THE CHINESE SOYBEAN INDUSTRY: A U.S. SUCCESS STORY?*

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The story of China's dramatic transformation from a closed, planned economy into a dynamic, rapidly-growing, market-driven economy over the last several decades is now well known, the consequences of which are increasingly evident in the rapid growth of per capita incomes which has lifted millions of people in China from poverty. Less well known is story of the consequent growing shift in the composition of Chinese diets to include increasingly more calories and protein from livestock products (meat, eggs, and dairy products) and less from traditional foods like rice, pulses, root tubers, breads, and noodles (Lohmar et al. 2009). This shift in the composition of the diets of the Chinese people is the almost inevitable consequence of income increases associated with economic development (Farm Foundation 2006). The impact on China's agricultural sector has been predictable – an enormous across-the-board, sustained increase in Chinese agricultural and livestock production.

When China acceded to the WTO in December 2001, many expected a broad-based surge in Chinese imports of grains and other agricultural commodities to help feed the expanding, increasingly affluent, and rapidly urbanizing Chinese population. For the most part, however, growth in Chinese domestic agricultural production has been robust enough to satisfy much of the burgeoning food demand of Chinese consumers (Lohmar et al. 2009). However, the relatively more rapid growth in the demand for livestock products has challenged the ability of the Chinese agricultural sector to expand foodgrain production while, at the same time, diverting land into the production of feedgrains and oilseeds to support the continued expansion of its livestock industry. Together with price support and subsidy policies that have enhanced the relative profitability of foodgrains over oilseeds, the opening of Chinese markets to trade helped spur a meteoric rise in soybean imports for processing to keep up with the growth in demand for soymeal as a protein supplement in livestock feeds and to supply the growing domestic demand for cooking oil.

The growth in Chinese soybean imports has recently been hailed as a U.S. success story by the U.S. soybean industry (Brandon 2012). Through the American Soybean Association and later joined by the United Soybean Board and its international marketing contractor, the U.S. Soybean Export Council, U.S. soybean producers have invested millions of dollars since the early 1980s to develop China as a market for U.S. soybeans. Indeed, research has concluded that the U.S. soybean checkoff program which has funded U.S. soybean producers' efforts to build demand for U.S. soybeans in China and elsewhere in the world has been highly effective, generating a $6.4 return to soybean producers for every dollar they have invested in all their soybean and soybean product promotion programs (Williams, Capps and Bessler 2009) and a $9.2 return for each dollar spent specifically on export promotion and (Williams 2012).

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* Prepared for the 4th CAER-IFPRI Annual International Conference, "Transforming China's Agricultural and Rural Sector: Challenges and Solutions," China Agricultural University, Beijing, P.R. China, October 18-19, 2012.

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Is the surge in Chinese soybean imports over the last 15 years a "U.S. success story" in the sense that the millions of U.S. soybean checkoff dollars invested in China over the years can be credited for a large share of that growth? Regardless of the extent of the contribution of soybean checkoff program investments to the growth in Chinese soybean imports, what have been the benefits of those investments to U.S. soybean producers in terms of additional net revenues earned relative to the cost of the investments over the years? This paper explores the answers to these questions. Following a brief review of the changes in Chinese soybean and soybean product markets and the promotion efforts of the U.S. soybean producers in China, the econometric simulation model used in the succeeding analysis of the contribution of the U.S. soybean checkoff program to the rise in Chinese soybean imports is outlined. Then the results of the simulation analysis of the effectiveness of the U.S. soybean checkoff program in China based on that model are discussed. The analysis includes a benefit-cost evaluation of the soybean checkoff program investments in China. The paper concludes with some caveats and a summary of the main findings.

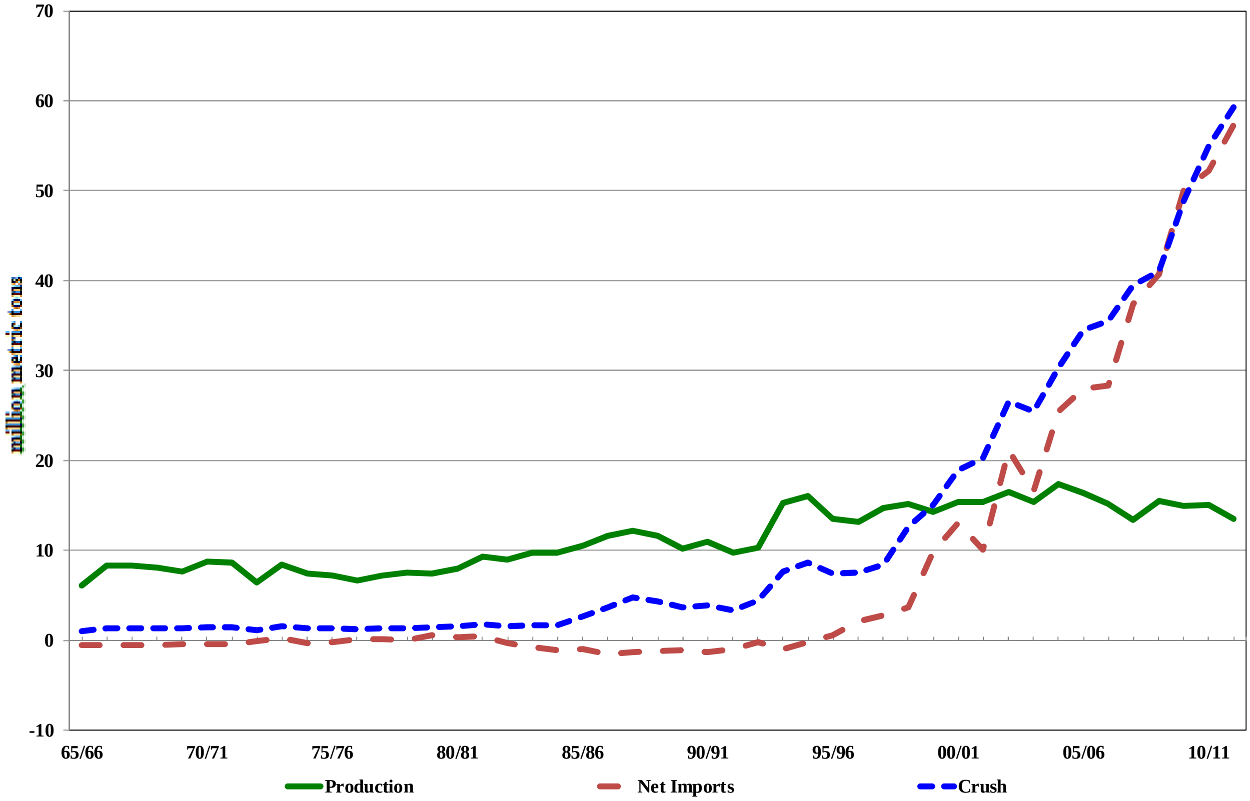
The Chinese Soybean Market and the U.S. Soybean Checkoff Program in China

