

# THE ECONOMIC VIABILITY OF SUGAR PRODUCTION BASED ON SLAVE LABOR IN CUBA, 1859–1878\*

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During the two decades preceding the abolition law of 1880, Cuban sugar planters pursued two parallel goals. The first undertaking was a concerted effort to increase the efficiency of agricultural and industrial production. A sophisticated railroad network was constructed to the interior from the ports of Havana, Matanzas, Cárdenas, and Cienfuegos in the 1840s and 1850s. Railroads opened high-yielding virgin land in frontier regions to production, and in the 1860s and 1870s, planters attempted to further the transportation revolution by developing rail systems within their estates to carry cane from fields to mills.<sup>1</sup> Because the sucrose content of cane begins to drop immediately after the cane is cut, internal railway lines had the potential to revolutionize sugar production by moving cane quickly to the processing phase. Railroads also helped to resolve the recurring problem of roads washed out by heavy rains, which often precluded transporting harvested cane to mills for refining. In addition to revolutionizing transportation, planters also sought to raise industrial yields by installing modern milling equipment with greater processing capacity. The Jamaican trains of the early nineteenth century were replaced by vacuum-pan evaporators and centrifuges on the most modern mills by the 1860s and 1870s, a change that produced higher grades of sugar more efficiently.<sup>2</sup>

No comparable technological transformations emerged in the agricultural phase of sugar production, which remained land-extensive and labor-intensive. But with respect to cane cultivation, planters avidly pursued a second goal: the transformation of the labor basis of Cuban sugar production by diversifying their work forces away from dependence on slave labor. Attempts to transform labor were especially pronounced from the late 1860s on, when a number of factors heralded the end of slavery. African imports had virtually ceased; the spectre of

\*I would like to thank the John Simon Guggenheim Memorial Foundation and the Latin American and Caribbean Program of the Social Science Research Council for financial support to conduct the research for this article. I also want to thank Rebecca Scott, Stanley Engerman, and three anonymous *LARR* readers for their comments on an earlier draft.

large-scale slave desertions was raised by the deepening insurrection in eastern Cuba; and the process of legal abolition was initiated in 1870 when Spain enacted the Moret Law, which freed all children born to slave women after 1868 and all slaves reaching sixty years of age.

Despite their efforts to broaden plantation labor forces, planters were largely unsuccessful in this regard. Cuban sugar production remained nearly as dependent on slave labor in the 1870s as it had been in the 1850s or 1860s. In 1877, for example, slaves accounted for over 70 percent of all workers on *ingenios* in Cuba's main sugar-producing regions, which were located in the province of Matanzas.<sup>3</sup> Thus while manufacturing and transportation were being modernized at considerable cost, traditional methods and forms of organizing labor persisted in the labor-intensive agricultural phase of sugar production.

A series of questions central to modern nineteenth-century Cuban historiography have been generated by this seeming paradox. Did continued planter reliance on slaves make sugar production less profitable and lead directly to the crisis of the 1880s when manufacturing was centralized and production was structurally subdivided into cane production and sugar processing?<sup>4</sup> Was abolition a response to internal contradictions in the industry that revolved around the persistence of slavery in an epoch of costly technological innovation?<sup>5</sup> Was abolition the mechanism that sugar planters used to reduce labor costs by creating a free labor market that would lead to greater productivity and higher profits?<sup>6</sup>

Although planters sought to diversify plantation labor forces and finally recognized that abolition was inevitable, their efforts did not necessarily result from the decreasing economic viability of slave labor. Planters may have reacted to predominantly exogenous factors, such as the externally imposed end of the slave trade and Spain's intent to abolish servitude. But even though some progressive planters were opposed to slavery on humanitarian grounds and small-scale inefficient operations had difficulty meeting labor needs because of high slave prices in the late 1850s and 1860s, sugar production based on slave labor nevertheless remained extremely lucrative.

This article will examine the economic viability of slave labor in the sugar-producing jurisdictions of Matanzas between 1859 and 1878. It will show that planter efforts to increase efficiency resulted in improved economic yields per laborer during the 1860s and 1870s. As a result, slave labor was becoming more economically viable to plantation owners and more advantageous than free labor. Economic variables currently available for the sugar sector in this period do not indicate any compelling need for Matanzas planters to abandon slavery as a labor system in the 1860s or 1870s. On the contrary, modernization in processing and transportation made slave labor more efficient and higher-

yielding in terms of income produced per slave. The economic viability of slave labor was related to two key factors that determined planter income and labor expenses: the price of sugar and the price of slaves. The price structures of both acted to sustain a slave-sugar complex that continued to expand dynamically through the end of the Ten Years' War.

#### SOURCES, DATA, AND METHODS

This study is based on manuscript farm census returns for the jurisdiction of Colón for 1859, 1865, and 1876 and of Cárdenas for 1867 and 1875, as well as on the sugar estate census of 1877–78 for the entire province of Matanzas, which was published in the *Revista Económica*.<sup>7</sup> Standard information was recorded in each census. All list the area of individual plantations in *caballerías* (one *caballería* equals 33.6 acres), the number of slaves, and the gross income by farm. The Colón census of 1859 also notes the number of rented slaves and Chinese contract laborers on each farm, figures that allow calculation of the total work force. In addition to the data on farm size, the 1876 Colón census lists slave population, total income, and the number of *caballerías* of land cultivated in sugarcane.

The 1867 and 1875 Cárdenas data also indicate the extent of land planted in cane as well as the standard data, and the 1875 material notes the different components of plantation labor forces. The 1877–78 data are the most complete and are available for all of the jurisdictions of the province of Matanzas: Colón, Cárdenas, Matanzas, Alacranes, and Jovellanos. Plantation workers are disaggregated into different categories; cultivated acreage is indicated; and net income is noted by estimating the costs of *refacción* contracts, or plantation credit and supply expenses, and then deducting them from gross income (see table 1).<sup>8</sup>

The most important indicator of the economic viability of slave labor is the amount of income generated per slave. Two variables were used to calculate these data: gross income, or net income when available, divided by the total number of workers. Because available data do not permit estimates of the relative income productivity of different types of workers by occupations within estates, the calculations presented here examine the total income productivity of all workers. Thus for purposes of this study, income per worker equals income per slave. Although differences may have existed among categories of workers, no documentary materials exist that would permit analysis of income productivity by type of worker or by task.

