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FOOD SAFETY AND VALUE ADDED
PRODUCTION AND MARKETING
OF TROPICAL CROPS

Title: Marketing Opportunities for Jamaican's Grapefruit Industry

Authors: Evans, Edward A.[1]; Nalampang, Sikavas[2] and Spreen, Thomas H.[3]

1. Department of Agricultural Food and Resource Economics, Rutgers, The State University of New Jersey
2. Department of Agricultural Food and Resource Economics, Rutgers, The State University of New Jersey
3. Department of Agricultural Food and Resource Economics, Rutgers, The State University of New Jersey

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MARKETING OPPORTUNITIES FOR JAMAICA'S GRAPEFRUIT INDUSTRY

Evans, Edward A.; Nalampang, Sikavas and Spreen, Thomas H.
Department of Agricultural Food and Resource Economics
Rutgers, The State University of New Jersey

ABSTRACT

Several Caribbean sugar producing countries are actively looking for viable alternatives to recover some of the expected lost revenues due to the WTO (World Trade Organization) ruling that sugar subsidies in the European Union (EU) are illegal. One alternative worth considering is exporting fresh grapefruits to the EU. This marketing opportunity comes about as the United States of America (U.S.), the world's leading grapefruit producer and exporter (over half of world production), has suffered a series of recent setbacks (citrus canker, citrus greening diseases, and devastating hurricanes) that threaten the future of that industry. Specifically, grapefruit and pomelo production in the U.S. has declined steadily since 2000 (from 2,506 thousand metric tons in 2000 to only 914 thousand metric tons in 2005). Approximately 25% of U.S. fresh grapefruit exports are directed to Europe, which is the largest grapefruit and pomelo import region (nearly 60% of world grapefruit and pomelo imports). Rising grapefruit prices in the EU due to reduced supplies coming from the US and an increase in the demand for the fruit in the EU could create a marketing opportunities for countries such as Jamaica. The paper discusses the state of the Florida citrus industry with particular reference to grapefruits and the marketing prospects for Jamaican grapefruit exports to Europe.

Keywords: grapefruit, marketing, Florida citrus industry, World Trade Organization

Introduction

Several Caribbean sugar-producing countries, including Jamaica, are actively looking for viable alternatives to recover some of the lost revenues due to the World Trade Organization (WTO) ruling that sugar subsidies in the European Union (EU) are illegal.[1] One alternative worth considering is converting some of the sugar cane lands to citrus orchards and exporting fresh grapefruits to the EU. This marketing opportunity comes about as Florida, the largest citrus-producing state in the United States (US) and the second largest citrus-producing region in the world following the state of São Paulo, Brazil, has suffered a series of recent setbacks (citrus canker, citrus greening diseases, escalating land values, and devastating hurricanes) that threaten the future of that industry.

Florida/United States has historically accounted for over 40% of world grapefruit production and dominates the world market in the trade of both fresh and processed grapefruit ["Citrus Summary," Florida Agricultural Statistics Service (FASS), and Food and Agriculture Organization (FAO) of the United Nations]. However, because of setbacks, grapefruit production in the United States has been on the decline, from 2.51 million metric tons (MMT) in 2000 to only 914,000 metric tons in 2005. A recently released study conducted by the University of Florida (UF) on the economic impact assessment of citrus canker and citrus greening diseases on the future prospects for the Florida citrus industry points to a bleak future for the industry.

Since the US accounts for approximately 40% of world grapefruit exports, of which 25% goes to the EU, any interruption in supplies in the US is bound to impact the market. Given that Jamaica enjoys duty-free privileges for agricultural commodities shipped to the EU, rising grapefruit prices in the EU market due to reduction of supplies in the US and favorable demand for the fruit due to health reasons could create marketing opportunities for Jamaica's grapefruit industry.

The purpose of this paper therefore is to discuss the state of the Florida citrus industry with particular reference to grapefruits and to assess the long-term marketing prospects for Jamaican grapefruit exports to the EU. Our

[1] Under the sugar protocol Caribbean, the EU agreed to pay Caribbean sugar producers the same rate as that paid to their producers.

decision to focus on the grapefruit vis-a-vis other citrus products stems from *a prior* assessment which indicates that of all the citrus products, fresh grapefruit production in Florida is likely to be impacted the most as a result of developments within the Florida Citrus Industry and therefore offers the greatest marketing opportunity.

The paper commences by highlighting the major trends in the international production and trade of grapefruits. The next two sections discuss the situation in the US/Florida citrus industry and the Jamaican citrus industry with reference to the grapefruit industry. Following this, the methodology used to assess the long-term prospects for fresh grapefruit marketed in the EU is outlined. The penultimate section discusses the results of our investigation, and the paper ends with a few concluding remarks.

Trends in International Production and Trade of Grapefruits

World grapefruit production peaked in 2000 at about 5.33 MMT but since then has declined to 3.66 MMT in 2005 (Table 1). The noticeable drop in world production is due mainly to a steady decline in production in the US, the world's number one grapefruit-producing country, which on average accounts for 40% of total world production. China, the second most important grapefruit producing country, accounts for about 8% of total production. Over the last few years, production in China has been increasing spurred by increased domestic demand. However, the increases were insufficient to offset the shortfalls in the US. Other major producers include Mexico, Israel, and Cuba, each with shares of approximately 6% (FAOSTAT). In terms of utilization, it is estimated that on average 60% of the crop is marketed as fresh and 40% is sold as frozen concentrated grapefruit juice.