Linguistic, historical, and geographical evidence indicates the eastern half of the northern region of China as the primary soybean gene center where the soybean was first domesticated in about the 11th century B.C. (Hymowitz 1990). Domestication in China probably took place during the Shang dynasty between about 1700 B.C. and 1100 B.C. Soybean production reached southern China and Korea by the first century A.D. Through the 15th to 16th centuries, cultivated soybeans were introduced into many Asian countries, including Japan, Indonesia, the Philippines, Vietnam, Thailand, Malaysia, Myanmar, Nepal, and northern India (Hymowitz 1990). Over the centuries, the soybean became a key component of East Asian nutrition. Soybeans were planted in Europe as early as the 1730s and not much later in the United States (Hymowitz 1990). They were introduced into Brazil by Japanese immigrant farmers in the early 1900s and then found their way into Argentina in the 1950s (Williams 1984).

Following World War II, the socialist Chinese government sought to implement economic development plans which focused on the rapid development of industry (Williams, 1984). Only a minor share of the capital investment was to be spared for agriculture. Given the low level of technology available in the Chinese agricultural sector, the expectation was that a small amount of public investment in agriculture would yield large returns. Mismanagement and the weakening of economic incentives as a result of the newly established commune system, along with several years of unfavorable weather, caused Chinese agricultural output to plummet in the 1950s (Erisman, 1976). In the early 1960s, China invoked strong measures to stabilize its agricultural sector. A major share of the acreage normally sown to soybeans and industrial crops was shifted to grains. As a result, soybean production began to drop. Although agricultural output gains were achieved, population growth and the demand for food grains continued to restrain the growth in area allocated to soybeans and other oilseeds.

Chinese soybean production began a slow growth in the mid-1970s (Figure 1), mainly as a result of a change in Chinese government policy that expanded soybean area and public investments in soybean research that boosted yields (Shurtleff and Aoyagi, 2007). Before that time, soybean production had been directed primarily to food markets. With some success in expanding live-

Figure 1: China Soybean Production, Crush, and Imports, 1965/66-2010/11



stock production and concurrent growth in per capita incomes and food demand, the need to expand livestock feed supplies and vegetable oils soon became evident. An increase in Chinese soybean production achieved between 1980/81 and 1994/95 from 7.9 million metric tons (mmt) to 16.0 mmt allowed some increase in the domestic processing of soybeans in China to produce meal and oil and, as a result, reduced the share of Chinese production used for food (see Figure 1). Over much of that period, China was a small net exporter of soybeans. In 1995/96, the Chinese government changed its strategy and began to open its soybean market to imports for crushing to meet the rapidly growing domestic soybean meal and oil demand. Soybean production consequently leveled out, taking some pressure off the demand for land to allow more rapid growth in grain production. With the accession of China to the WTO in 2001, Chinese soybean imports soared and are forecast to hit a record 57.5 mmt in 2011/12 with no end to the growth path in sight. Domestic soybean crush is now almost entirely from imports, relegating domestic production once more to supplying food demand. To support the growth of soybean imports, China has invested heavily in the expansion of oilseed crushing capacity. Chinese crush capacity is reportedly now nearly twice the size of its annual soybean crush (Donley 2011).

Despite the growth in domestic Chinese demand for protein feeds and vegetable oils, nearly all of the domestic use of soymeal and soyoil is supplied from processing imported soybeans. China imposes a differential import tax (3% on soybeans, 5% on soymeal, and 9% on soyoil) to promote the use of its over-built and under-utilized crush capacity and to encourage imports of whole soybeans rather than imports of soymeal and soyoil (Donley, 2011). The result has been minimal imports of Chinese soymeal and soyoil over the years (Figures 2 and 3). Virtually all