It was important to determine whether data on gross income were recorded in constant values or current values reflecting inflation. This problem is critical because inflation ran rampant in the 1870s. The

TABLE 1 Variables Included in Source Material

Variable	Colón	Colón	Colón	Cárdenas	Cárdenas	Matanzas Sugar Estates
	1859	1865	1876	1867	1875	1877–78
Farm size	X	X	X	X	X	X
Land in cane			X	X	X	X
Slaves	X	X	X	X	X	X
Rented slaves	X					X
Free workers					X	X
Chinese contract laborers	X				X	X
Gross income	X	X	X	X	X	X
Net income						X

Banco Español de la Habana was directed by colonial authorities to print enormous quantities of paper money during the Ten Years' War to finance the Spanish military effort to defeat the rebellion.<sup>9</sup> During this period, planters and merchants strove to retain fiscal control over their accounts by noting whether transactions took place in inflated *billetes* (paper money) or in gold, which denoted real values. Thus legal contracts recorded in the notarial protocols of the 1870s usually referred to the type of currency.

None of the documents on which this article is based indicates whether income values were in paper or gold. But the data clearly show that gross income figures were not listed in inflated paper currency and can therefore be used with confidence to estimate real income. This was determined by examining the number of producing ingenios and comparing them with gross income. In Colón, for example, total income for all 125 sugar ingenios in 1859 was 7,692,883 pesos. In 1876, when inflation peaked, income from the 117 sugar mills totaled 7,616,361 pesos. That is to say, the average gross income per plantation had hardly changed.

To verify that inflation was not a factor in the income data, sugar prices must also be examined because planter income was determined by the level of sugar prices. The most notable aspect of sugar prices between 1859 and 1878 was their long-term stability. Short-term fluctuations occurred, to be sure. But in 1859, best-grade white sugars were marketed for seven cents per pound in Matanzas, while *quebrados* were sold for six cents per pound. In 1876 white sugars brought seven and a half cents per pound, and quebrados were quoted at six and a quarter cents per pound.<sup>10</sup> Thus income did not fluctuate in either year because of price changes. If inflation was a factor, a radical change in income

would be expected between 1859 and 1876, and because no change occurred, it is assumed here that income data reflected relatively constant prices. The 1877–78 data for Colón confirm the accuracy of this observation. Income was only slightly higher (7,863,017 pesos) than in 1876.

The Cárdenas data reinforce the finding that inflation was not a factor in determining the income recorded in the documentary sources used here. In 1867, prior to the outbreak of the insurrection, the sugar sector (142 ingenios) generated 8,036,190 pesos. By 1875, after inflation rates had soared, 150 Cárdenas mills produced less value, a total of 7,053,459 pesos. Again, if inflation was a factor in gross income data, much higher figures would have been likely. It can therefore be concluded that because local sugar prices were tied to prices on international markets, they did not reflect an inflationary process specific to Spain and Cuba due to monetary policies adopted during the Ten Years' War. It is certain, then, that sugar prices were quoted in gold, which did not reflect the inflation of paper money.

Because slaves were not the exclusive source of labor on Cuban sugar estates in the 1860s and 1870s, it was important to this study to determine the ratio of slaves to the total work force. To calculate income per slave, gross or net income must be divided by the total number of laborers, not the total number of slaves. The 1859 data for Colón plantations noted all categories of workers, and 81 percent were slaves.<sup>11</sup>

But the 1865 Colón census listed only the number of slaves, revealing a 1.5 percent decline from 1859 (425 fewer slaves). Because the number of slaves remained relatively constant between 1859 and 1865 and no factors existed that would have substantially increased the number of nonslave workers, slaves were estimated to comprise 81 percent of the sugar plantation work force in 1865. Accordingly, total workers were ascertained by dividing the number of slaves by .81, then the result was divided into gross income to determine income per worker.

The 1876 data for Colón also noted only the number of slaves on each estate. By this date, new factors had decisively reduced the ratio of slaves to total workers. The slave trade had been curbed, and the legal abolition process had begun in 1870. Slaves on ingenios in Colón declined from 22,534 in 1865 to 14,532 in 1876. To determine the total work force on sugar plantations in 1876, the 1877–78 sugar census data were examined. At that time, 69.3 percent of workers on Colón estates were slaves, and it is assumed here that approximately the same percentage was valid for 1876. To determine the total work force in 1876, the number of slaves was therefore divided by .69. The result, total workers, was divided into the gross income to calculate income per worker.

The Cárdenas data for 1867 also only listed slaves. To calculate total workers, I assumed that slaves would have comprised a percent-

TABLE 2 *Income per Worker in Colón, 1859–1876, by Partido (in Pesos)*

<i>Partido</i>	Gross Income 1859	Gross Income 1865	Gross Income 1876	Gross Income 1878	Net Income 1878
Jiquimas	337	354		340	129
Macuriges	250	249	302	339	122
Hanabana	104	580	779	423	148
Macagua	254	293	348	387	135
Palmilla	228	347	434	396	138
Cabecera			288	165	58
Colón average	275	310	362	369	130

age of total workers similar to that in Colón in 1865, or 81 percent. Cárdenas is contiguous to Colón, shares the same ecological characteristics, and its patterns of economic development were similar in the mid-nineteenth century. Boundaries were fixed for administrative purposes and thus do not reflect economic differences. Total workers for Cárdenas in 1867 were derived by dividing the number of slaves by .81 and dividing the result into gross income to determine income per worker. The 1875 Cárdenas data include different categories of workers, with slaves accounting for 74.9 percent of all laborers on ingenios.