With respect to trade, global exports of fresh grapefruits have remained relatively flat over the five-year period of 2000 to 2004, averaging about 1.1 MMT, or about 23% of global production (Table 2). As in the case of production, the US dominates the trade with an average share of 38%. The EU accounts for about 18% of the trade, followed by South Africa (15%), Turkey (9%) and Israel (7%) as major exporters (FAOSTAT).

On the import side, both Japan and the EU dominate the trade in fresh grapefruits, and together they account for about 85% of total imports. Over the five-year period (2000 to 2004), Japan absorbed on average 58% of world's fresh grapefruit exports and the EU about 26% (Table 3). Other noticeable importers include Canada (5%), China (2.9%) and the US (1.8%).

US/Florida Grapefruit Production and Trade

Production of grapefruits in the US occurs in four states: Florida, California, Texas, and Arizona. Florida is by far the leading grapefruit-producing state and accounts for about 82% of domestic production. About 47% of total grapefruit production is marketed fresh while the rest is processed into grapefruit juice. As shown in Table 1, grapefruit production in the US declined steadily from 2.51 MMT in 2000 to 1.96 MMT in 2004 and then plummeted to 914,440 metric tons in 2005. Between 2000 and 2005, bearing acreage fell from 153,000 acres to current levels of about 103,000 acres, or by 32.7%. The bulk of the reduction in bearing acreage occurred in Florida, which saw a 37.7% reduction in acreage, from 114,000 to 71,000 acres, over the same time frame. The reduction in bearing acreage and crop produced is due to a combination of factors (discussed below).

With regards to the trade, the US historically has been the number one exporter of fresh grapefruits. Exports of fresh grapefruits increased from 391,166 metric tons in 2000 to peak at 406,994 metric tons in 2002 but since then have been on the decline. In 2005, exports totaled only 214,231 tons worth $152.8 million; almost half the volume exported in 2002, of 406,994 metric tons valued at $207.5 million. Table 4 shows the main export destinations for fresh grapefruit shipped from the US. The data indicate that the bulk of US fresh grapefruit exports goes to Japan. Between 2000 and 2005, Japan accounted for 51% of all fresh grapefruits shipped from the US while the EU accounted for another 28.1%. Other noticeable importers were Canada (12.7%), Republic of Korea (1.8%) and Mexico (0.4%). The US also imports a small amount of fresh grapefruits, mainly from The Bahamas, Mexico, and Israel.

As mentioned earlier, the decline in US production and exports of fresh grapefruits is due to a combination of factors impacting the Florida citrus industry. Chief among such factors are two worrisome, relatively new diseases (citrus canker and citrus greening); frequent hurricanes; and sharp increases in land values.

Citrus canker is a bacterial disease that is mainly spread by human contact and wind-driven rain. The disease attacks citrus trees of

which grapefruit trees are extremely susceptible. The disease causes distinctive necrotic raised lesions on leaves, stems, and fruit. Severe infections cause defoliation, blemished fruit, premature fruit drop, twig dieback, and general tree decline (Schubert et al., 2001). Because there are no effective disease suppression strategies against the disease and blemished fruits are unsuitable for fresh consumption, there is widespread regulatory prohibition against shipping fresh fruit from areas where the disease has become endemic. Efforts to eradicate the disease require destroying all citrus trees (commercial as well as residential) within a 1,900-foot radius of an infected tree.

Although the disease had been a periodic problem in Florida since the early twentieth century, it was successfully managed. However, a new infestation in 1995 gained foothold and spread into southwest and southeast Florida. Efforts to eradicate the disease was inhibited first by homeowners who were opposed to their trees being cut down and later by a series of hurricanes in 2004 and 2005 that helped to rapidly spread canker throughout the citrus areas. In 2006, the decision was made to stop the practice of destroying trees within the 1,900-foot radius and to develop a new science-based Citrus Health Response Program. To date, more than 12.7 million citrus trees have been cut down at a cost of more than $600 million, including compensation (Science, 2006).

Citrus greening, also known as Huanglongbing, is a bacterial disease with far worse consequences than citrus canker. Whereas canker makes the trees less productive and blemishes the fruit, greening causes the fruit to be totally unusable and eventually kills the trees. The dreaded disease was discovered in Florida in August of 2005. Some researchers have expressed the view that it is virtually impossible to prevent the spread of the disease throughout the state because the bacterium is spread by another introduced insect that is found throughout Florida. Management of the disease is made even more difficult since infected and contagious trees do not show symptoms for several years. It is believed that the full impact of this disease on the Florida citrus industry has not yet been realized and that the prospect of maintaining an economically viable citrus industry in the presence of this disease will be a challenge.

Added to the disease and hurricane problems, there has been a rapid increase in the value of both undeveloped and agricultural land in the state of Florida over the last five years. A rural land value survey conducted by the University of Florida reported that agricultural land in South and Central Florida increased in value between $1,866 per acre and $4,633 per acre from May 2004 to May 2005 (Reynolds, 2006). This has affected the willingness of investors to commit capital to citrus production in Florida and, in some cases, has hastened the conversion of citrus land to other land uses, notably real estate development (Spreen, 2006).