Figure 2: China Soymeal Production, Domestic Use, and Imports, 1965/66-2010/11

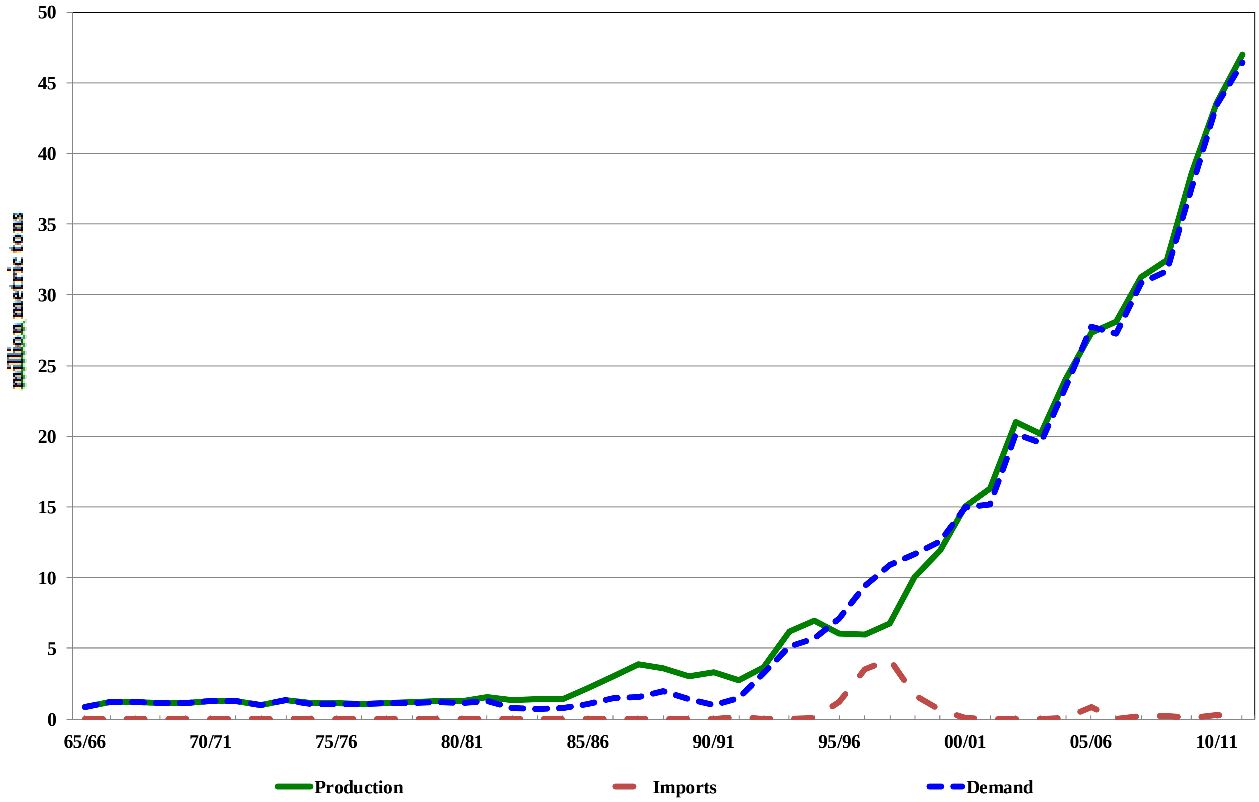
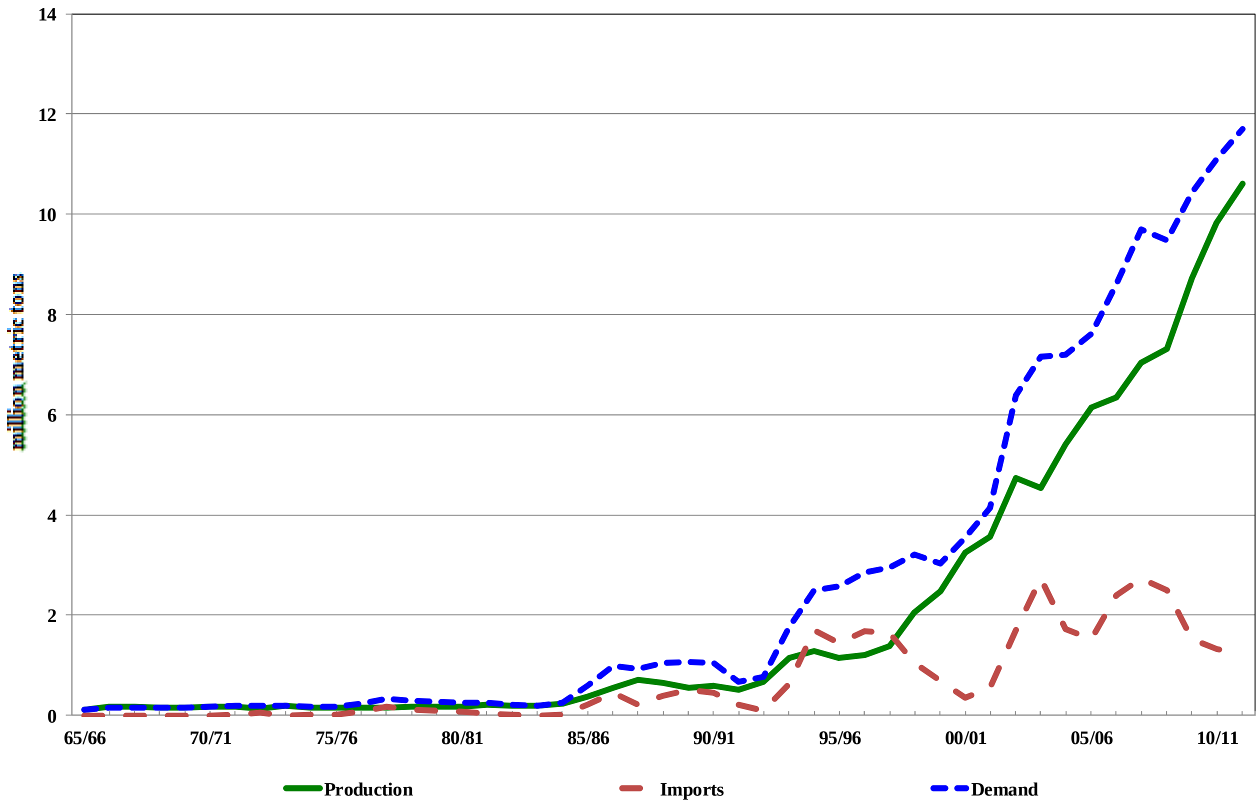


Figure 3: China Soyoil Production, Domestic Use, and Imports, 1965/66-2010/11



the domestic use of soymeal and all but 10% of the domestic use of soyoil is supplied by the domestic soybean crushing industry.