The 1877–78 data for the entire province of Matanzas subdivides the sugar plantation work force into its components. This subdivision allows a fairly accurate calculation of slaves as a percentage of all workers and of income per slave. Some 69.3 percent of the work force was enslaved in Colón; 71.0 percent in Cárdenas; 67.6 percent in Alacranes; 83.5 percent in Matanzas; and 68.0 percent in Jovellanos. These figures yield an average of 72.2 percent for the entire province of Matanzas.<sup>12</sup>

Because several assumptions had to be made to determine the total work force for some years, an unquantifiable margin of error exists in calculating income per worker. But even if an arbitrary margin of error as high as plus or minus 10 percent is used, it would not detract from the fundamental analyses outlined below.

#### SLAVE INCOME PRODUCTIVITY

Several factors indicate that planter efforts to increase efficiency by investing in sophisticated transportation and milling technology were successful. One indicator is the decreasing number of workers utilized for each cultivated caballería of sugarcane. The 1867 data for Cárdenas reveal that planters utilized 9.0 workers per caballería of cane.

TABLE 3 *Income per Worker in Cárdenas, 1867–1878, by Partido (in Pesos)*

<i>Partido</i>	<i>Gross Income 1867</i>	<i>Gross Income 1875</i>	<i>Gross Income 1878</i>	<i>Net Income 1878</i>
Camarioca	300	318	279	128
Cimarrones	337	322	337	147
Guamutas	377	414	332	146
Guanajayabo	447	386	300	126
Lagunillas	255	249	202	82
Rastro de la Villa		258		
Cárdenas average	349	354	313	133

By 1875 this figure had decreased a significant 17.8 percent to an average of 7.4 workers per cultivated *caballería*.

Although no comparable data exist for Colón in the 1850s or 1860s, in 1876 Colón's ingenios utilized 6.7 workers per *caballería* of cane. The 1877–78 data confirm the accuracy of the data for Cárdenas and Colón in the mid-1870s. Colón's 116 ingenios utilized 6.8 workers per cultivated *caballería*, and the 154 Cárdenas estates utilized 7.0 workers. The entire province of Matanzas (516 ingenios) employed 7.0 workers per cultivated *caballería* of cane.<sup>13</sup>

The second variable, gross income per worker, is an even more persuasive indicator of greater efficiency. In Colón each plantation worker generated an average gross income of 275 pesos in 1859, 310 pesos in 1865, 362 pesos in 1876, and 369 pesos in 1878. This sequence represents a 34.0 percent increase in income per worker between 1859 and 1878.<sup>14</sup>

Comparable data for Cárdenas confirm the probable accuracy of the Colón data for 1865, 1876, and 1878. Each worker on a Cárdenas sugar plantation produced an average of 349 pesos of gross income in 1867, 354 pesos in 1875, and 313 pesos in 1878. Differences existed between the two jurisdictions, however. The increase in the average income per worker in Colón between 1865 and 1876 was 16.8 percent, while in Cárdenas between 1867 and 1875, the increase was a mere 1.3 percent. In addition, income per worker increased in Colón between 1876 and 1878 (2.0 percent) while it fell in Cárdenas 11.7 percent between 1875 and 1878. Although the precise reasons for these differences are not known, Colón was a newer area of sugar plantation development and its soils may therefore have produced higher yields of cane. But the comparative similarities in income per worker for both jurisdictions, which were derived from documentary sources generated by authorities who were administratively independent from one another, confirm the probable reliability of these data (see tables 2 and 3 above).

To arrive at crude estimates of the economic viability of slave labor, slave prices must be compared with the income generated per slave. Estimates of slave prices in Cuba in the 1850s and 1860s vary considerably. A table of slave values was compiled by José María Morales's slave insurance company, La Protectora, for 1855.<sup>15</sup> The most expensive slave was a thirty-year-old male valued at 690 pesos, although his value decreased to 655 pesos if he worked on a sugar ingenio. This figure seems fairly accurate when compared with the value of 668 pesos for prime-age creole males found by Manuel Moreno Fraginals, Herbert Klein, and Stanley Engerman, a value based on sugar plantation assessments in 1856.<sup>16</sup> The 690-peso value is also in line with the 661.5 pesos estimated for male prime-age *bozales* between 1851 and 1855, a calculation that David Eltis based on British Foreign Office reports.<sup>17</sup>

Estimates of slave prices for the late 1850s and early 1860s are extremely contradictory, however. Moreno Fraginals, Klein, and Engerman found that prime-age creole males on Cuban plantations were assessed at 1,271 pesos in 1859, 1,163 pesos in 1861, and 914 pesos in 1863. Eltis estimated the average value of prime-age *bozales* to be 1,018 pesos between 1856 and 1860. But he found a considerable decline to 681 pesos between 1861 and 1865, in marked contrast to the levels found by Moreno Fraginals, Klein, and Engerman. Neither of these two studies provides any estimates on slave prices for the late 1860s or early 1870s.

The estimates on slave prices used in this article are based on actual transactions in the slave markets of Matanzas and Colón. Significantly lower values were found in the period between 1860 and 1863. The most expensive slaves in 1860 were prime-age creole males sold in Matanzas at an average price of 775 pesos, 39 percent lower than the 1,271 pesos for 1859 noted by Moreno Fraginals, Klein, and Engerman. For 1863, prime-age male slaves in Colón were sold for average prices of 698 pesos, 23.6 percent lower than the estimate of 914 pesos by Moreno Fraginals, Klein, and Engerman. The structure of prices on the Colón slave market in 1863 and 1864 approximates the average price of 681 pesos for prime-age male *bozales* noted by Eltis for the period between 1861 and 1865.

