873	Estimated

Table 4. Economic and Nutritional Effects from a 10% Decrease in Government Expenditures for Agricultural Export Promotions

Parameters		Decrease in export promotion for horticultural and non-horticultural products				Decrease in export promotion for horticultural products only			
		No Response	Minor Response <sup>a</sup>	Modest Response <sup>b</sup>	Major Response <sup>c</sup>	No Response	Minor Response <sup>a</sup>	Modest Response <sup>b</sup>	Major Response <sup>c</sup>
Change in price (%)	Horticultural	-0.98	-0.95	-0.82	-0.65	-2.30	-2.22	-1.92	-1.52
	Non-horticultural	-0.30	-0.25	-0.03	0.26	0	0	0	0
Change in quantity (%)	Horticultural	0.69	0.95	2.01	3.34	1.66	2.26	4.71	7.81
	Non-horticultural	0.14	0.23	0.56	0.99	-0.12	-0.11	-0.10	-0.08
Change in producer surplus (million \$)	Horticultural	-241	-233	-201	-160	-563	-544	-469	-374
	Non-horticultural	-506	-417	-51	435	0	0	0	0
Change in consumer surplus (million \$)	Horticultural	123	171	363	609	291	400	844	1421
	Non-horticultural	363	553	1325	2316	0	87	437	880
Change in social surplus <sup>d</sup> (million \$)	Horticultural	-118	-62	162	449	-272	-144	375	1047
	Non-horticultural	-143	136	1274	2751	0	87	437	880
Change in annual caloric consumption per capita (calories)	Horticultural	539	742	1570	2609	1297	1765	3679	6100
	Non-horticultural	947	1556	3788	6696	-812	-744	-676	-541
Change in annual intake of selected macronutrients and micronutrients per capita	Cholesterol (mg)	186.5	306.3	745.9	1318.6	-159.8	-146.5	-133.2	-106.6
	Fiber (g)	18.9	26.8	58.5	98.7	34.6	48.4	103.9	174.3
	Vitamin A (μg)	593.0	870.5	1948.4	3324.0	763.0	1116.3	2514.2	4293.7
	Vitamin C (mg)	135.0	186.7	396.8	660.7	314.0	428.7	896.5	1488.6
	Calcium (mg)	384.8	587.8	1358.1	2349.4	213.5	373.9	980.8	1760.1
	Iron (mg)	10.8	16.2	36.8	63.3	9.7	15.1	36.1	62.9

<sup>a</sup> We set domestic promotion elasticities ( $\alpha_d^h = \alpha_d^n$ ) equal to 0.02 and consumer trust parameters for domestic promotion ( $\psi_d^h = \psi_d^n$ ) equal to 0.5. <sup>b</sup> We set  $\alpha_d^h = \alpha_d^n = 0.10$ , and  $\psi_d^h = \psi_d^n = 0.5$ . <sup>c</sup> We set  $\alpha_d^h = \alpha_d^n = 0.20$ , and  $\psi_d^h = \psi_d^n = 0.5$ . <sup>d</sup> Here we assume that  $\Delta TS^h = \Delta TS^n = 0$ .

Table 5. Additional Simulation Results for a 10% Decrease in Government Expenditures for Horticultural Export Promotions

Parameters		Full consumer trust in government-sponsored promotion for horticultural commodities <sup>b</sup>			Stronger substitution effect between horticultural and non-horticultural products <sup>c</sup>		
		Minor Response	Modest Response	Major Response	Minor Response	Modest Response	Major Response
Domestic response to advertising <sup>a</sup>							
Change in price (%)	Horticultural	-2.15	-1.52	-0.71	-2.24	-1.93	-1.53
	Non-horticultural	0	0	0	0	0	0
Change in quantity (%)	Horticultural	2.87	7.81	14.13	2.27	4.72	7.81
	Non-horticultural	-0.11	-0.08	-0.04	-0.56	-0.48	-0.38
Change in producer surplus (million \$)	Horticultural	-526	-374	-174	-547	-472	-376
	Non-horticultural	0	0	0	0	0	0
Change in consumer surplus (million \$)	Horticultural	509	1421	2652	419	935	1606
	Non-horticultural	174	880	1787	499	2509	5057
Change in social surplus (million \$)	Horticultural	-17	1047	2478	-128	463	1230
	Non-horticultural	174	880	1787	499	2509	5057
Change in annual caloric consumption per capita (calories)	Horticultural	2242	6100	11037	1773	3687	6100
	Non-horticultural	-744	-541	-271	-3788	-3246	-2570
Change in annual intake of selected macronutrients and micronutrients per capita	Cholesterol (mg)	-146.5	-106.6	-53.3	-745.9	-639.3	-506.1
	Fiber (g)	62.1	174.3	317.8	38.0	95.2	167.2
	Vitamin A (μg)	1460.8	4293.7	7920.4	468.3	1967.9	3857.9
	Vitamin C (mg)	545.1	1488.6	2695.7	420.0	889.5	1481.5
	Calcium (mg)	521.1	1760.1	3347.6	-325.2	390.8	1292.4
	Iron (mg)	20.2	62.9	117.5	-0.8	22.7	52.2

<sup>a</sup> Again, we set the domestic promotion elasticities ( $\alpha_d^h = \alpha_d^n$ ) equal to 0.02 for a minor response, equal to 0.10 for a modest response, and equal to 0.20 for a major response. <sup>b</sup> In this simulation we set the consumer trust parameter for domestic horticultural promotions,  $\psi_d^h$ , equal to 1.0 and leave the consumer trust parameter for non-horticultural promotions,  $\psi_d^n$ , equal to 0.5. <sup>c</sup> Elasticity of substitution is set at 0.25 ( $\eta_d^{hn} = \eta_d^{nh} = 0.25$ ).

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