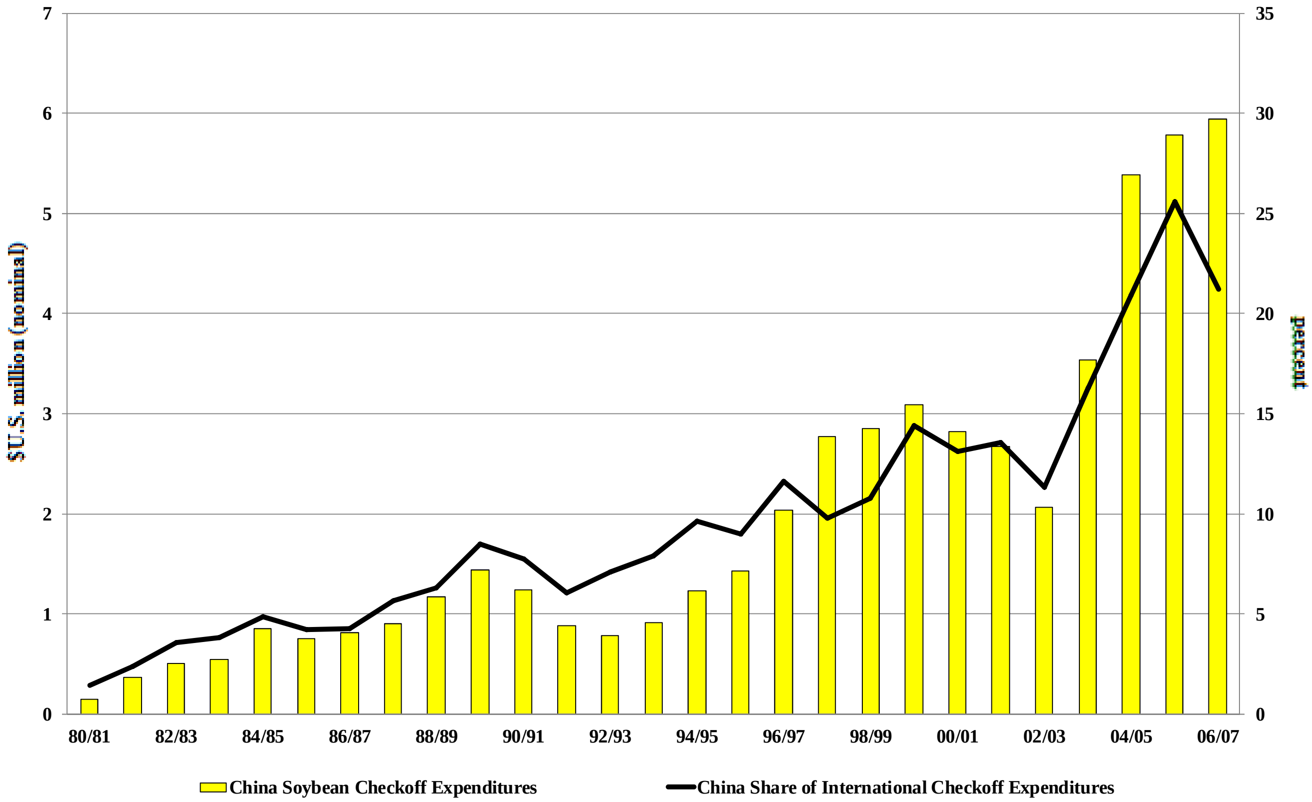
The American Soybean Association (ASA) began investing checkoff dollars to build the Chinese soybean market shortly following U.S. diplomatic recognition of China in 1978. Available data record that $148,000 of checkoff funds were spent in China in 1980/81, representing only about 1.5% of the total international soybean checkoff expenditures in that year (Figure 4). After a few years of exchanges of delegations and scientific personnel with China, ASA opened an office in Beijing in 1982 (Shurtleff and Akiko Aoyagi 2007). Since that time, soybean checkoff investments in China have grown steadily, reaching about $6 million in 2006/07 (the most current data available[1]), about 20% of international soybean checkoff expenditures. Much of the soybean checkoff investment in China has focused on technical assistance to Chinese livestock producers and feeders to enhance the efficiency and productivity of their operations. A major emphasis of the assistance has been shifting livestock feeding away from traditional feedstuffs like table scraps and stover to more balanced rations that include soymeal as a protein supplement. A substantial investment of soybean checkoff funds in China has also been made to assist the Chinese oilseed processing industry in adopting more efficient soybean extraction technologies and other forms of technical assistance.

Methodology and Data

The analysis of the contribution of the U.S. soybean checkoff program to the growth in Chinese soybean imports is based on the results of the 2009 evaluation of the soybean checkoff program[2] (Williams, Capps, and Bessler 2009). In that study, the basic tool of analysis was a 180-equation, annual econometric simulation model of world soybean and product markets that allows for the simultaneous determination of the supplies, demands, prices, and trade of soybeans, soybean meal, and soybean oil in six major world trading regions: (1) the United States, (2) Brazil, (3) Argentina, (4) the European Union 15/27, (5) Japan, and (6) a Rest-of-the-World (ROW) region which includes China. To determine the effectiveness of the soybean checkoff program, the first step was to isolate the effects of checkoff expenditures on the U.S. production of soybeans and on the demand for soybeans and soybean products in both domestic and foreign markets from those of other events that may have affected those production and demand variables in those same markets over the years. For this purpose, soybean checkoff research, domestic promotion, and foreign demand promotion stock variables were constructed and treated as regressors in the U.S. supply (acreage and yield), domestic demand, and foreign demand equations of the world model of soybeans and soybean products. Data for all types of soybean checkoff expenditures across all commodities, activities, and countries over a long period of time were needed for the analysis. All expenditure data used in the study were converted to a constant dollar basis to remove the effects of inflation in the regions of expenditure. Foreign market expenditures were also converted to the local currencies for the countries and regions of expenditure defined in the study. The data were then transformed into

[1] Updated soybean checkoff expenditure data are currently being collected for an updated analysis of the soybean checkoff program due to be completed and published in late 2013.
[2] This is the most recent of the required 5-year evaluations of the soybean checkoff program. As indicated in the previous footnote, the next 5-year study is expected to be completed in 2013.

Figure 4: China Soybean Checkoff Expenditures, 1980/81-2006/07



research and promotion stock variables to account for the time lag between expenditure and market impact for each commodity (soybeans, soymeal, and soyoil) in domestic and international markets. Model specification tests were conducted to determine appropriate lag structures for calculating the stock variables[3]. The research stock variables enter the model as arguments of the regional soybean acreage and yield functions. The domestic and international soybean, soybean meal, and soybean oil demand promotion expenditure stock variables enter the model as arguments of the respective demand functions of the U.S. or of the importing regions in which the expenditures were made.

The parameters of the world soybean and soybean products model were then estimated using standard econometric procedures[4]. The estimated international market promotion elasticities of the foreign demands for soybeans, soymeal, and soyoil are quite small and consistent in both magnitude and sign with those of previous studies of the soybean checkoff program (for example, Williams, Shumway, and Love 2003) as well as with studies of other checkoff commodities (see the section on "Studies on the Return to Commodity Promotion Expenditures" in the 2009 study to compare the results to those of other studies) (Table 1). Most of the estimated international market promotion elasticities are statistically significant at the 1% or 5%

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[3] More details about the construction of the research and promotion stock variables are available in Williams, Capps, and Bessler (2009).