Trends in On-tree Grapefruit Prices in Florida and Wholesale Market Prices in EU

Table 5 shows the average on-tree prices received by Florida growers over the marketing seasons 2001/02 to 2005/06. This price represents the returns to growers' net of marketing costs. The data presented in Table 5 indicate that between crop seasons 2001/02 and 2004/05, prices increased from $3.53 per 85-pound box (4 cents per pound) to $14.86 per box (17 cents per pound). Although price fell slightly in the following year to $10.16 per box (12 cents per pound), it was still three times the price received in the 2001/02 crop season (USDA Fruit and Tree Nuts Outlook). The high prices in the last two seasons reflected tight supplies in the market.

As to be expected, given the dominance of Florida's grapefruit industry in world production and trade, prices in the EU market were similarly affected. Table 6 shows the wholesale equivalent market prices in selected European Markets for Florida fresh grapefruit for the corresponding period. As shown in Table 6, prices for fresh grapefruits increased from $27.72 per 85-pound box (32 cents per pound) in marketing year 2001/02 to $49.36 per 85-pound box (58 cents per pound) and $51.6 per box (61 cents per pound) 2004/05 and 2005/06, respectively.

Brief Overview of Jamaica's Citrus/Grapefruit Industry[2]

The Jamaican citrus industry remains an economically important agricultural industry for the country, behind sugar, bananas, and coffee. In 2004, the industry's direct contribution to the economy was estimated at US $20 million, with

[2] Information presented in this section was obtained from personal communication with Drs, Florence Young and Percy Miller, Jamaica Citrus Replanting Program and Jamaica Citrus Growers Association, respectively

an economic output impact of $60 million. It provides direct employment for about 5,400 persons and total direct and indirect employment of about 20,000.

In 2004, a total of 21,840 acres were allocated to the production of citrus with bearing and non-bearing acreages of 20,152 and 1,688, respectively. Oranges account for approximately 88% of the total acreage while grapefruit accounts for the majority of the balance. Production is carried out by a large number of small-scale growers cultivating between 2 and 10 acres, accounting for about 95% of the growers and 30% of total acreage. The remaining 5% of growers have farms ranging from 25 to 5 000 acres.

Production of citrus has been declining due to the presence of the virus Citrus tristeza disease (CTV). However, both the government and the industry have taken steps to manage the disease by encouraging growers to replant with certified virus-free seedlings and new rootstocks that are tolerant to CTV. Expectations are that these measures will help to reverse the downward trend. In 2004, a total of 3.53 million boxes of citrus were produced, of which 47,158 were grapefruit. As with the declining trend in production, exports have also been declining. Fresh and processed fruit for export accounted for about 19% of the total citrus production. Between 1998 and 2004, exports of fresh citrus declined from about 7,846 metric tons valued at US$ 3.70 million to 2,786 tons with a value of $1.77 million, respectively, with oranges accounting for the bulk of the exports. Since 2001, there have been no exports of grapefruit due to strong domestic demand. The main destinations for citrus exports from Jamaica are the EU, US, Canada, and Barbados.

Methodology

Given the importance of the citrus industry to the US economy and the state of Florida in particular, researchers at the University of Florida undertook a comprehensive study to assess the future of the Florida citrus industry (Spreen et al., 2006). Among the objectives of the study was an assessment of the long-run production and price forecasts for Florida citrus under varying assumptions that relate to supply issues, including the impact of canker and greening and higher undeveloped land prices. Of interest to the current study were the long-term projections for the grapefruit industry. Building on these projections and taking into consideration the relationship between prices that the Florida growers received and those obtained in the EU market, we provide forecasts for long-term grapefruit prices in the EU market. Below is a brief discussion of the grapefruit model used by Spreen et al. (2006) to determine the long-run projections, followed by a discussion of the scenarios chosen and the approach used to forecast wholesale prices in the EU.

Spreen et al. (2006) apply a modification of Pana's spatial equilibrium model (1988) to predict Florida grapefruit production between the 2006/07 and the 2020/1 seasons.[3] Assuming red seedless and white seedless as the main varieties of grapefruit as well as fresh grapefruit and processed grapefruit as the two markets, the model uses average yields per acre, on-tree prices, tree inventory, and tree mortality for Florida grapefruit production estimates. Using Florida grapefruit tree inventory as an input to the model, the simulation starts by calculating total grapefruit production (both red seedless and white seedless) from grapefruit average yields per acre across age categories and the number of grapefruit acres across age categories. The equilibrium FOB price of grapefruit in each market is solved by equating demand and supply of the Florida grapefruit. The obtained FOB price estimate for grapefruit is then deducted by packing costs, processing costs, and picking and hauling costs to get on-tree prices and to predict new Florida grapefruit planting levels. Impacts on planting levels due to cost changes, such as higher land cost, are imposed by adjusting the expected on-tree price. Production yields per acre and tree death loss are adjusted for potential impacts from citrus canker and citrus greening, respectively. After the existing tree inventory is aged and adjusted for tree mortality, the model is solved for the next season and the process is repeated for the rest of the projection periods.