Until a broader data base is generated on slave prices based on actual marketplace transactions, the precise level of slave prices cannot be ascertained. But the prices utilized here for the early 1860s are probably more reliable as indicators of the actual price structure for slaves than the data presented by Moreno Fraginals, Klein, and Engerman. There are a number of reasons why plantation assessments may have been artificially inflated by planters. One was the practice of most large plantations of carrying insurance policies on their slave labor forces. It

was consequently in the planters' interest to inflate values for possible claims when slaves died. Although the slave insurance company La Protectora published slave assessments in the mid-1850s, no subsequent assessment lists have yet been discovered in Cuban archival collections that could be used to confirm planter assessments.

A second reason for planters to inflate assessment values of slave *dotaciones* was the spectre of abolition and the hope for possible indemnification. A third reason was related to the quest for working capital through loans linked to the value of assets. Planters commonly used their slaves as collateral to secure loans, and it was thus in their interest to inflate assets in order to secure ample amounts of working capital from merchants.

A final reason had to do with planter concepts of "worth" and their own self-serving images of wealth. Planters may have collectively viewed their slaves as worth a certain amount of value for a variety of reasons. Ultimately, however, "worth" can only be objectively gauged by examining the marketplace. An individual slave was really only worth what he or she could be sold for in the Cuban slave markets.

Although the sample of sales I have used is relatively small (541 transactions involving prime-age slaves), it is broad enough to raise significant questions about the average assessment values presented by Moreno Fragnals, Klein, and Engerman. In addition, average slave prices found in the Matanzas and Colón slave markets for prime-age slaves were close to those found in 1856 by Moreno Fragnals, Klein, and Engerman as well as those estimated by Eltis for the period from 1861 to 1865.

Tables 4 and 5 indicate the average prices for prime-age slaves (ages fifteen through forty) from a sample of slaves sold in Colón between 1863 and 1878 and in Matanzas from 1860 through 1875.<sup>18</sup> Price trends differed in each region, probably because a large number of Matanzas slaves were employed in urban or other operations outside the sugar sector. In Colón over 90 percent of all slaves were employed on ingenios from the late 1860s through the 1870s. Slave prices in Colón rose through the 1860s, peaked in 1870 (the year the Moret Law was promulgated), remained at a high plateau until 1872, and dropped precipitously from 1872 to 1878 as final abolition approached. The trend in more urbanized Matanzas differed. Prices peaked for creole males in 1860, declined until 1870, then rose slightly until 1875.

Although precise chronological intersections between information on income per worker and slave prices are rare (see tables 2 and 3), the years for which data are available are close enough to arrive at some calculations. In 1859 the average income per worker on Colón ingenios was 275 pesos. The highest average price for a prime-age slave in 1860

TABLE 4 Average Prices of Prime-Age Slaves (between ages 15 and 40) in Colón, 1863–1878 (in Pesos)

Category	1863	1864	1867	1870	1872	1875	1876	1878
Creole males	698	628	714	737	737	440	390	384
Creole females	653	662	692	738	634	380	359	272
African males	557	533	653	638	837	400	300	250
African females	520		850	550	700			

Note: The number of transactions involved for each year was: 39 in 1863, 58 in 1864, 103 in 1867, 47 in 1870, 69 in 1872, 32 in 1875, 15 in 1876, and 15 in 1878.

was 775 pesos on the Matanzas slave market. If each worker produced 275 pesos in gross income, the labor of a newly purchased slave would pay for himself or herself in 2.8 years.

By the fourth *zafra*, the cost of slave labor would involve only maintenance and depreciation expenses. The average working life of each slave is unknown, but if one conservatively estimates five years of labor per slave at constant income per worker, slaves would have generated 1.8 times their purchase price in gross income after five harvests in the 1860s.

It is probable that by the 1860s, the average number of years of labor per slave exceeded five years, although there are no reliable studies estimating the average productive life of Cuban slaves. But each additional year beyond five in the extremely cautious formula offered above translates into greater rates of return over the productive life of an individual slave.

The above estimates are extraordinarily conservative. In reality, income per slave increased over time, and the years of labor may have been as high as fifteen or twenty years.<sup>19</sup> Such increases mean that far greater income would have been produced over the life of a slave purchased in 1860 if he or she continued working through 1875, when more than 350 pesos were produced by each slave on Colón and Cárdenas sugar plantations.

Even when average prices for prime-age slaves peaked in Colón in 1870, the increased income per slave meant that purchase prices were recouped in a relatively short period of time. It can be estimated that Colón sugar ingenios produced 333 pesos per worker in 1870.<sup>20</sup> The most expensive prime-age slaves sold at an average price of 738 pesos in 1870. According to these data, planters would have recovered their purchase prices in 2.2 years, and after 5 years of labor, slaves would have generated more than double their purchase prices. Maintenance costs must be deducted from all years to arrive at accurate estimates of annual income per slave, but each additional year after the

TABLE 5 *Average Prices of Prime-Age Slaves (between ages 15 and 40) in Matanzas, 1860–1875 (in Pesos)*

<i>Category</i>	1860	1865	1870	1875
Creole males	775	706	517	547
Creole females	759	708	499	200
African males	500	641	677	263
African females	725	475	500	308

Note: The number of transactions involved for each year was: 19 in 1860, 49 in 1865, 75 in 1870, and 20 in 1875.

first 2.2 years translated into greater income over the productive life of a slave.

By 1876, when the cost of slave labor had collapsed because of the imminent end of slavery, each newly purchased slave generated the income to pay for himself or herself in 1.1 years. Slaves produced 362 pesos per year income, and the most expensive average price for a prime-age slave was 390 pesos.<sup>21</sup>

Up to this point, the economic dynamics of slavery have been considered only for average ingenios. When one examines the most productive capital-intensive mills (those with incomes over 100,000 pesos) and compares them with estates with gross incomes less than 100,000 pesos, one finds that the economics of slavery were even more favorable in terms of income yields per worker. For example, in 1859 Colón mills having less than 100,000 pesos in gross income produced 235 pesos per worker. But on the twenty estates that generated over 100,000 pesos in gross revenues, income per worker was 363 pesos, or 54.1 percent greater than the smaller mills. In 1865 Colón's twenty-six mills with incomes greater than 100,000 pesos produced 45 percent more income per worker than the smaller mills, 28.9 percent more in 1876, and 31.2 percent more in 1878. These data are summarized in table 6.