[4] More details about the structure of the model and the econometric procedures used as well as the parameter estimates and associated regression and model validation statistics from the 2009 analysis can be found in Williams, Capps, and Bessler (2009).

Table 1: Estimated International Market Promotion Expenditure Elasticities of Foreign Demand for Soybeans and Products by Region[a]

Regions	Soybeans	Soymeal	Soyoil
EU-15/27	0.040***	0.059**	0.031**
Japan	0.029**	0.043*	0.020***
Rest-of-the-World (ROW)	0.063**	0.062	0.052**

[a] All elasticities evaluated at the means of the data.. * = significant at the 1% level. **= significant at the 5% level, and ***=significant at the 10% level.

level. The regional promotion elasticities indicate the estimated percentage change in the market demand for the respective product in each region given a 1% change in the real (inflation-adjusted) and exchange-rate-adjusted promotion expenditures for those products in each region. Validation of the world soybean and products model through dynamic, within-sample simulation indicated a highly satisfactory fit of the historical, dynamic simulation solution values to the observed data. A sensitivity test indicated that the model is highly stable to changes in checkoff expenditures over time (see Williams, Capps, and Bessler (2009) for more details).

The model was then simulated over the period of 1980/81 to 2006/07 under two scenarios and the results used to calculate benefit-cost ratios for the full soybean checkoff program[5]. The first scenario (the "*with expenditures*" scenario") represented actual history over the 1980/81 to 2006/07 period of analysis by assuming that the soybean checkoff program existed over that period. Thus, the simulation results for the level of supply, demand, prices, trade, etc. in world soybean and soybean product markets included the impacts on those markets from soybean checkoff expenditures in the U.S. and around the world. The second scenario (the "*without expenditures*" scenario) assumed that the soybean checkoff program had never been implemented. This second simulation was conducted by setting the historic values of soybean checkoff expenditures to zero in the world model of soybeans and soybean products and then simulating the model once again over the same period to generate new values for U.S. and world soybean and product production, consumption, trade, prices, etc. Because the changes in the model variables in the "*without expenditures*" scenario were generated by changing only the levels of checkoff expenditures, they represent the levels of supply, demand, prices, trade, etc. that would have existed over time *in the absence of a soybean checkoff program*.

Differences in the simulated levels of the model variables (production, demand, prices, trade, etc.) in the "*with expenditures*" scenario from those in the "*without expenditures*" scenario are then taken as direct measures of the effects of the checkoff expenditures over time. Because no other exogenous variable in the model (e.g., levels of inflation, exchange rates, income levels, agricultural and trade policies, etc.) other than checkoff expenditures is allowed to change in either scenario, this process effectively isolates the effects of the soybean checkoff program on the U.S. and world soybean markets, prices, and trade. That is, the simulated differences between the values of the endogenous variables from the "*with expenditures*" scenario and from the "*without expenditures*" scenario in which those expenditures are set to zero provide direct measures of the historical effects of the soybean checkoff expenditures (and only those expenditures) on the U.S. and world soybean and product markets.

[5] Details of the simulation procedure and results can be found in Williams, Capps, and Bessler (2009).

The Williams, Capps, and Bessler (2009) study measured the joint effects of all promotion expenditures in all regions for all commodities by all contributors on world soybean and product markets. The study did not analyze the effects of just international promotion expenditures or for specific countries or world regions independent of those of the other two main categories of soybean checkoff expenditure (production research and domestic market promotion) primarily because such an analysis would have required an assumption that international promotion over the years was done in a vacuum. That is, the results of such an analysis would have ignored the synergistic effects (both positive and negative interactions) of the three main checkoff program components in the market and provided unrealistic and largely meaningless results. For example, domestic market promotion tends to increase the domestic demand for soybeans and soybean products and reduce their availability for export. Production research boosts export availability but tends to depress price, and therefore, the value of exports. Analyzing the returns only to international market promotion (in total, or by region, or country) while ignoring the export-reducing effects of domestic market promotion or the price-depressing effects of production research could lead to a conclusion that international market promotion expenditures are more (or less) effective in enhancing exports than is actually the case.

Nevertheless, the results of the Williams, Capps, and Bessler (2009) study, as supplemented by a more recent study measuring the specific effects of the international soybean checkoff program (Williams, 2012), provide the basis for exploring the relationship between international market promotion expenditures in various world regions, such as China, and the net changes in exports of soybeans and soybean products achieved as a result of the checkoff program. In using the results of the Williams, Capps, and Bessler (2009) and Williams (2012) studies, therefore, this analysis of the effects of international market promotion expenditures in China makes the realistic assumption that over the period of analysis, domestic market promotion and production research in the U.S. and international promotion expenditures in other areas of the world were on-going over that same period. In the following section, the results of the 2009 and 2012 simulation scenario analyses described above for U.S. soybean and soybean product exports and China soybean imports are first discussed. Those results are then used to calculate the contribution of the soybean checkoff program to the growth in Chinese soybean imports over the years. Then the simulation results for Chinese soybean imports are used to measure the returns to international market promotion activities in China through the calculation of two benefit-cost ratios: (1) the gross U.S. export revenue benefit-cost ratio (EBCR) which measures the additional export revenue generated by the checkoff expenditures in China per dollar of soybean checkoff funds spent in China (net of the cost of the promotion efforts in China) and (2) the grower profit from exports benefit-cost ratio (NEBCR) which measures the additional soybean grower profit generated from the additional U.S. soybean exports resulting from the checkoff expenditures in China (net of additional production costs and the cost of promotion in China) per checkoff dollar spent in China.

Analysis of the Effectiveness of and Returns to International Market Promotion

The Williams, Capps, and Bessler (2009) study concludes that, on average over the entire 1980/81-2006/07 period of analysis, the soybean checkoff program added U.S. soybean export volume in each year by an average of 993,600 mt or nearly 5%. For soymeal and soyoil, the average annual addition to exports was somewhat larger in percentage terms. Over the period of

1980/81 through the early 1990s when China was a small net exporter of soybeans and Chinese imports were strictly controlled, the Williams, Capps, and Bessler (2009) study concludes that the checkoff program consistently added about a million metric tons to annual U.S. exports of soybeans worldwide each year plus additional soymeal and soyoil exports as well.

