Cooperative Extension Service
College of Tropical Agriculture and Human Resources
University of Hawai'i at Mānoa

Economic Issues
Apr. 2004
EI-6

Economic Impacts of Shutting Down Hawaii's Sugar Industry

Junning Cai and PingSun Leung
Department of Molecular Biosciences and Bioengineering

The purpose of this publication is to assess the economic repercussions of a complete shutdown of Hawaii's sugarcane cultivation and processing industry. The sugar industry has gone through another dramatic transformation in the past decade, following previous decades of decline. It dropped from 55 farms producing 6.5 million tons of cane in 1990 to only two farms producing 2.1 million tons of cane in 2002 (Table 1). The possibility of a complete demise of Hawaii's sugar industry has been a major concern in the state. Estimating the economic impact of a potential, sudden disappearance of the entire sugar industry on the Hawaii economy will provide state legislators and others with much-needed information as they continue to deliberate and act to accommodate the major structural changes that have occurred with sugar's decline.

Methodology for estimating economic impacts

We used the latest available (1997) input-output (I-O) model of 131 sectors in the Hawaii economy for an economic impact assessment of a complete elimination of the sugar industry. Economic impact is expressed in terms of output (business sales), value added (industry's contribution to the gross state product), employment, labor earnings, and state taxes.

The I-O model provides a comprehensive snapshot of the intertwined economy at a particular point in time. It allows us to trace the direct, indirect, and induced effects of a reduction in a particular sector of concern.

For example, a reduction of $1 in sugar sales will *directly* reduce sugar output by $1. The *indirect* effect of this $1 reduction in turn will decrease the input purchases (fertilizers, water, fuel, etc.) by the sugar industry from other sectors. The reduction in the sales of these sectors will trigger further decreases in their supporting input sectors. This will continue on throughout the economy with further rounds of sales reduction. Furthermore, the sugar industry and its direct and indirect input suppliers pay their employees, who will use the earnings to purchase goods and services in the economy; these are the *induced* effects. Similarly, the sugar industry and its direct and indirect input suppliers pay rents and interest on loans, and they take home profits; these incomes are eventually spent in the economy as well.

A sector's indirect and induced effects are generally referred to as its "backward linkage" impacts, which, together with its direct effect, provide a measure of the sector's total impact on the economy.[1]

The I-O model provides a systematic way to estimate sectors' impacts on the economy. Specifically, we use a supply-driven approach to (counterfactually) simulate how Hawaii's economy would have been affected had its sugar industry been shut down in a specific year.[2]

[1]Sectors can also have forward linkages through selling their products to other sectors. Because virtually all final products of Hawaii's sugar industry are destined for final consumption (primarily for exports), its forward linkage is trivial.

[2]A brief technical explanation of the simulation methodology is provided in the Appendix. For more details about the supply-driven approach, see Leung and Pooley (2002), "Regional economic impacts of reductions in fisheries production: a supply driven approach" in *Marine Resource Economics* 16:251–262.

Published by the College of Tropical Agriculture and Human Resources (CTAHR) and issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Andrew G. Hashimoto, Director/Dean, Cooperative Extension Service/CTAHR, University of Hawaii at Manoa, Honolulu, Hawaii 96822. An Equal Opportunity / Affirmative Action Institution providing programs and services to the people of Hawaii without regard to race, sex, age, religion, color, national origin, ancestry, disability, marital status, arrest and court record, sexual orientation, or veteran status. CTAHR publications can be found on the Web site <http://www.ctahr.hawaii.edu> or ordered by calling 808-956-7046 or sending e-mail to ctahrpub@hawaii.edu.

Table 1: Hawaii's sugar industry (1990–2002).

Sugarcane cultivation

Year	Number of farms	Acreage (thousands)		Yield (tons / acre)	Production (1,000 tons)	Farm price ($ / ton)	Value of production (million $)	Employment (jobs)
		In crop	Harvested					
1990	55	162.0	72.0	90.8	6538	32.7	213.8	3100
1997	4	67.8	32.0	91.4	2924	29.2	85.5	1200
1998	4	67.6	30.3	90.0	2726	32.0	87.4	1200
1999	4	67.0	35.4	81.7	2891	30.0	86.8	1200
2000	3	60.0	30.2	78.3	2364	26.3	62.2	1000
2001	2	46.0	19.3	97.3	1877	30.8	57.8	800
2002	2	47.5	21.3	99.0	2109	30.5	64.3	1000

Sugarcane processing

Year	Production of sugar products (1,000 tons)		Price of sugar products ($ / ton)		Value of production (million $)			Employment (jobs)
	Raw sugar	Molasses	Raw sugar	Molasses	Raw sugar	Molasses	Total	
1990	820	228	389	43.8	319.0	9.9	328.9	2550
1997	357	131	357	38.6	127.5	5.0	132.5	516
1998	354	118	368	23.5	130.3	2.8	133.1	512[1]
1999	368	137	352	13.3	129.5	1.8	131.3	498[1]
2000	301	102	309	27.2	93.1	2.8	95.9	444
2001	246	86	351	49.7	86.4	4.2	90.6	414[1]
2002	270	90	355	49.4	95.9	4.4	100.3	453[1]

Sources: *Statistics of Hawaii Agriculture* (various issues); *The State of Hawaii Data Book* (various issues)
[1]Estimated by authors

Simulated impacts of sugar industry shutdown

Had the sugar industry been shut down in 2002, its total impact on Hawaii's economy would have been a loss of $264 million in output, $137 million in value added, $71 million in labor earnings, $9.4 million in state taxes, and 2,570 jobs (Table 2). For comparison, the entire economy in Hawaii generated a $46-billion gross state product (GSP or value added), $26 billion in labor earnings, and $3.6 billion in state taxes in 2002, and over 772,000 jobs in 2001.