The Cárdenas data confirm the tendency of larger estates to produce more efficiently in terms of income per worker. In 1867, while Cárdenas mills with less than 100,000 pesos in gross income produced 291 pesos per worker, ingenios with gross incomes over 100,000 pesos earned 430 pesos per worker, or 47.9 percent more. The 1875 data provide the greatest contrast of all: the mills grossing more than 100,000 pesos earned 107 percent more in income per worker than smaller mills. Data on Cárdenas incomes are summarized in table 7.<sup>22</sup>

This information is striking because it indicates that the utilization of more sophisticated technology at ingenios, which was the case in all mills earning large incomes, led to greater levels of economic

TABLE 6 Comparison of Gross Income per Worker on Larger and Smaller Sugar Mills in Colón, 1859–1878

Year	Number of Ingenios	Gross Income per Worker (GI/W) (in pesos)
1859		
Less than 100,000 pesos	101	235.4
More than 100,000 pesos	20	362.8
(% difference in GI/W)		(54.1)
1865		
Less than 100,000 pesos	91	257.8
More than 100,000 pesos	26	373.8
(% difference in GI/W)		(45.0)
1876		
Less than 100,000 pesos	92	322.9
More than 100,000 pesos	20	416.2
(% difference in GI/W)		(28.9)
1878		
Less than 100,000 pesos	52	320.5
More than 100,000 pesos	18	420.4
(% difference in GI/W)		(31.2)

Note: In order not to distort these data, only mills that had information on the number of slaves were utilized for this table. If the 1878 data on Colón are compared with the 1876 data, there appears to be a drop in the total number of ingenios. This decrease is illusory: data on the labor force were missing for 1878 for a large number of mills, and they were therefore not included in these calculations.

output per worker. Rather than making slave labor less viable, the exact opposite was true, at least at the prices for sugar and slaves prevailing in local markets in the 1860s and 1870s. Consequently, the conclusion that the progressive adoption of advanced transportation and processing technology led to the economic obsolescence of slave labor is not supported by the evidence presented here.

A number of factors make it difficult to compare the economic viability of salaried labor on sugar ingenios with slave labor. The most important factor is the absence of data on the average productive work life of slave populations. Another is the number of workers needed throughout the year. By the 1860s and 1870s, the Cuban sugar harvest was completed in six or seven months on most estates, from December through June. A labor force at full strength was needed during the *zafra*, but an undetermined number of workers also had to be employed throughout the year for such tasks as weeding, replanting, clearing new land, repairs on machinery and structures, and stockpiling timber reserves.

TABLE 7 Comparison of Gross Income per Worker on Larger and Smaller Sugar Mills in Cárdenas, 1859–1878

Year	Number of Ingenios	Gross Income per Worker (GI/W) (in pesos)
1867		
Less than 100,000 pesos	110	291.1
More than 100,000 pesos	19	430.4
(% difference in GI/W)		(47.9)
1875		
Less than 100,000 pesos	125	285.2
More than 100,000 pesos	12	590.3
(% difference in GI/W)		(107.0)
1878		
Less than 100,000 pesos	127	269.4
More than 100,000 pesos	12	418.0
(% difference in GI/W)		(55.2)

In the late 1860s and early 1870s, the standard wage rate for unskilled labor was 25 pesos per month. Additionally, slaves could be hired for 17 pesos per month, but maintenance costs were assumed by renters, which probably raised the labor costs of rented slaves to 25 pesos per month.<sup>23</sup> Accordingly, the cost of one worker for seven months was 175 pesos in the 1860s and 1870s. The available evidence suggests that salaries did not rise even though income per worker clearly increased through this period.

Examining the peak year of slave costs in Colón—1870, when the highest average price of a prime-age slave was 738 pesos—a slave would have had to work for 4.2 seven-month harvests to make the cost of a free worker over 4.2 seven-month harvests equal to the cost of a slave. Other unknown factors must be added to this equation. One is the cost of slave maintenance, which cannot be estimated precisely. But these costs were offset in this comparative example by the fact that masters derived twelve months of labor from slaves, not seven. Thus the estimate of 4.2 years of labor from a slave purchased for 738 pesos as the point of comparable costs for slave versus salaried labor is an extremely conservative estimate. Any labor derived by masters beyond the 4.2 seven-month harvests would imply an economic advantage of slave labor over free labor.

If the actual twelve months of labor extracted from each slave are substituted for the seven-month harvest, economic calculations change decisively. One year of salaried labor at 25 pesos per month would

mean the same cost to planters purchasing slaves at 738 pesos after 2.5 years of slave labor. After 2.5 years, the economic benefits of slave over salaried labor would begin to accrue.

Only the peak year in slave prices has been considered for the most expensive slaves. Prices for prime-age slaves fluctuated while salary rates did not in the 1860s and 1870s. These facts mean that the economic break-even point between slave and free labor was much shorter when slave prices were lower.

This evidence suggests that slave labor continued to have an economic advantage over free labor, even toward the end of Cuban slavery, and this advantage explains why planters were willing to underwrite the comparatively high costs of slave labor even after legal abolition had begun in 1870. Investments in slaves offered other advantages as well. The relative reliability of labor was one plus. Planters had no guarantee that a free worker would work over the entire course of the seven-month harvest, but coercion assured no alternative for most slaves. Slaves could also be used for collateral to obtain credit and could generate substantial income if rented. Free labor offered none of these possibilities.

## CONCLUSION

Two separate methods have been used to examine the economic viability of sugar production based on slave labor in Cuba during the 1860s and 1870s. The first method has been to study income yields per worker on sugar plantations and to compare them with prevailing slave prices. Between 1859 and 1878, the average income produced by each worker on all sugar estates rose considerably. Even more impressive was the comparatively greater efficiency found on the highest income-producing plantations (those producing more than 100,000 pesos in gross annual income). When income per worker is compared with the highest average prices for prime-age slaves, the time frame over which a slave's labor would pay for himself or herself was less than five years on average mills, and considerably less on the largest plantations.