In our analysis, four scenarios from Spreen et al. (2006) are selected for discussion and provide the basis our analysis. The first scenario (the base run of the model) assumes only the presence of citrus canker, which will increase acre-loss rate and decrease acre yields by 10% each. Growth in domestic and export demands for fresh grapefruit and grapefruit juice is not imposed. The second scenario incorporates the potential impact of low citrus greening (i.e., tree

[3] Here we provide only a brief overview of the model. Details of the model can be found in Appendix 1 of this study and Appendix B of the study conducted by Spreen, et al., 2006)

mortality for non-bearing trees increases by 150% compared to the base, 100% for trees ages four through eleven, and 75% for all older trees) in addition to the presence of citrus canker. The third and the fourth scenarios are modifications of the second scenario. The third scenario differs slightly from the second scenario in that the potential impact from citrus greening has intensified in addition to the presence of citrus canker. Tree mortality for non-bearing trees increases from 150% in the second scenario to 300% in the third scenario, compared to the base. For trees ages four through eleven, tree mortality increases from 100% in the second scenario to 200% in the third scenario. For all trees age 12 and older, tree mortality increases from 75% in the second scenario to 150% in the third scenario. In the fourth scenario, the presence of citrus canker and low citrus greening are maintained while the assumption of higher land costs in Florida by $3,500 per acre is added to the second scenario.

Having obtained the projections for Florida grapefruit industry for the above scenarios over the period 2005/06 to 2020/01, we then determined the relationship between Florida grapefruit on-tree prices and market prices in selected EU markets (Hamburg, Germany; Paris, France; and Rotterdam, Netherlands) through a simple linear regression (Appendix 2). Data employed in the regression include monthly average EU market prices for Florida grapefruit in selected EU markets from the USDA fruit and vegetable market news portal and monthly average on-tree prices received by Florida growers from National Agricultural Statistics Service (NASS, USDA) between October 2001 and February 2006 (Tables 5 and 6). The coefficients obtained from regressing monthly average EU market prices on monthly average on-tree prices are then applied to the long-run projections on Florida on-tree price developed by Spreen et al. (2006) to give long-run projections on average EU market price from the 2006/07 season to the 2020/21 season.

Results and Discussion

The long-run projections of the prices growers are likely to receive (on-tree price) under the various scenarios over the period 2006/07 through 2020/21 as well as the forecast wholesale market prices in selected EU markets are shown in Table 7 and illustrated in Figures 1 and 2.. In the base case (scenario 1) which assumes only the presence of citrus canker, the data in Table 7 suggest that the growers are likely to receive an on-tree price of about $7.00 per box in the base year (2006/07). This price is expected to increase to a maximum of $9.68 per box in crop season 2013/14 and subsequently decline to $5.20 per box in crop season 2020/21. The corresponding prices that are likely to obtain in the EU, given our assumption, are $40.10, $44.69, and $36.75 per box, respectively. The price trends reflect the expected pattern of grapefruit production in Florida if this scenario were to be the case. In particular, Florida's grapefruit production is expected to decline from 24 million boxes in 2006/07 to 20 million boxes per annum by 2013/14 before recovering somewhat to 25 million boxes in the final year of the projection.

Scenario 2 assumes that in addition to the presence of citrus canker, there is also the presence of low greening. Under this scenario, the on-tree prices received by the growers would peak in crop season 2015/16 at around $11.38 per box, or about 37.7% above the base price in 2006/07, and then decline to $8.25 per box in 2020/21. These prices suggest that the wholesale prices in the EU would increase to around $47.71 per box before falling to $42.16 per box in the final year. The higher prices of course reflect tighter supplies, as the Florida grapefruit crop is projected to decrease from 24 million boxes in 2006/07 to a low of 19 million boxes in 2015/16, with only a slight recovery to 22 million boxes at the end of the simulation period.

Scenario 3, which is more likely to be the case, assumes the presence of citrus canker and high greening. As discussed earlier, citrus greening is likely to impact the industry more severely with higher tree mortality than would be the case if there was only citrus canker. This is reflected in the projection of the Florida grapefruit crop, which is expected to decline from 24 million boxes in 2006/07, reaching a low of 16 million boxes in 2016/17, and recovering slightly to 18 million boxes in 220/21. The recovery towards the end of the projection is highly contingent upon successful management of the disease. Reflecting the expected steep decline in production, on-tree prices for Florida growers is projected to increase from about $7.00 per box to peak at $15.17 per box in 2016/17 and thereafter decline to $12.08 per box at the end of the projection. These prices suggest EU prices of fresh grapefruit reaching $54.17 per box in 2016/17 and dropping back slightly to $48.95 per box in 2020/21.

The final scenario considered is similar to scenario 2, which assumes the presence of canker and low greening while taking into consideration the effects of higher land values. The results are similar to scenario 2. Grapefruit production is projected to range from a high of 24 million boxes in 2006-07 to a low of 18 million boxes in 2014-15 and then increase to 20 million boxes in 2020-21. Grower prices range from $7.09 per box in 2006-07 to $12.36 per box in 2016-17 and $9.76 per box in 2020-21. Correspondingly, the EU market prices would range from $40.10 per box in 2006-07 to $12.36 per box in 2016-17 and $9.76 per box in 2020-21.

In general, the results suggest that in all cases, growers' prices and the corresponding EU market prices for fresh grapefruits are likely to remain high over the entire forecast period. Prices under scenario 3 were the highest, followed by those under scenario 4. It should be pointed out that in all the cases considered, the model assumed that successful management strategy would be developed to control the diseases. Most important, none of the scenarios consider the possibility of a statewide quarantine to prohibit any shipments of citrus from Florida to the EU; a development that would cause an even greater impact on the market.

