The Rents From Trade and Coercive Institutions: Removing the Sugar Coating

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Abstract

The 19th century collapse of world sugar prices should have depressed wages in the British West Indies sugar colonies. It did not. We explain this by showing how lower prices weakened the power of the white planter elite and thus led to an easing of the coercive institutions that depressed wages e.g., institutions that kept land out of the hands of peasants. Using unique data for 14 British West Indies sugar colonies from 1838 to 1913, we examine the impact of the collapse of sugar prices on wages and incarceration rates. We find that in colonies that were poorly suited for sugar cane cultivation (an exogenous colony characteristic), the planter elite declined in power and the institutions they created and supported became less coercive. As a result, wages *rose* by 20% and incarceration rates per capita were cut in half. In contrast, in colonies that were highly suited for sugar cane there was little change in the power of the planter elite — as a result, institutions did not change, the market-based mechanisms of standard trade theory were salient, and wages *fell* by 24%. In short, movements in the terms of trade induced changes in coercive institutions, changes that are central for understanding how the terms of trade affects wages.

Keywords: International Trade, Coercive Institutions, Economic Development
JEL Codes: F1, F16, N26

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1 Introduction

Changes in the terms of trade that reduce labour demand should, in theory, reduce wages e.g., Stolper and Samuelson (1941) and Dornbusch, Fischer and Samuelson (1977). Yet the 19th century collapse of world sugar prices did not reduce wages in the British West Indies sugar colonies. Despite the fact that sugar in 1913 was worth just one quarter of what it had been in 1838, sugar prices and wages were uncorrelated during 1838–1913.

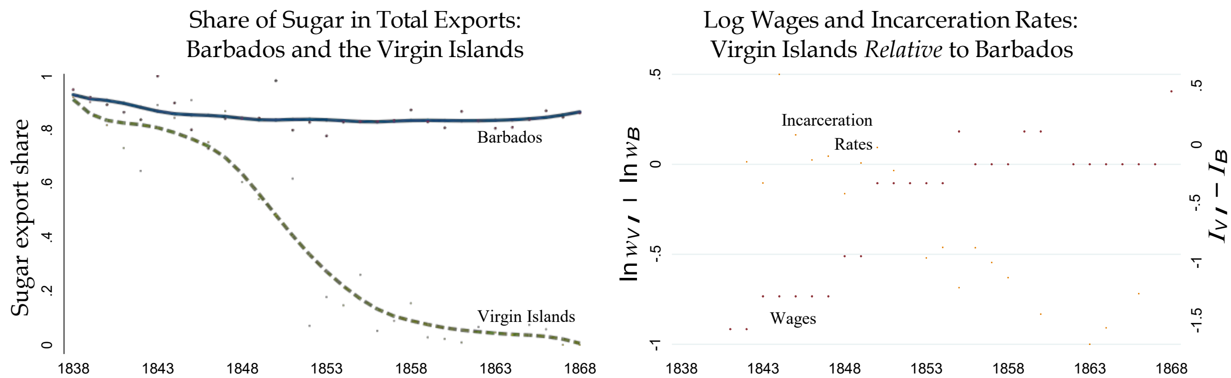
This paper explains this historical episode by appeal to the institutional changes that were induced by international trade. A fall in the price of sugar reduces the rents from trade that accrue to elites, which both reduces the resources available for investing in coercive institutions and reduces the returns to those investments. As a result, institutions become less coercive and wages rise. We take this insight to our historical setting of 14 British West Indies sugar colonies from 1838 (the abolition of slavery) to 1913. At the start of the period, sugar prices were high and the white planter elite used its political power over the legislature, the judiciary, and the police to limit ex-slaves' opportunities for earning a living off the plantation. This depressed wages. As sugar prices and the rents from sugar exports declined, the planter elite reduced its investments in coercive institutions, thus freeing up non-plantation opportunities for peasants. This raised wages.

A comparison of Barbados with the Virgin Islands illustrates. The left panel of figure 1 tracks the share of sugar in total exports in Barbados and the Virgin Islands for 30 years after abolition, during which sugar prices fell by a third. Barbados was so geographically suitable for sugar that despite the price decline, sugar continued to account for 85% of all its exports. In contrast, Virgin Island plantations were destroyed by a series of devastating hurricanes and rebuilding was made unprofitable by the low price of sugar. As a result, sugar ceased being exported.

In this setting, and bearing in mind that sugar is labour-intensive, the standard economic channel predicts that wages in the Virgin Islands should have declined relative to wages in Barbados. In fact, the opposite was the case, as shown by the upward-sloping curve in the right panel of figure 1. It tracks the difference between the log wages of the Virgin Islands and Barbados ($\ln w_{VI} - \ln w_B$). Relative wages rose by a full log point (270%) in just 20 years.

Trade-induced institutional change explains why. In Barbados, the planter elite continued to

Figure 1: The Evolution of Trade, Wages, and Coercion in Barbados and the Virgin Islands



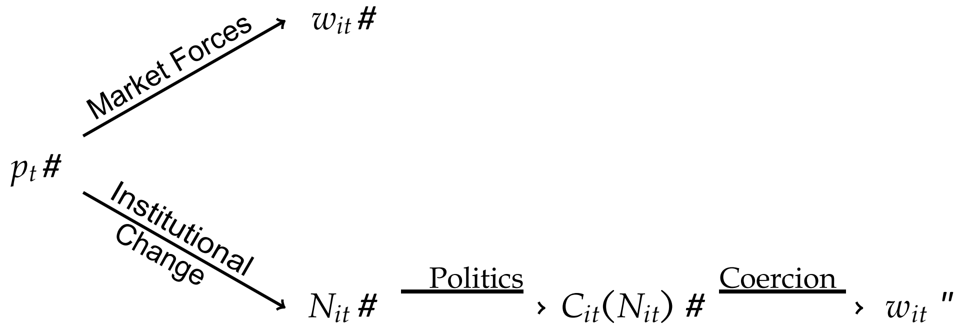
Notes: Authors' calculations based on data from the *Colonial Blue Books*, 1838–1868. The left panel is the share of sugar in total exports. The right panel has two axes. The left axis is the log difference between wages in the Virgin Islands and Barbados ($\ln w_{VI} - \ln w_B$). The right axis is the difference between incarceration rates per capita in the Virgin Islands and Barbados ($I_{VI} - I_B$).

