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Economic Impacts of Citrus Greening (HLB) in Florida, 2006/07–2010/11[1]

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Introduction

The state of Florida is the largest citrus producer in the United States, and the second largest producer of orange juice in the world, behind Brazil. The Florida citrus industry represents an important part of the Florida agricultural economy—with estimated output (revenue) impacts of $8.91 billion and value added contributions of $4.62 billion to Gross Domestic Product. The Florida citrus industry generated at least 75,800 jobs, based on over 203 million boxes of citrus fruit produced in the 2007/08 season (Hodges and Rahmani 2009).

Citrus Huanglongbing (HLB), more commonly known as citrus greening disease, has become endemic in the state of Florida and in São Paulo, Brazil, where it has caused major damage to citrus production. Believed to have originated in or near southern China more than a century ago, HLB's presence was detected in the São Paulo state in Brazil in 2004. By September 2005, the disease was found in Miami-Dade County, and it soon spread throughout the commercial production area in Florida. The disease affects citrus production by causing premature fruit drop. Infected trees also produce small, misshapen fruit with bitter juice that has no economic value. As the disease progresses, the tree becomes more vulnerable to other diseases. Currently, there is no strategy to cure the disease. Some growers attempt to suppress the disease through an aggressive eradication program, while others are employing foliar nutritional techniques in an attempt to mask the symptoms of the disease and extend the economic life of infected groves.

This study attempts to estimate the regional economic impacts of HLB on production of Florida oranges utilized for juice manufacturing only. The potential economic impacts on the fresh citrus fruit market were not assessed.

Methods

Estimation of Florida Citrus Industry Revenues

Revenues for Florida oranges utilized for juice production were estimated for production years 2006/07 through 2010/11 under scenarios with and without the presence of HLB. For without-HLB, this was accomplished with a mathematical model of the world orange juice market that accounts for production volumes and market prices in Florida and Brazil, the two largest global production regions (Spreen, Brewster, and Brown 2003). The model uses the tree inventories in Florida and São Paulo to predict annual orange production in each area. Juice yield and processed utilization in each region are used to convert orange production into orange juice production. Consumption markets include the United States, European Union, Canada, and the rest of the world (ROW). The model allocates annual juice production in Florida and São Paulo across these four markets, accounting for transportation costs and tariffs so as to achieve a spatial price equilibrium.

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The impact of without-HLB is incorporated into the model through modified tree mortality rates, which were estimated with the assistance of citrus experts from the University of Florida. Florida orange production was projected over the period 2006/07 through 2010/11, and the model was used to estimate world and Florida orange juice prices. After deducting the estimated cost of processing, delivered-in prices were calculated, and delivered-in revenues were computed by multiplying delivered-in prices times orange production. For with-HLB, actual production and price data were used based on statistics reported by the Florida Agricultural Statistics Service (FASS).

Economic Impact Analysis

Based on changes in production volumes and prices estimated from the econometric model, total regional economic impacts of HLB in Florida were estimated using a regional model developed with the *Impact Analysis for Planning (IMPLAN)* Input-Output (I-O) software and its associated regional dataset for Florida in 2009 (MIG, Inc. 2010). *IMPLAN* regional data incorporate federal and state economic statistics on commodity production, household and government final demand (consumption), industry output, employment, labor and property income, domestic and international trade (imports, exports), personal and business taxes, transfer payments (pensions, welfare, etc.), capital investment, and business inventories. The model was constructed with all social accounts endogenous, including households and local/state and federal governments, and capital investment. The model estimates regional economic multiplier effects, including direct changes in output or employment, indirect effects on supply chain activity, and induced effects on employee household and government spending.

For this analysis, estimated revenues for each year were entered into the *IMPLAN* model in the "Fruit Farming" sector, which includes the activities for grove establishment and management, fruit harvesting, and delivery to first point of sale. The *IMPLAN* software automatically applies industry-specific deflators to convert the revenues for each year to 2009 (the model year) dollars, and then re-inflates estimated impacts to current year (2011) dollars. All input purchases were assumed to have been made in the local area (in this case, the state of Florida).