Table 8 compares the average costs and returns for grapefruit produced in Jamaica with those that would likely prevail in Florida under the various scenarios. Several interesting observations can be made with respect to the data presented in Table 8. First, under all scenarios considered, Florida yields were greater than those in Jamaica. In the worst-case scenario in Florida in which there is the presence of canker and high greening (scenario 3), the expected yield is 261 boxes per acre compare with 240 boxes per acre in Jamaica. Second, the average cost of production on a per acre basis is considerably less in Jamaica than in Florida. For example the lowest per acre cost of production in Florida at $1,133 (in a situation in which neither of the diseases is present) is still more than twice that in Jamaica ($500 per acre). The low cost of production in Jamaica is due mainly to the availability of cheap labor relative the prices paid in the US. The hourly wage rate for an agricultural worker in Jamaica is about US $1.10 per hour compared with agricultural wages paid in the US of about $10 per hour. However, when costs are expressed on a per box basis, most of the cost advantage enjoyed by Jamaica disappears due to the relatively low yields in Jamaica. Hence, the per box cost for Florida in a no disease situation and that for Jamaica are $3.12 and $2.08, respectively. Third, there is a noticeable disparity between the net returns to growers in Jamaica and those in Florida. In the case of Florida, the average net returns range from $2.69 per box where neither of the diseases considered is present to a high of $5.87 per box where both diseases are present. In comparison, the current average net returns to the growers in Jamaica were estimated at 42 cents per box. By adding value through the sale of fresh grapefruits in the EU, returns to Jamaican growers can be increased substantially.

Conclusion

The bleak prospect for the Florida citrus industry serves as a reminder of the importance of preventing the introduction of invasive species. The introduction and spread of such pests and diseases, as is the case in point, has the potential to destroy the whole industry or cause massive losses. While certainly an unwelcome development for the Florida citrus industry, as was the situation with the outbreak of BSE in UK and the subsequent expansion of cattle industry in Australia, it does present a potential marketing opportunity for countries such as Jamaica which are in the citrus belt and where the diseases are not present.[4]

Our preliminary assessment of the market potential for Jamaica's exports of grapefruit to the EU suggests that the prospects are promising from several perspectives. First, all situations examined with regards to the Florida grapefruit industry points to a bleak future for that country's industry and suggests that these developments are likely to cause grapefruit prices to remain relatively high in the EU market over the long term. Second, Jamaica enjoys a cost advantage over the US. The country has certain comparative and other advantages that make it ideally suited for large-scale citrus production. These include the availability of low-cost labor, low incidence of plant diseases, adequate hours of sunlight, a climate that allows many horticultural crops to provide two harvests a year, adequate rainfall in citrus areas, and access to ports and foreign markets. In addition,

[4] Citrus greening has not been detected in Jamaica even though the psyllid vector that transmits the causative organism is present in the country (personal communication with Dr. Florence Young)

the country currently benefits from preferential treatment in the EU. While it is true that current yields in Jamaica are relatively low, this should be seen as a positive since it implies that there is considerable scope for improving productivity. Third, suitable lands for large-scale planting of grapefruit trees are likely to become available as the country reduces its reliance on sugar and banana production.

Notwithstanding the above, we are fully aware that the citrus industry and markets are complex and that any sustained price increases could encourage others to participate in the market. Also, the intent of our analysis was not to predict the numbers precisely but to show the general long-term direction of prices in the EU market. It therefore goes without saying that any serious investments contemplated by the government or the industry should rest on a detailed investigation of the EU markets.

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Table 1: World grapefruit and pomelos top producers (metric tons), 2000-2005

Country/ Region	2000	2001	2002	2003	2004	2005	Average
US	2,505,640	2,233,490	2,199,020	1,871,520	1,964,050	914,440	1,948,027
China	268,128	323,296	356,786	400,840	433,000	443,000	370,842
Mexico	263,126	319,793	269,069	257,711	257,711	257,711	270,854
Israel	246,000	329,500	251,900	255,900	247,000	250,000	263,383
Cuba	443,705	302,487	137,312	227,800	225,000	226,000	260,384
ROW	1,600,958	1,553,788	1,604,238	1,576,544	1,579,272	1,570,161	1,580,827
Total	5,327,557	5,062,354	4,818,325	4,590,315	4,706,033	3,661,312	4,694,316

Note: ROW represents the rest of the world
Source: FAOSTAT data, 2006

Table 2: World grapefruit and pomelos top exporters (metric tons), 2000-2004

Country/Region	2000	2001	2002	2003	2004	Average
US	398,762	397,572	427,097	387,302	370,823	396,311
South Africa	133,570	129,335	165,725	177,453	197,682	160,753
EU	199,447	176,669	188,209	191,040	189,500	188,973
Turkey	85,181	73,131	102,768	86,703	116,632	92,883
Israel	110,319	69,408	44,050	88,986	57,241	74,001
ROW	110,221	133,640	119,537	142,307	145,546	130,250
Total	1,037,500	979,755	1,047,386	1,073,791	1,077,424	1,043,171