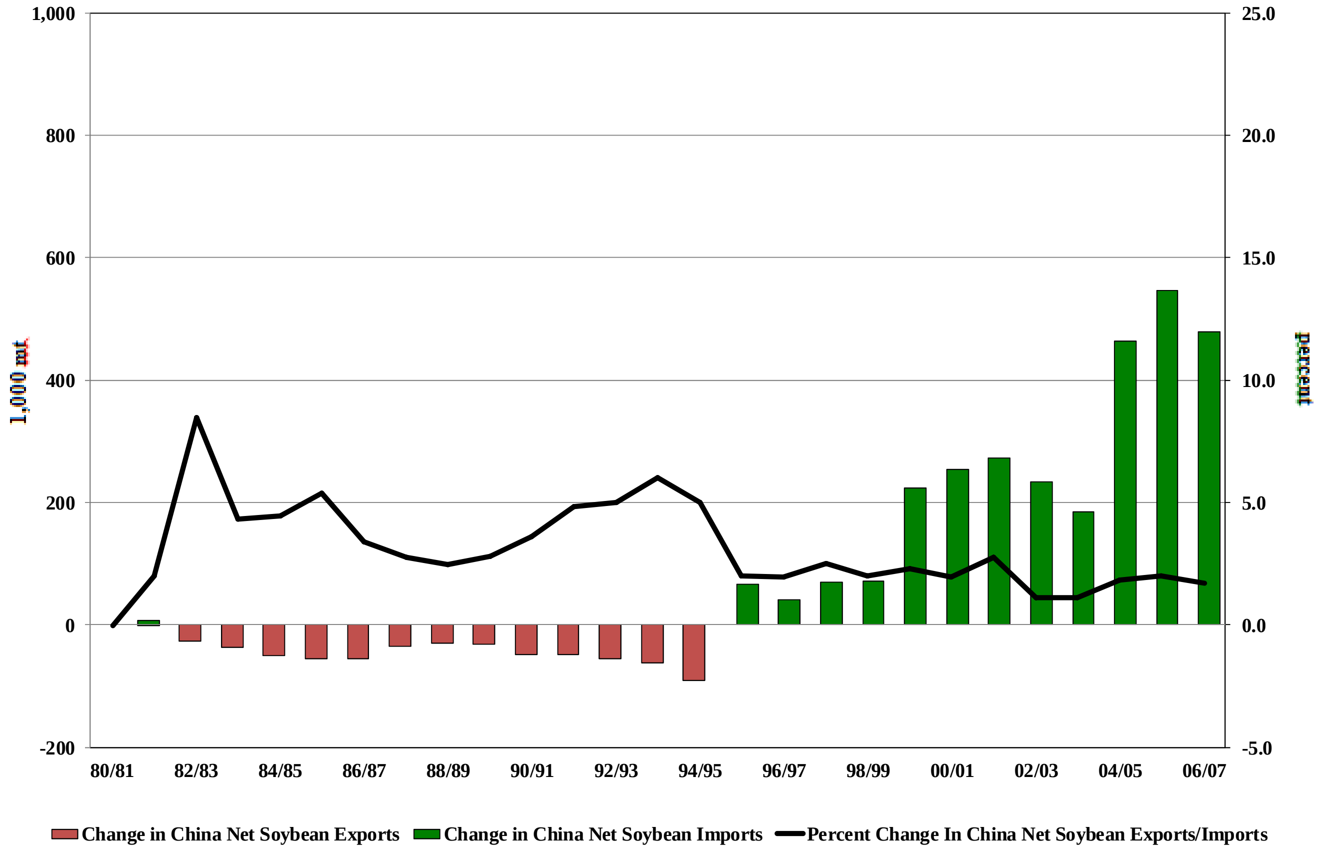
During that period, China accounted for a small but growing share of the total international soybean checkoff export promotion expenditures from 1.5% in 1980/81 to 9.6% in 1994/95 (see Figure 4). Consequently, the share of the simulated average annual addition to soybean exports from the soybean checkoff program accounted for the checkoff expenditures in China was also small during that period. During those early years, the simulation results indicate that the small soybean checkoff expenditures in China contributed primarily to a small annual average reduction in China's net exports of soybeans of about 43,000 mt (Figure 5). Once China opened its markets in 1995/96 to soybean imports, soybean checkoff expenditures in China began to increase from 9% of all expenditures in all countries in 1995/96 to 21.2% in 2006/07 (see Figure 4). Adjusting the Williams, Capps, and Bessler (2009) simulation results for the impact of the soybean checkoff program on U.S. soybean exports by China's share of expenditures during that period indicates that the soybean expenditures in China added increasing volume to China's net soybean imports from about 65,000 mt in 1995/96 to around a half million tons in 2006/07 with some ups and downs related primarily to changes in levels of funding from year to year (Figure 5). In other words, between 1995/96 and 2006/07, the U.S. soybean checkoff program added an average of about 2% annually to the volume of China's growing net soybean imports. In percentage terms, the soybean checkoff program in China contributed more in the early years to reducing China's small, relatively stable net exports than to boosting the rapidly increasing net imports in later years (Figure 5). Rapidly growing per capita incomes, the consequent growth in food demand in China, and Chinese agricultural and trade policy have dwarfed all other market forces and programs in their effects on the volume of Chinese soybean imports. Thus, despite a growing annual addition to Chinese import volume from the soybean checkoff program in recent years, the share of Chinese soybean imports accounted for by the program has been small.

The small impact of the soybean checkoff program on the volume of Chinese soybean net imports is not surprising and, in fact, is consistent with what researchers have found across all commodity checkoff programs. The primary reason for the small impact is that despite the millions of dollars spent by U.S. commodity boards to promote sales of their commodities both domestically and internationally, the amount they spend to fund research and promotion is extremely small in comparison to the sales volumes of their industries. In the case of soybeans, for example, between 1970/71 and 2006/07, total soybean checkoff expenditures amounted to only between 0.05% and 0.48% of total soybean farm cash receipts in each year. With such a low checkoff investment intensity, i.e., the level of investment compared to the size of the soybean market as measured by farm sales, the overall impact of the program could hardly be expected to be highly significant in a practical sense in its effects on U.S. and world soybean and product markets even if the impact could be said to be statistically significant.