Results

Estimated production volumes, prices, and revenues for oranges produced in Florida and in Brazil for the past five production seasons (2006/07 through 2010/11 with- and without-HLB) are summarized in Table 1. Total cumulative production in Florida over the five-year period under the "without-HLB" scenario was 951 million boxes, while actual production under the "with-HLB" scenario was 734 million boxes, or about 23 percent lower. Production volumes decline over time in the without-HLB scenario due to other technical and market factors. Actual Brazilian production was 1,433 million boxes, and declined during this period. Cumulative orange juice production in Florida was estimated at 6.32 billion gallons of single-strength equivalent (SSE) without-HLB and 4.62 billion gallons with-HLB. The average price received by growers for oranges delivered to processing plants ranged from $1.47 to $2.14 per SSE gallon under the without-HLB scenario. In the with-HLB scenario, prices paid to growers were 10–26 percent higher, or $1.66–$2.33 per SSE gallon. Total revenue received by Florida orange growers over the five-year period is $10.913 billion for without-HLB, compared to $9.204 billion for with-HLB, or about 16 percent lower. These model results represent revenues to growers on a "delivered-in" basis (i.e., on-tree value plus harvest and transportation cost). So, although prices rise under the lower supply conditions in the with-HLB scenario, this does not completely offset the lower production volumes.

Total cumulative economic impacts from the *IMPLAN* model, including direct, indirect, and induced multiplier effects, over the five-year period (2006/07–2010/11) for the two HLB scenarios are summarized in Table 2. Under the without-HLB scenario, total output impacts were estimated at $28.816 billion; total value added impacts were $17.243 billion; total labor income impacts were $11.125 billion; and total employment impacts were 261,970 job-years, or the equivalent of an average of 52,394 permanent jobs, including both full-time and part-time positions. Under the with-HLB scenario, total output was $24.275 billion; total value added was $14.526 billion; total labor income was $9.372 billion; and total employment was 220,686 job-years, or an average of 44,137 jobs. (Note that for a multi-year impact analysis such as this, the total employment impacts are given in job-years, so the average number of permanent or ongoing jobs is reckoned by dividing the total job-years by the number of years.)

The difference between the scenarios with- versus without-HLB is a total output impact of –$4.541 billion, total value added of –$2.717 billion, total labor income of –$1.753 billion, and average total employment of –8,257 jobs. These impact estimates include the direct, indirect, and induced multiplier effects, as previously noted. The total

employment impact of HLB represents 0.08 percent of the total Florida workforce of 9.773 million in 2010.

The employment impacts under the with- and without-HLB scenarios are shown by industry sector in Table 3. Naturally, the largest impacts occur in the *Agriculture, Forestry, Fisheries* sector, with over 3,900 jobs lost, or 48 percent of total jobs lost, because this is the sector in which the direct impacts reside for the *Fruit Farming* industry. However, large employment impacts also occur in the sectors for *Government* (–650 jobs, 7.9%), *Health and Social Services* (–602 jobs, 7.3%), and *Retail Trade* (–566 jobs, 6.8%) due to the induced multiplier effects of reduced disposable income and personal consumption spending by citrus industry employees. For example, citrus industry employees will have less income available to make discretionary purchases of consumer goods at retail stores.

Concluding Remarks

This study presents estimates of the economic impacts of Huanglongbing (HLB, or citrus greening) on the Florida economy. The introduction of HLB has had profound impacts on citrus production in the state, and significant employment impacts on the agricultural sector. Given the importance of the citrus industry to the Florida economy, HLB has also had adverse economic impacts to overall GDP, income, and employment in other industries related to Florida citrus, although less in relative terms. This analysis did not attempt to quantify the impacts of citrus greening on the fresh citrus fruit market, although it is believed that these impacts are small relative to those for processed fruit. These results should assist decision makers in the Florida citrus industry and state government to better understand the economic importance of finding solutions to citrus greening.