The second method has been to compare the cost of slaves with the cost of salaried labor. Irrespective of income per worker, sugar estates had minimal labor requirements to be met if they were to remain in business. The estimate of 25 pesos per month as prevailing wages for unskilled labor in the 1860s and 1870s seems reliable. By comparing this rate with the cost of slave labor at its peak, free and slave labor would have had identical costs after two to three years. Although the average productive working life of a slave on Cuban sugar plantations is not known, any labor derived beyond three years meant an economic advantage of slave labor over free wage labor.

These data challenge the conclusion that abolition in Cuba resulted from slavery's increasing economic inefficiency or lack of viability. No empirical evidence exists to support the position that slavery collapsed under the weight of its own economic obsolescence. In fact, with the prevailing prices of sugar and slaves in the 1860s and 1870s, slave labor became more economically viable. Improvements in processing and transportation technology applied to the sugar sector were responsible for making slave labor more efficient in terms of the income produced by each slave.

According to the data presented here, abolition made little sense for planters in the 1870s or early 1880s from a strictly economic point of view. Abolition seems to have resulted instead from a series of non-economic factors. The slave trade had been abolished almost exclusively because of external pressures, and there is little evidence that many planters welcomed the enforced end of the *trata* (slave trade). The Moret Law had been imposed by Spain in 1870 largely in response to the political crisis posed by the insurrection in Cuba, which had freed slaves fighting with revolutionary forces. Although the Ten Years' War may have altered the political framework of the debate over slavery in Cuba from 1868 on, in reality, the insurrection had little economic impact on the central sugar-producing regions of Matanzas, which were based on slave labor.<sup>24</sup>

Had slave imports been permitted through the 1870s and into the early 1880s, sugar production probably would have continued to flourish on the foundation of slave labor. But by the late 1880s and early 1890s, slave labor would have become economically untenable due to the substantial decline in sugar prices on international markets, which would have radically reduced the income generated by each slave. During the harvest of 1883, planters received up to 9 cents per pound for top-grade white sugar, which certainly softened the blow of ongoing abolition after the 1880 law established the *patronato*.

But during the harvest of 1884, as the economies of the North Atlantic consuming markets contracted, sugar prices began to fall. By September 1884, best-grade white sugar had declined to 6.75 cents per pound; and although prices stabilized at 4.5 to 5.5 cents per pound through 1889, by the harvest of 1890, Cuban sugar producers received a top price of 2.88 cents per pound. By 1895, on the eve of the War for Independence, sugar prices had fallen to 1.82 cents per pound for best-grade centrifuge sugar.<sup>25</sup> Thus the correlation between insurrection and the fall in sugar prices should be noted. Had slavery persisted, it might indeed have collapsed because of the lack of economic viability by the early 1890s, due to reduced planter income. Such a situation, however, was not the case during the 1860s, 1870s, or early 1880s.

NOTES

1. On Cuban railroads, see Gert J. Oostindie, "La burguesía cubana y sus caminos de hierro, 1830–1868," *Boletín de Estudios Latinoamericanos y del Caribe* 37 (Dec. 1984):99–115; Levi Marrero, *Cuba: economía y sociedad* (Madrid: Editorial Playor, 1984), 11:139–213; Patria Cok Márquez, "La introducción de los ferrocarriles portátiles en la industria azucarera, 1870–1880," *Santiago* 4 (Mar. 1981):137–47; and Oscar Zanetti and Alejandro García, *Caminos para el azúcar* (Havana: Editorial de Ciencias Sociales, 1987). On the labor problems encountered by Cuban railroad builders, see Oscar Zanetti Lecuono, "Esclavitud i treball lliure: el problema laboral dels ferrocarrils cubans, 1837–1867," *L'Avenc*, no. 101 (Jan. 1987):17–23. I want to thank Rebecca Scott for calling my attention to this article.
2. For a listing of all Cuban sugar ingenios and the technology they employed in 1859, see Carlos Rebello, *Estados relativos a la producción azucarera de la Isla de Cuba, formados competentemente y con autorización de la Intendencia de Ejército y Hacienda* (Havana: n.p., 1860).
3. This figure was derived from the data on Matanzas sugar ingenios listed in the sugar plantation census conducted in 1877. See "Noticia de las fincas azucareras en producción que existían en toda la isla de Cuba al comenzar el presupuesto de 1877–78," *Revista Económica*, 7 June 1878, pp. 7–24. My article focuses on the most important sugar-producing regions of Cuba located in Matanzas province. Almost all of Cuba's great nineteenth-century mills were located in the zones considered here. The economic dynamics of sugar production in Matanzas do not apply to the less capital-intensive areas of marginal sugar output in eastern Cuba. But this inapplicability does not detract from the arguments outlined here because Matanzas was the center of Cuba's nineteenth-century slave-sugar complex.
4. In the aftermath of the Ten Years' War and final abolition of slavery, Cuban sugar production was substantially reorganized. The central factories that emerged specialized in processing. Cane was largely provided by *colonos*, who specialized in growing cane. The Cuban *colonato* was highly stratified into small-scale minifundia, medium-sized properties, and large plantations. On the *colonato*, see the classic study by Ramiro Guerra y Sánchez, *Azúcar y población en las Antillas* (Havana: Editorial de Ciencias Sociales, 1976 edition).
5. This argument has been advanced by the distinguished Cuban historian Manuel Moreno Fraginals, who emphasizes it in *El ingenio: complejo económico social cubano del azúcar* (Havana: Editorial de Ciencias Sociales, 1978), 3 vols. He also makes the argument in an article, "El esclavo y la mecanización de los ingenios," *Bohemia*, 13 June 1969; and in two chapters of his *La historia como arma y otros estudios sobre esclavos ingenios y plantaciones* (Barcelona: Editorial Crítica, 1983): "Abolición o disintegración?," 50–55; and "Plantaciones en el Caribe: el caso Cuba–Puerto Rico–Santo Domingo (1860–1940)," 56–117. Fe Iglesias García varies her interpretation but stresses the incompatibility of slave labor with technological modernization of refining in several works: "The Development of Capitalism in Cuban Sugar Production, 1860–1900," in *Between Slavery and Free Labor: The Spanish-Speaking Caribbean in the Nineteenth Century*, edited by Manuel Moreno Fraginals, Frank Moya Pons, and Stanley Engerman (Baltimore: Johns Hopkins University Press, 1985), 54–76; "Formación del capitalismo en la producción de azúcar en Cuba (1860–1900)," manuscript; and "Changes in Cane Cultivation in Cuba, 1860–1900," paper presented to the Symposium on Caribbean Economic History, University of the West Indies, Jamaica, 7–8 Nov. 1986 (forthcoming in *Social and Economic Studies*). Rebecca Scott skillfully challenges this interpretation by examining the abolition process from a regional perspective within Cuba. See her *Slave Emancipation in Cuba: The Transition to Free Labor, 1860–1899* (Princeton: Princeton University Press, 1985). The persistence of slavery in the areas of intense sugar production after abolition began in 1870 is emphasized.
6. The use of the term *productivity* in this article refers to the income produced by each plantation. The documentary material utilized does not differentiate between agricultural and industrial sectors; no distinctions are made between output produced by slave, Chinese, or free labor, nor is productive output by task indicated. Al-