Note: ROW represents the rest of the world
Source: FAOSTAT data, 2006

Table 3: World grapefruit and pomelos top importers (metric tons), 2000-2004

Country/ Region	2000	2001	2002	2003	2004	Average
EU	640,670	578,728	620,560	589,388	601,123	606,094
Japan	272,278	268,650	284,687	274,328	288,510	277,691
Canada	55,194	53,036	57,476	50,696	50,788	53,438
US	10,040	25,221	23,248	20,710	13,737	18,591
Turkey	0	1,995	12,668	10,267	11,367	7,259
China	17,461	16,646	19,041	10,491	11,289	14,986
China, Hong Kong	16,152	14,423	21,017	15,307	10,899	15,560
ROW	40,790	44,003	41,253	57,514	47,895	46,291
Total	1,052,585	1,002,702	1,079,950	1,028,701	1,035,608	1,039,909

Note: ROW represents the rest of the world
Source: FAOSTAT data, 2006

Table 4: US grapefruit exports by destination (metric tons), 2000-2005

Country/ Region	2000	2001	2002	2003	2004	2005	Average
Japan	206,284	195,871	209,479	181,752	190,703	88,203	178,715
EU	115,437	116,867	114,920	102,104	85,762	56,070	98,527
Canada	49,230	48,057	50,607	44,264	41,256	34,612	44,671
Korea	2,930	1,870	7,905	6,917	7,684	10,404	6,285
Mexico	75	283	554	316	1,483	6,406	1,519
ROW	17,212	20,105	23,529	24,945	21,133	18,537	20,910
Total	391,167	383,052	406,995	360,298	348,021	214,231	350,627

Note: ROW represents the rest of the world
Source: USDA Foreign Agricultural Service, BICO Report

Table 5. Average on-tree prices received by Florida growers ($ per 85-lb box), 2001-02 through 2005-06

Month	2001/02	2002/03	2003/04	2004/05	2005/06
October	6.46	5.37	6.98	15.00	--
November	3.64	3.61	4.49	15.95	9.20
December	2.69	2.67	3.90	14.58	9.37
January	2.76	2.42	3.32	15.30	10.99
February	2.10	2.18	3.10	13.48	11.07
March	1.85	1.80	2.74	11.54	--
April	1.61	1.37	2.12	10.46	--
May	1.37	1.24	2.38	10.48	--
Average (October-February)	3.53	3.25	4.36	14.86	10.16

Note: -- Represents data not available
Source: USDA National Agricultural Statistics Service

Table 6: Average wholesale prices for Florida grapefruit in selected EU markets ($ per 85-lb box), 2001-02 through 2005-06

Month	2001/02	2002/03	2003/04	2004/05	2005/06
October	31.75	35.13	43.86	--	--
November	26.45	32.17	36.68	48.55	54.30
December	27.00	30.01	35.36	50.72	53.09
January	25.30	30.45	34.14	48.53	51.29
February	28.11	32.35	33.13	49.63	47.70
March	27.19	33.02	33.98	50.80	46.78
April	26.91	33.52	34.54	49.40	49.11
May	29.00	36.88	34.42	50.86	49.91
Average (October-February)	27.72	32.02	36.63	49.36	51.60

Note: Represents data not available. EU markets include Hamburg (Germany), Paris (France), and Rotterdam (Netherlands).
Source: Compiled by authors, data were obtained from USDA Fruit and Vegetable Market News

Table 7: Grapefruit long-run projections on Florida fresh/processed on-tree price and average market price for Florida grapefruit in selected EU markets by scenario ($ per box), 2006-07 season through 2020-21 season

Season	**Scenario 1** (Canker only)		**Scenario 2** (Canker and low greening)		**Scenario 3** (Canker and high greening)		**Scenario 4** (Canker, low greening, and higher land values)	
	On-tree price	EU market price	On-tree price	EU market price	On-tree price	EU market price	On-tree price	EU market price
2006-07	7.09	40.10	7.09	40.10	7.10	40.12	7.09	40.10
2007-08	7.26	40.40	7.26	40.40	7.27	40.42	7.26	40.40
2008-09	7.74	41.25	7.74	41.25	7.75	41.27	7.74	41.25
2009-10	8.32	42.28	8.34	42.32	8.38	42.39	8.34	42.32
2010-11	8.90	43.31	8.98	43.45	9.13	43.72	8.98	43.45
2011-12	9.40	44.20	9.70	44.73	10.21	45.63	9.76	44.83
2012-13	9.62	44.59	10.33	45.85	11.47	47.87	10.52	46.18
2013-14	9.68	44.69	10.88	46.82	12.80	50.23	11.26	47.50
2014-15	9.56	44.48	11.29	47.55	13.98	52.32	11.90	48.63
2015-16	9.17	43.79	11.38	47.71	14.78	53.74	12.25	49.25
2016-17	8.62	42.81	11.24	47.46	15.17	54.43	12.36	49.45
2017-18	7.86	41.47	10.78	46.64	15.02	54.16	12.10	48.98
2018-19	7.00	39.94	10.08	45.40	14.40	53.06	11.54	47.99
2019-20	6.10	38.34	9.22	43.88	13.39	51.27	10.75	46.59
2020-21	5.20	36.75	8.25	42.16	12.08	48.95	9.76	44.83

Note: EU markets include Hamburg (Germany), Paris (France), and Rotterdam (Netherlands).
Source: Average market prices in selected EU markets are estimated by authors. Data were obtained from USDA Fruit and Vegetable Market News. On-tree prices are from Spreen et al. (2006)

Table 8: Comparison of the average costs and returns for grapefruits produced in Jamaica and in Florida