The direct impacts would have amounted to a loss of $165 million in output, $67 million in value added, $44 million in labor earnings, $3.0 million in state taxes, and 1,453 jobs in the sugar industry (Table 2).

The indirect and induced impacts would have included a $99 million output loss, a $70 million loss in value added, $27 million lost in labor earnings, a $6.5 million tax loss, and 1,118 fewer jobs in the rest of the economy (Table 2).[3]

Table 2 also shows the separate impacts of sugarcane cultivation and sugar processing as two subsectors of the sugar industry. In general, the impacts from the

[3]The sectors most affected by the reduction of the sugar industry include real estate (land rental), wholesale trade, manufacturing (chemical and petroleum), electricity, transportation (water and trucking), and services (repairing, warehousing, insurance, banking, employment services, etc.).

Table 2: Simulated economic impacts of shutting down Hawaii's sugar industry (2002).

	Output (million $)	Value added (million $)	Employment (jobs)	Labor earnings (million $)	State taxes (million $)
Entire sugar industry					
Direct impacts	164.60	66.66	1453	44.12	2.99
Indirect and induced impacts	99.28	70.12	1118	27.33	6.45
Total impacts	263.88	136.78	2570	71.45	9.44
Sugarcane cultivation					
Direct impacts	64.30	43.81	1000	31.62	2.16
Indirect and induced impacts	63.94	39.16	527	12.98	3.58
Total impacts	128.24	82.97	1527	44.61	5.74
Sugar processing					
Direct impacts	100.30	22.85	453	12.49	0.83
Indirect and induced impacts	35.34	30.96	591	14.35	2.87
Total impacts	135.64	53.81	1044	26.84	3.70

Table 3: Simulated economic impacts of shutting down Hawaii's sugar industry (1997–2002).

Year	Output (million $)	Value added (million $)	Employment (jobs)	Labor earnings (million $)	State taxes (million $)
1997	349.16	181.07	3290	94.66	12.49
1998	352.25	182.92	3272	95.83	12.60
1999	348.07	180.84	3219	94.82	12.45
2000	253.03	131.27	2540	68.67	9.05
2001	238.08	123.36	2237	64.40	8.52
2002	263.88	136.78	2570	71.45	9.44

cultivation sector are greater than those from the processing sector.

To account for possible annual fluctuations in production and prices, we also simulated the impacts of completely shutting down the sugar industry in each year of the recent past, from 1997 to 2001 (Table 3). As expected, the estimated annual total economic impacts show a declining trend as a result of the continuing reduction in sugar production since 1997. The estimated loss in total output is estimated at $349 million in 1997, declining to a low of $238 million in 2001, and rebounding slightly to $264 million in 2002.

Conclusion

Hawaii's sugar industry remains a vital contributor of export income and rural employment to the state economy. For example, the sugar industry directly and indirectly generated 2,570 jobs in 2002, which amounts to 2.1 percent of the total employment on Kauai and Maui, where the remaining two sugar operations are located.

The sugar industry also has an aesthetic value, providing an open, green, agricultural landscape pleasing both to residents and to the millions of visitors who come to Hawaii annually and support our vitally important tourism industry. Also, many observers of Hawaii's resources believe that sugarcane cultivation can potentially benefit groundwater recharge, thus serving as an important contributor to Hawaii's water supply. Values such as these go beyond the traditional economic values as estimated in this analysis.

Appendix

The simulation is based on a 1997 input-output model of 131 sectors of the Hawaii economy.

We partition the 131-sector Leontief input-output model into

$$\begin{pmatrix} \mathbf{x}_i \\ \mathbf{x}_j \end{pmatrix} = \begin{pmatrix} \mathbf{A}_{ii} & \mathbf{A}_{ij} \\ \mathbf{A}_{ji} & \mathbf{A}_{jj} \end{pmatrix} \begin{pmatrix} \mathbf{x}_i \\ \mathbf{x}_j \end{pmatrix} + \begin{pmatrix} \mathbf{f}_i \\ \mathbf{f}_j \end{pmatrix}$$

where $\mathbf{x}_i$ (or $\mathbf{f}_i$) is a 2×1 vector with elements being the outputs (or final demands) of sugarcane cultivation and sugar processing, $\mathbf{x}_j$ (or $\mathbf{f}_j$) is a 129×1 vector with elements being other sectors' outputs (or final demands), and $\mathbf{A}_{ii}$, $\mathbf{A}_{ij}$, $\mathbf{A}_{ji}$, $\mathbf{A}_{jj}$ are partitioned components of the direct requirement matrix.

Based on this model, the backward-linkage impacts of a hypothetical sugar industry shutdown can be calculated by the formula $\Delta\mathbf{x}_j = (\mathbf{I} - \mathbf{A}_{jj})^{-1} \mathbf{A}_{ji} \Delta\mathbf{x}_i$, where $\Delta\mathbf{x}_i$ represents the (direct) output losses in the sugar industry, and $\Delta\mathbf{x}_j$ represents the (indirect) output losses in the rest of the economy.

With the estimated impacts on outputs, the impacts on other dimensions (e.g., value added, labor earnings, jobs, state taxes, etc.) can easily be calculated.

Assume that the structure of Hawaii's economy has not changed much from 1997 to 2002; then, the multipliers estimated from the 1997 input-output model can be used to estimate the indirect impacts of the shutdown of the sugar industry in each of the years from 1998 to 2002.

Acknowledgments

This document benefited greatly from the constructive comments and suggestions of Dr. Chauncey Ching, CTAHR, and Mr. Jack Roney, American Sugar Alliance. Responsibility for the final content rests with the authors.