References

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Table 1. Florida orange production, juice prices and grower revenues under with- and without-HLB scenarios, 2006/07–2010/11

Season	Production (million boxes)		Average Juice Price (dollars per SSE gallon)		FOB Revenue (million dollars)		
	Without-HLB	With-HLB	Without-HLB	With-HLB	Without-HLB	With-HLB	Difference
2006/07	196.0	129.0	1.55	1.95	2,014	1,593	421
2007/08	194.0	170.2	1.51	1.66	1,949	1,841	108
2008/09	191.0	162.5	1.79	1.98	2,271	2,053	218
2009/10	187.0	133.6	1.78	2.15	2,215	1,730	485
2010/11	183.0	139.0	2.02	2.33	2,463	1,987	476
Cumulative Total	951.0	734.3			10,913	9,204	1,709

Table 2. Summary of economic impacts of orange production for juice processing in Florida, 2006/07–2010/11, under HLB scenarios

Impact Type	Employment (average permanent jobs)	Employment (job-years)	Labor Income (million dollars)	Value Added (million dollars)	Output (million dollars)
Without-HLB					
Direct Effect	16,840	84,201	$3,572	$5,717	$10,514
Indirect Effect	10,843	54,213	$1,731	$2,258	$3,715
Induced Effect	24,711	123,556	$5,822	$9,268	$14,587
Total Effect	52,394	261,970	$11,125	$17,243	$28,816
With-HLB					
Direct Effect	14,186	70,932	$3,009	$4,816	$8,857
Indirect Effect	9,134	45,669	$1,458	$1,902	$3,130
Induced Effect	20,817	104,085	$4,905	$7,808	$12,288
Total Effect	44,137	220,686	$9,372	$14,526	$24,275
Difference: With-HLB minus Without-HLB					
Direct Effect	–2,654	–13,269	–$563	–$901	–$1,657
Indirect Effect	–1,709	–8,543	–$273	–$356	–$585
Induced Effect	–3,894	–19,471	–$918	–$1,461	–$2,299
Total Effect	–8,257	–41,284	–$1,753	–$2,717	–$4,541

* Values expressed in 2011 dollars. Employment impacts represent full-time and part-time jobs.

Table 3. Employment impacts by industry sector of orange production in Florida, 2006/07–2010/11, under scenarios with- and without-HLB

Industry Sector (2 digit NAICS)		Without-HLB	With-HLB	Change	Percent of Total Change
11	Agriculture, Forestry, Fishing	25,000	21,061	–3,940	47.7%
21	Mining	34	29	–5	0.1%
22	Utilities	157	132	–25	0.3%
23	Construction	1,561	1,315	–246	3.0%
31–33	Manufacturing	606	511	–96	1.2%
42	Wholesale Trade	1,005	847	–158	1.9%
44–45	Retail Trade	3,589	3,023	–566	6.8%
48–49	Transportation & Warehousing	890	750	–140	1.7%
51	Information	296	249	–47	0.6%
52	Finance & Insurance	1,554	1,309	–245	3.0%
53	Real Estate & Rental	1,374	1,157	–217	2.6%
54	Professional, Scientific & Tech Services	1,780	1,499	–281	3.4%
55	Management of Companies	149	125	–23	0.3%
56	Administrative & Waste Services	1,293	1,089	–204	2.5%
61	Educational Services	631	531	–99	1.2%
62	Health & Social Services	3,817	3,216	–602	7.3%
71	Arts–Entertainment & Recreation	510	429	–80	1.0%
72	Accommodation & Food Services	2,037	1,716	–321	3.9%
81	Other Services	1,986	1,673	–313	3.8%
92	Government & Non-NAICs	4,126	3,476	–650	7.9%
	Total	52,394	44,137	–8,257	100.0%

* Employment impacts represent average permanent full-time and part-time jobs.
NAICS is the North American Industry Classification System.