	Jamaica[1]	**Florida**[2]				
		No disease	Scenario 1 (Canker only)	Scenario 2 (Canker and low greening)	Scenario 3 (Canker and high greening)	Scenario 4 (Canker, low greening, and higher land values)
Average Yields (boxes per acre)	240	363	321	302	261	302
Average Production Costs ($ per acre)	500	1,133	1,394	1,521	1,478	1,521
Average Production Costs ($ per box)	2.08	3.12	4.34	5.04	5.66	5.04
Average Growers Price ($ per box)	2.50	5.81	8.10	9.5	11.53	10.11
Average Net Returns ($ per box)	0.42	2.69	3.76	4.46	5.87	5.07

Note: 1/ Based on personal communication with Drs. Florence Young and Percy Miller
2/ Compiled by authors using data from Spreen et al., 2006

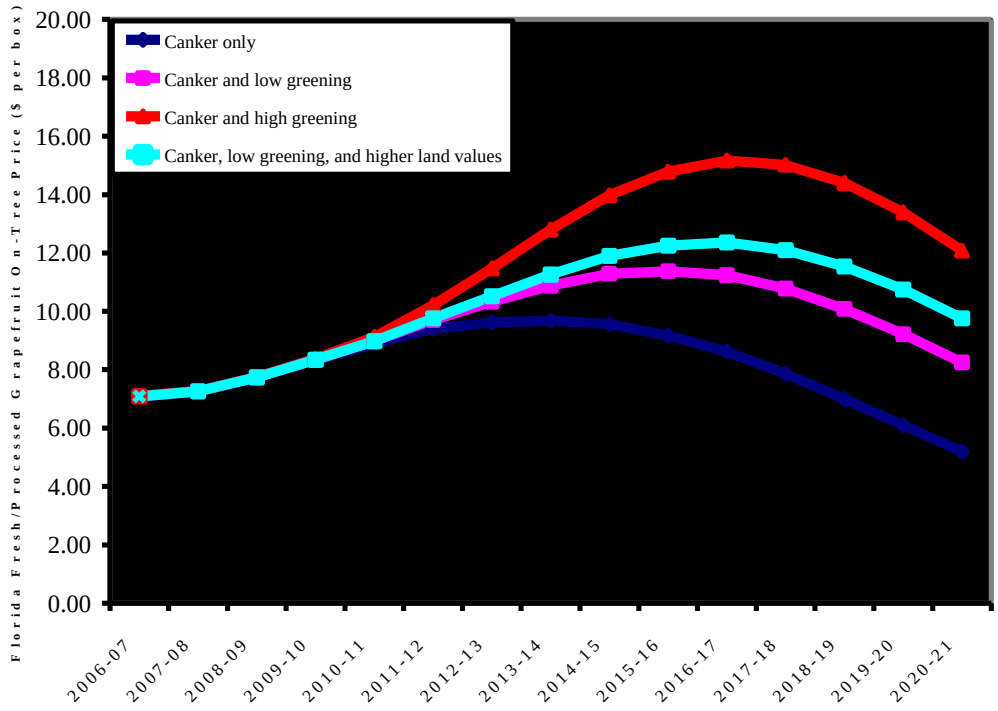


Figure 1: Grapefruit long-run projections on Florida fresh/processed grapefruit on-tree price ($ per box)

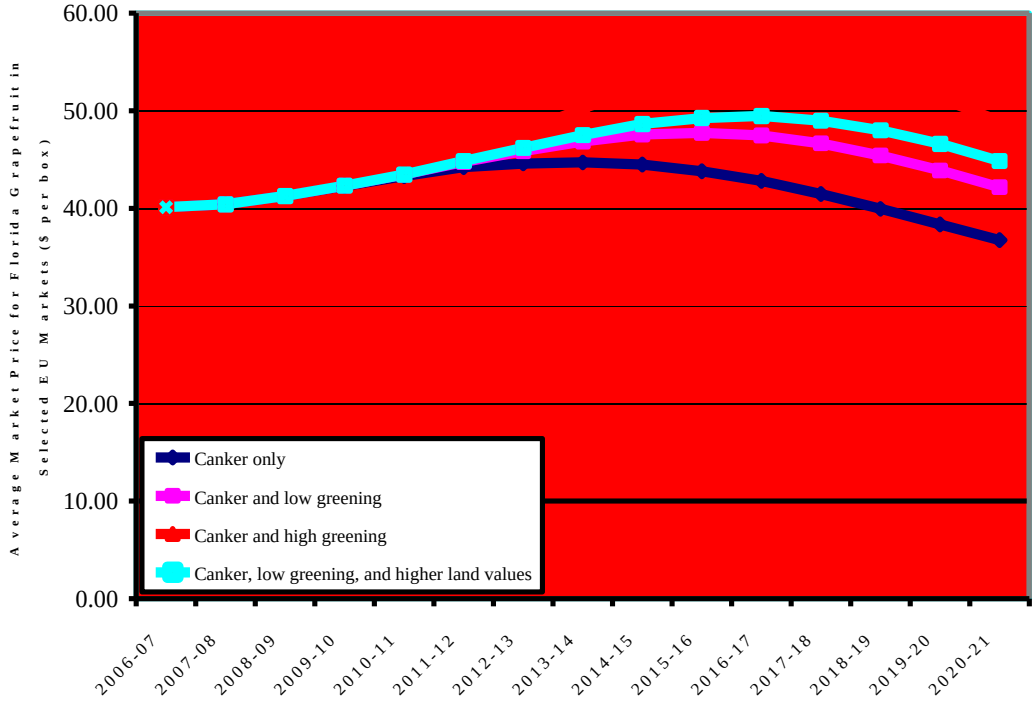


Figure 2: Average market price for Florida grapefruit in selected EU markets ($ per box)