Benefit-Cost Analysis: Return on Investment from International Market Promotion

Knowing whether or not the checkoff program has boosted China's imports of soybeans is important because if that has not occurred then, of course, there is little obvious benefit from

Figure 5: Change in Chinese Net Exports/Imports of Soybeans from the Soybean Checkoff Program, 1980/81-2006/07



continuing to spend soybean checkoff dollars in China. The foregoing analysis clearly shows that the soybean checkoff program in China has added to the volume and value of China's imports of soybeans. Nevertheless, knowing that checkoff expenditures have boosted China's soybean imports is not sufficient support for a decision to continue funding promotion activities in China with soybean checkoff dollars. The critical question for U.S. soybean producers is whether the promotional expenditures that have been made in China with their checkoff dollars have been cost effective. In other words, have the benefits of the soybean checkoff promotional activities in China in terms of the additional U.S. export revenue and the additional profits to U.S. soybean growers earned from the additional soybean exports generated by those activities been larger than the cost of those promotional activities in China?

To assess the returns to the expenditure of soybean checkoff funds to promote Chinese soybean imports, this section provides a benefit-cost analysis of those expenditures by focusing primarily on two benefit-cost measures: (1) the gross export revenue benefit-cost ratio (EBCR) and (2) the grower profit from exports benefit-cost ratio (NEBCR). The first ratio measures the per dollar return to soybean checkoff dollars spent in China at the export level of the U.S. market calculated as the additional U.S. soybean and soybean product export revenue generated (net of the expenditures made in China) per dollar spent in China to promote soybean imports.

The additional U.S. soybean and soybean product export revenue (XR) generated by the total soybean checkoff expenditures in any given year (t) from the Williams, Capps, and Bessler study (2009) is calculated as:

$$(1)\ \ XR_t = \sum_i p_{xit}^{w} x_{it}^{w} - \sum_i p_{xit}^{wo} x_{it}^{wo}$$

where p_x is export price ($/mt); x is the volume of exports (million mt); i = soybeans, soymeal, and soyoil; and "w" and "wo" indicate the values from the *with* checkoff expenditure scenario and the *without* checkoff expenditures scenario, respectively, from the Williams, Capps, and Bessler (2009) study.

Then the gross export revenue benefit-cost ratio (EBCR) from checkoff expenditures in China is then calculated as:

$$(2)\ \ EBCR = \sum_{t=1}^{T} \frac{\sigma_t XR_t - E_t}{E_t}$$

where σ is the China share of total international checkoff promotion expenditures and E represents the checkoff expenditures in China ($US million). Note that E is netted out of the additional U.S. export revenues generated by those expenditures (σXR) in each year since the checkoff represents the cost of generating those revenues.

The second benefit-cost ratio, the grower profit from exports benefit-cost ratio (NEBCR), measures the per dollar return to the checkoff expenditures in China <u>at the producer level</u> of the U.S. market calculated as the additional soybean grower profits (additional cash receipts net of additional production costs and the checkoff expenditures in China) generated per dollar of checkoff expenditure in China. The additional soybean industry profits (R*) generated by the total soybean checkoff program expenditures in any given year (t) from Williams, Capps, and Bessler (2009) are calculated as:

$$(3)\ \ R^*_t = \gamma_t^{w}(p_t^{w} q_t^{w} - c_t^{w} A_t^{w}) - \gamma_t^{wo}(p_t^{wo} q_t^{wo} - c_t^{wo} A_t^{wo})$$

where p is the farm price of soybeans ($/bu.); c is production cost ($/acre); A is the area planted to soybeans (million acres); q is production of soybeans (million bu.); γ is the export share of total soybean industry revenues; and "w" and "wo" indicate the values from the *with* checkoff expenditures scenario and the *without* checkoff expenditures scenario, respectively.

Then the grower profit BCR (NEBCR) from additional exports as a result of the China checkoff program is calculated as:

$$(4)\ \ NEBCR = \sum_{t=1}^{T} \frac{\sigma_t R^*_t - E_t}{E_t}$$

Again, note that E is first netted out of the additional profit generated (σR*) in those years since the expenditures represent a cost to producers.

To account for the time value of money, as various researchers have done in considering the soybean and other commodity checkoff programs, a discounted grower profit from exports BCR is calculated as:

$$(5)\ DEBCR = \frac{\sum_{t=1}^{T} (\sigma_t R_t^* - E_t)/(1+i)^t}{\sum_{t=1}^{T} E_t}$$

where i is the interest rate chosen to discount the additional profit flows to present value. Obviously the level of the DEBCR depends on the rate used to discount the benefits over time. The DEBCR was calculated using the 30-day Treasury bill interest rates for 1980/81 through 2006/07 as done by Williams (1999), Williams, Shumway, and Love (2002), Williams, Capps, and Bessler (2009), and others. The Treasury bill interest rate, which averaged 5.6% between 1980/81 and 2006/07, was selected because it represents a realistic alternative investment rate for the 1980/81 through 2006/07 period of analysis.

A BCR as calculated in equations (2), (4), and (5) that is greater than 1 is interpreted as meaning that the soybean checkoff expenditures in China have more than paid for themselves. Otherwise, the expenditures would be considered to have been ineffective in increasing export revenues (equation (2)) or the profits of the soybean producers (equations (4) and (5)) who pay for the expenditures in China.

Using the simulation results from the *with expenditure* and *without expenditure* scenario results from the Williams, Capps, and Bessler study (2009) and equations (1) and (2) above, the gross export revenue benefit-cost ratio (EBCR) is calculated to be 27 to 1 (Table 2). In other words, for every dollar of soybean checkoff expenditure in China over the 1980/81 to 2006/07 period, \$27.0 of additional U.S. export revenue (net of the cost of the promotion) was generated. In terms of export revenue generated, therefore, the returns to checkoff expenditures in China have far exceeded their cost. Note from Table 2 that the EBCR was higher during the earlier years (1980/81-1994/95) when the expenditures in China were relatively small. The actual export revenues generated during that period were extremely small and mostly helped reduce China's small net exports of soybeans by increasing internal demand for soybeans to some extent. In essence, the checkoff expenditures in China during that period allowed a small increase in U.S. soybean exports worldwide to replace the small reduction in exports by China. The small additional revenue generated divided by an even smaller expenditure during that period resulted in a high EBCR (38.3 to 1). However, as Chinese imports began to increase rapidly after 1995/96, the declining marginal impact of increasing checkoff dollars in China led to lower increase in revenues relative to the increase in cost and, thus, a lower EBCR during that period (23.5 to 1).