- though it would have been ideal to have access to these kinds of data, their nonexistence means that productive units must be considered as totalities, rather than according to their components. These factors do not compromise the conclusions of this article for reasons outlined in the text and subsequent notes.
7. The data for this article are contained in the following sources: for Colón, Archivo Nacional de Cuba (hereafter ANC), *Miscelánea de Expedientes* (hereafter ME), legajo 4120, no. M, "Repartos municipales de la jurisdicción de Colón, 1859"; ANC, Gobierno General, legajo 405, no. 19209, "Padrón de fincas rústicas de la jurisdicción de Colón, 1865"; ANC, Gobierno General, legajo 270, no. 13563, "Padrón general de fincas rústicas de este distrito, año de 1875 a 1876." The data for Cárdenas are in ANC, Gobierno General, legajo 945, no. 16724, "Padrón general de la riqueza rústica para regir en los años económicos de 1866 a 1867"; ANC, Gobierno General, legajo 269, no. 13554, "Jurisdicción de Cárdenas. Padrón general de la riqueza rústica de esta ciudad y su jurisdicción formado para los años económicos de 1875 a 1876." The 1877–78 sugar census is found in "Noticias de las fincas azucareras en producción que existían en toda la isla de Cuba al comenzar el presupuesto de 1877–78," *Revista Económica*, 7 June 1878, pp. 7–24. Unless otherwise indicated, all of the data and statistical tables presented in this article were derived from these sources.
  8. Refacción contracts were the main means used by planters to secure credit and supplies for their plantations at harvest time. They were also the legal mechanism that tied planters to particular merchants for marketing sugar and molasses. These contracts stipulated several important points. First, merchants would supply the capital and supplies needed to maintain the ingenio. This amount would include salary disbursements to free workers, capital to purchase slaves if needed, food and clothing for the slave population, capital for the medical maintenance of the slave population, all kinds of supplies (from containers to hold processed sugar to the most elementary items such as nails and lumber), and transportation services to move sugar from plantation to port or capital to pay for transportation. Second, planters usually mortgaged some or all of their harvests to the merchant granting the refacción contract. Planters were forbidden to market their products to other merchant houses but were usually paid the current price in the port at the time of delivery. Warehousing fees, commissions on marketing, and transportation costs were deducted at this time. The terms of these contracts are important to take into consideration, especially when the 1877–78 census is examined. This document listed refacción contract expenses for each plantation. Usually, 65 percent of gross income was deducted for refacción costs to determine net income, although in some cases 50 or 60 percent was deducted. The importance of this procedure is that slave maintenance costs were thus deducted from gross income, allowing this variable to be factored into the formula to determine net income per slave for 1877–78.
  9. On inflation in the 1870s, see Fe Iglesias García, "Azúcar y crédito durante la segunda mitad del siglo xix en Cuba," *Santiago* 52 (1983):119–44.
  10. For sugar prices in the middle of the 1859 *zafra*, see Biblioteca Gener y del Monte, Matanzas, *Aurora del Yumuri*, 23 Mar. 1859; and for 1878, see Biblioteca Nacional José Martí, *Gaceta de la Habana*, 1 May 1878. Evidence that local sugar prices were quoted in gold, rather than in paper money, is contained in the invoices sent to U.S. importers of Cuban sugar. See, for example, New York Public Library, Moses Taylor Collection, Individual Letters for 1870 (formerly boxes 86 and 123), invoice of Zaldo and Company to Moses Taylor, 1 Jan. 1870.
  11. A fundamental problem in determining slave profitability is ascertaining the ratio of productive or prime-age slaves to unproductive or young and old slaves who contributed marginally to production. Unfortunately, data on the age structure of the slave population in these jurisdictions are lacking for the years under consideration.
  12. The data for Matanzas, which shows 83.5 percent of all workers as slaves, is suspect. With the exception of Ceiba Mocha, Matanzas *partidos* (jurisdictional subdivisions) did not report on rented or freed slaves. The only other category noted was Chinese contract laborers. Thus the number of slaves as a percentage of all workers was in all likelihood artificially inflated.
  13. The economic data on which this study is based, covering ingenios in Colón and