Appendix 1: Overview of Grapefruit Model

Spreen et al. (2006) apply a modification of Pana's spatial equilibrium model (1988) to predict Florida grapefruit production between 2006/07 season and 2020/21 season. Assuming red seedless and white seedless as the two main varieties of grapefruit as well as fresh grapefruit and processed grapefruit as the two markets, the model uses average yields per acre, on-tree prices, tree inventory, and tree mortality for Florida grapefruit production estimates. Production yields per acre and tree death loss are adjusted for potential impacts from citrus canker and citrus greening, respectively. Specifically, FOB price for fresh grapefruit is determined as follows. The FOB price of the fresh grapefruit is identified by first equating demand and supply or certified fresh utilization of Florida fresh grapefruit ($Q_t = \alpha p_t^{\varepsilon} e^{rt}$) and solving for the FOB price such that

(1) $$p_t = p_{t-1}\left[\frac{(Q_t/Q_{t-1})}{e^r}\right]^{1/\varepsilon},$$

where p_t and p_{t-1} are FOB prices of fresh grapefruit at time *t* and *t*-1, respectively; Q_t and Q_{t-1} are Florida certified fresh utilizations at time *t* and *t*-1, respectively; *r* is the assumed grapefruit demand growth rate; *e* is the natural logarithm base; and ε is a domestic-export weighted-average price elasticity.

The obtained FOB price estimate for fresh grapefruit is then deducted by packing costs, processing costs, picking and hauling costs to get on-tree prices which will be used to predict new plantings using the Florida grapefruit planting equation which is defined as

(2) $$n_t = a + bp^e_{f,t},$$

where n is the number of white or red grapefruit acres planted; p^e_f is the expected white or red on-tree returns or prices per acre, based on the fresh FOB and grapefruit juice price estimates, and *a* and *b* are estimated grapefruit-variety-specific (positive) parameters. Note that the impacts on planting levels due to cost changes, such as higher land cost, are considered by adjusting the expected on-tree price. Spreen et al. (2006) assume that the expected delivered-in price differs from the expected futures price by a constant.

(3) $$p^e_d = a_1 + p^e_f,$$

where p^e_d is the expected delivered-in price, a_1 is a constant, and p^e_f is the expected futures price. Expected net grower price (p^e_n) is then defined as

(4) $$p^e_n = p^e_d - c,$$

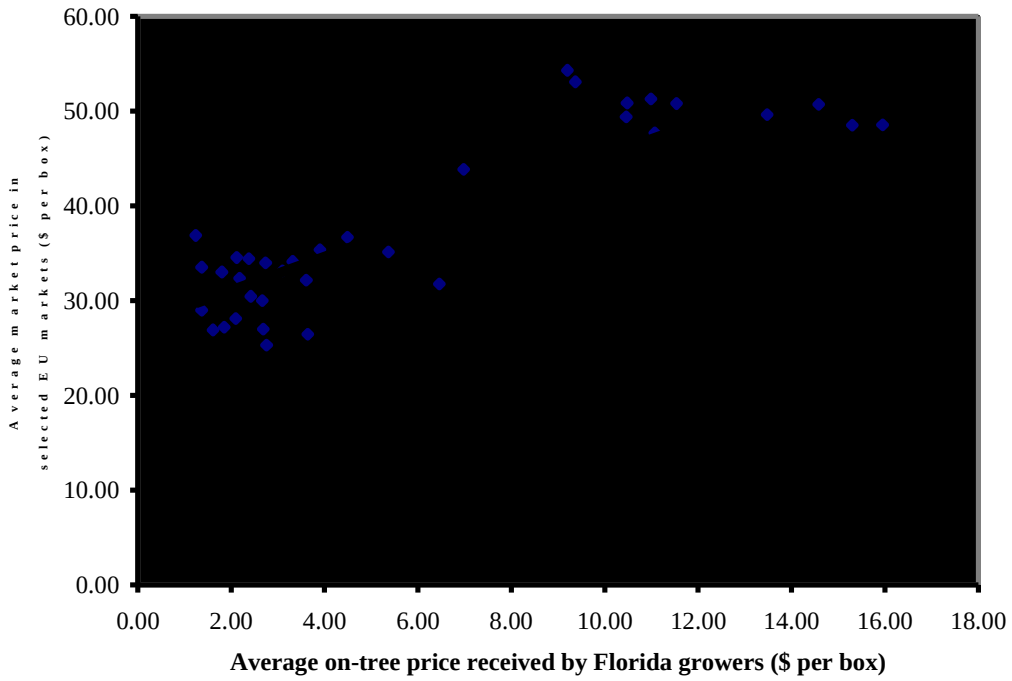
where *c* represents costs. The planting equation can be rewritten as

(5) $$n_t = a + b(a_1 + p^e_{f,t} - c_t).$$

Appendix2:

Results of regression EU market prices vs. Florida on-tree price

	Coefficient	Standard Error
Intercept	27.53	1.26
Average on-tree price	1.77	0.17
R^2	0.77	



Scatter plot between average market price of Florida grapefruit in selected EU markets and average on-tree price received by Florida growers ($ per box)