Of course, not all the benefits from the additional U.S. exports generated by checkoff expenditures in China have accrued to producers over the years. Others also have benefitted, including exporters, processors, feeders, manufacturers, and others along the supply chain. The grower profit from exports benefit-cost-ratio (NEBCR) measures the benefits accruing to producers from the additional exports generated by the soybean checkoff expenditures in China.

Table 2: Benefit-Cost Analysis for Soybean Checkoff Expenditures in China, 1980/81-2006/07

	1980/81 -1994/95	1995/96 -2006/07	**1980/81 -2006/07**
Added Export Revenue ($ million)	493.5	990.3	**1,483.8**
Foreign Market Promotion Investment[a] ($ million)	12.6	40.4	**53.0**
Gross Export Revenue Benefit-Cost Ratio (EBCR)[b] ($/$ spent)	38.3	23.5	**27.0**
Added Soybean Cash Receipts from Exports ($ million)	271.9	611.4	**883.3**
Per Acre Cost of Production ($/acre)			
Total	185.47	247.72	**213.14**
Variable cash expenses	63.16	80.85	**71.02**
All other (capital, land, etc.)	122.31	166.88	**142.12**
Per Bushel Cost of Production ($/bu)			
Total	5.83	6.41	**6.08**
Variable cash expenses	1.98	2.09	**2.03**
All other (capital, land, etc.)	3.85	4.32	**4.06**
Cost of Production Added by Exports ($ million)			
Total	86.4	377.7	**464.1**
Variable cash expenses	29.6	123.8	**153.5**
All other (capital, land, etc.)	56.7	253.8	**310.6**
Added Grower Profits from Exports[c] ($ million)	185.5	233.7	**419.2**
Grower Profit from Exports Benefit-Cost Ratio (PEBCR)[b] ($/$ spent)	14.8	5.8	**7.9**
Grower Net Profit from Exports Benefit-Cost Ratio (NEBCR) ($/$ spent)	13.8	4.8	**6.9**
Discounted NEBCR (DEBCR)[d] ($/$ spent)	8.4	4.7	**4.9**

[a] Soybean Checkoff promotion Expenditures in China (ASA/USB, USDA, and Third Party contributions).
[b] Cost of China soybean checkoff expenditures netted out.
[c] Added cash receipts from added exports to China minus production costs added by additional exports to China.
[d] The average interest rate on the 30-day Treasury Bill for the indicated years used as the discount rate.

Again, using the simulation results from the *with expenditures* and *without expenditures* scenario results from Williams, Capps, and Bessler (2009) with equations (3) and (4) above, the NEBCR for China checkoff expenditures over the years is calculated to be 6.9 to 1 indicating that soybean producers received $6.9 in additional profits for every soybean checkoff dollar spent in China (Table 2). That is, the profits received by soybean growers from soybean checkoff expenditures in China have far exceeded the cost of those expenditures.

Some caveats on the interpretation of the BCR measures presented are important to mention. Estimated BCRs for checkoff programs much in excess of 1:1 often are taken to imply large absolute impacts of a checkoff program on the market. Nothing could be less true. A BCR of 6:1 results from dividing a $6 billion industry profit benefit by a $1 billion checkoff investment or from dividing a $6 benefit by a $6 investment. As noted earlier, the value of total soybean checkoff expenditures on research and promotion activities in the U.S. and around the world has been extremely small in comparison to the total value of industry soybean and soybean product sales as is the case for most commodity checkoff programs. Thus, the reasonably high BCRs estimated for the checkoff expenditures in China over the years should not be interpreted as implying that those expenditures have had a large absolute impact on the level of Chinese soybean imports (and, thus, U.S. soybean exports and export revenue). As Figure 5 clearly shows, the absolute impact of those expenditures on Chinese soybean imports actually has been quite small. Many market factors, including economic growth and development, government domestic and trade policies, exchange rates, to name just a few, have had a much larger effect on the volume and value of Chinese soybean imports than the U.S. soybean checkoff expenditures in that country. The BCR simply indicates that the return to the soybean checkoff investment in developing the Chinese soybean market over the years has been reasonably high even though the investment has not been a major factor influencing Chinese soybean imports.

Conclusions

Can the explosion in Chinese soybean imports since the mid-1990s be thought of as a "U.S. success story"? The answer is, of course, "yes" and "no." The return to soybean producers' investment in developing the Chinese market has been extremely high. Few investments could return $6 to investors for every dollar they invest over a sustained period of time. In this sense, the soybean checkoff expenditures in China have been a highly successful investment for U.S. soybean producers. In fact, the high return suggests that soybean producers are underinvesting in the China soybean market. An additional allocation of checkoff funds to China would yield large additional returns. The marginal effect of each additional dollar invested in China would likely decline over time so that the additional returns would tend to decline as additional funds were invested. The optimal investment would be reached when the increase in profits to soybean producers of additional investments in China (the marginal benefit) is just equal to the increase in the cost of those investments (the marginal cost).

On the other hand, given that it has contributed no more than 2% to the annual increase in soybean imports by China since 1995/96, the U.S. soybean checkoff program could hardly be justified in claiming credit for the rapid growth in Chinese soybean imports over the years. That the program has successfully contributed to that growth is clear but it has been a minor factor behind the import growth achieved. Other factors such as economic development policy in China, growth in Chinese per capita incomes, Chinese government efforts to promote livestock production to meet growing Chinese demand for meat, growing urbanization in China, Chinese government export policy, particularly the accession of China to WTO in 2001, Chinese exchange rate policy, and a host of other factors have been the major factors in promoting Chinese imports of soybeans which have dwarfed the effects of the U.S. soybean checkoff program.

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