- Cárdenas between 1859 and 1878, may be obtained by writing to the author directly.
14. A large number of mills in Colón did not report information on their work forces for the 1877–78 census, while all mills reported income data. In order to calculate income per worker without statistical distortion, only those estates reporting data on their labor forces were utilized. They accounted for 70 of 116 sugar ingenios.
  15. See Public Records Office, FO 84/965, for this document. I would like to thank David Eltis, who provided this indirectly via Stanley Engerman.
  16. See Stanley Engerman, Manuel Moreno Fragnals, and Herbert Klein, "The Level and Structure of Slave Prices on Cuban Plantations in the Mid-Nineteenth Century: Some Comparative Perspectives," *American Historical Review* 88, no. 5 (Dec. 1983): 1201–18.
  17. See David Eltis, *Economic Growth and the Ending of the Transatlantic Slave Trade* (New York: Oxford University Press, 1987), Appendix C, "Prices of Slaves in the Transatlantic Slave Trade after 1810," 261–64.
  18. Data on slave sales were extracted from the notarial protocols of Colón stored in the Archivo Histórico Provincial de Matanzas (hereafter cited as AHPM). See AHPM, Protocolos Notariales, Manuel Vega Lavarría, 1863, 1864, 1867, 1870, 1872, 1875, 1876, 1878, 1880. More extensive information on slave prices is contained in Laird W. Bergad, "Slave Prices in Cuba, 1840–1875," *Hispanic American Historical Review* 67, no. 4 (1987):631–55. The inflation of the 1870s has been accounted for in the slave prices noted here. Slave transactions were listed in gold or paper money, and the ratio was 2 paper pesos to 1 gold peso. All values were adjusted to reflect the gold price.
  19. In an economic report on the sugar industry sent by the British consul in Havana, Joseph Crawford stated that the average productive life of an individual slave was twenty years. He also noted a 5 percent yearly death rate among slave populations. See Public Records Office (London), FO 72/748, Joseph T. Crawford to Viscount Palmerston of the Foreign Office, 28 Jan. 1848.
  20. Although no data on income per worker is available for 1870, between 1865 and 1876, income per worker increased in Colón 4.7 pesos per year from 309.6 to 361.6 pesos. Thus in the five years between 1865 and 1870, an increase of 23.5 pesos can be estimated, yielding an estimated income per worker of 333.1 pesos in 1870.
  21. No existing formulas can readily convert the gross income generated per slave into profitability. Sufficient data are not available to estimate accurately rates of return on slave labor over time. A different series of data would be needed to calculate such figures, including prices, depreciation, and replacement costs of machinery, tools, animals, and slaves; land values and depreciation; maintenance costs of slaves; costs of supplies, warehousing, commission fees, taxes; and the reproductive rate of the slave population. Moreover, no data on net income is available for any year except 1878, nor is there any way to calculate net income based on the formula used in the 1878 documentation. Estimates on profitability and costs were made by Juan Poey, owner of Ingenio Las Cañas, one of Cuba's largest mills in the early 1860s. He estimated a 2.5 percent depreciation of slave values due to death and presented a detailed array of economic calculations deriving a final yearly loss of 4.13 percent on investment capital on an "average" ingenio cultivating seventeen caballerías of cane with 132 workers. The 7.7 workers per caballería are strikingly close to the estimates noted in this article. See Juan Poey, *Informes presentados al excmo. capitán general Gobierno Superior Civil de la isla de Cuba sobre el proyecto de Colonización africana y al Illmo. Sr. Intendente de Hacienda de la propia isla sobre derechos de los azucares* (Madrid: Imp. de la Compañía de Empresas y Libretos a cargo de D. A. Aurial, 1862), 141–45. These data, however, must be viewed with caution because Poey's purpose was to persuade Spain to reduce taxes on sugar exports and imports and garner support for his ill-fated project to import "free" African laborers. Planters were always complaining about losing money while increasing production, constructing lavish homes, and leading lives of luxury. As a result, their printed testimonies on the internal economic dynamics of their estates cannot be used reliably. Until detailed internal account books are located and scrutinized, rates of return on investments in slaves cannot be accurately ascertained.
  22. In order not to distort these data, only mills with information on the number of

slaves were utilized for this comparison. If the 1878 data on Colón are compared with the 1876 data, there seems to be a drop in the total number of ingenios. This decline is illusory because there were a large number of mills for which data on the labor force was missing for 1878, and thus they were not included in these calculations.

23. See the accounts of Cosme de la Torriente's Ingenio La Reforma from 1866 through 1871 in AHPM, Gobierno Provincial, Ingenios, legajo 3, no. 38; and Mauricio Alfonso's Ingenio la Vega in 1874, legajo 3, no. 37. In *Slave Emancipation in Cuba*, Scott found wage rates in the late 1870s to range between 22 and 27 pesos per month (p. 119). With respect to the critical question of the comparative labor productivity of free versus slave labor, the identical monthly salary rate for free labor (25 pesos) and the hire rate plus maintenance cost for slaves (17 plus 8 pesos) strongly suggest that planters perceived little difference in labor productivity between the two. I want to thank an anonymous reader for suggesting this important point.
24. This period was one of active ingenio construction in the jurisdictions considered in this study. Between 1865 and 1876, the number of mills in the Colón partidos of Macuriges, Hanabana, Macagua, and Palmillas increased by over 45 percent, from 73 to 106 percent. See ANC, Gobierno General, legajo 405, no. 19209, "Padrón de fincas rústicas de la jurisdicción de Colón, 1865"; ANC, Gobierno General, legajo 270, no. 13563, "Padrón general de fincas rústicas de este distrito, año de 1875 a 1876." In a communiqué written in 1880, the British vice-consul in Matanzas noted that "the country round Matanzas has suffered little from the late insurrection, and that the sugar industry there is in a comparatively thriving condition." See Public Records Office, FO 72/1576.
25. For sugar prices, see issues for the corresponding years of the *Aurora de Yumuri* in the Biblioteca Gener y del Monte, Matanzas, and the *Gaceta de la Habana* in the Biblioteca Nacional José Martí in Havana.