grow sugar on all available land (Engerman, 1982, 197), making it easy for the planter elite to prevent former slaves from engaging in off-plantation activities. In contrast, many Virgin Island planters abandoned their lands, making it hard for the remaining planters to exercise coercion: They could not prevent ex-slaves from developing higher-paying, off-plantation work such as raising livestock on small freehold plots (Dookhan, 1975, 136,138).

The evidence from incarceration rates per capita is suggestive of coercion. The downward-sloping curve in the right panel of figure 1 is the difference between incarceration rates in the Virgin Islands and Barbados. Incarceration rates rose in Barbados and fell in the Virgin Islands, leading to a 1.5 percentage-point relative fall, which is huge in comparison to the base incarceration rates of about 2 percentage points.

Generalizing this example, the main thesis of our paper is illustrated in figure 2. Let i index colonies and t index years. The falling price of sugar (p_t) had two offsetting effects on wages (w_{it}). The first operates through *market forces* in that lower sugar prices reduced the demand for labor, thereby reducing wages. The second operates through *institutional change* in that lower sugar prices made plantation sugar less profitable, thereby limiting the economic and political strength of the planter elite (N_{it}). This reduced the equilibrium level of coercion (C_{it}), which made it easier and more remunerative for peasants to work off the plantation. Consequently, wages rose. Figure 2 provides a coherent explanation for why we see no correlation between output prices and wages,

Figure 2: The Impact of Trade on Wages via Market Forces and Institutions



Notes: p_t is the price of sugar, w_{it} is the wage, N_{it} is the economic and political strength of the planter elite and C_{it} is coercion.

as well as for the divergent paths of Barbados and the Virgin Islands.

Our example of Barbados and the Virgin Islands strongly suggests that one cannot understand the impact of terms-of-trade movements on wages solely in term of the conventional market-forces channel. One must also understand the role of the institutional-change channel. We are the first to examine the institutional-change channel and the first to simultaneously estimate the wage impacts of both channels.

For estimation, we have developed a rich new panel dataset on the evolution of 14 British West Indies sugar colonies from 1838 to 1913. Data are from the *Colonial Blue Books* and include wages, incarceration rates per capita and exports by crop. We augment these data with new data on the share of land that is suitable for sugar cane and on hurricane landfalls in order to provide instruments for why sugar declined more rapidly in some colonies (e.g., the Virgin Islands) than in others (e.g., Barbados).

Our conclusion is that the puzzling zero correlation between sugar prices and wages is the result of two offsetting terms-of-trade impacts, namely a negative market-forces impact and a positive institutional-change impact. But this result, which averages across 14 colonies, disguises important cross-colony differences. For colonies where sugar remained king the market-forces channel dominated and wages fell by 24%. In contrast, for colonies where sugar collapsed entirely the institutional-change channel dominated with the result that wages rose by 20% and incarceration rates per capita fell by 53%.

There is a compelling reason for why we chose the example of the sugar price collapse that rocked the 19th century British West Indies. This historical episode allows us to uniquely track the long-run economic and institutional evolution of 14 entities (colonies) that were initially similar. Economically, all were slave societies until Abolition in 1838 and all were completely specialized in sugar cane production. Institutionally, all had effective political and legal systems inherited from Britain (including some of the Western Hemisphere's first representative assemblies) and were dominated by a small group of white planters. After 1838, the colonies evolved independently of one another as a result of a hub-and-spoke trade system with Britain and the legislative, judicial, and policing autonomy enjoyed by each colony.

Here is precisely what we do: In section 2.1 we review the history of legal coercion in the British West Indies. In sections 2.2—2.3 we show historically that the decline in world sugar prices p_t was exogenous to the British West Indies, that the share of sugar in total exports is an excellent measure of the strength of the planter elite N_{it}, and that cross-colony differences in the rate at which N_{it} declined can be explained by exogenous agro-climactic factors, especially suitability for sugar cane cultivation and hurricanes. In section 3 we develop a model that motivates our empirical specification. In section 4 we describe the *Colonial Blue Book* data, including data on wages (w_{it}), incarceration rates (C_{it}) and sugar export shares (N_{it}).

In section 5 we present our core results, which involve two regressions: $\ln w_{it} = \beta N_{it} + \gamma \ln p_t$ and $C_{it} = \beta N_{it} + \gamma \ln p_t$ where for brevity we ignore error terms, fixed effects and all other regressors. We estimate $\beta < 0$ and $\beta > 0$ i.e., the weakening of the planter elite raised wages and reduced incarceration rates per capita. This is the institutional-change channel. We also estimate $\gamma > 0$ and $\gamma = 0$ i.e., the adverse terms-of-trade shock lowered wages and had no effect on incarceration rates per capita. This is the market-forces channel. In section 6 we instrument N_{it} with sugar suitability and hurricanes and find that the OLS and IV estimates are precisely estimated to be equal so that we can reject the endogeneity of N_{it}.[1] Section 8 concludes.

Turning to a literature review, there is a small literature that examines the impact of globalization on institutional dynamics, which in turn has implications for long-run wage dynamics. Seminal contributions are Acemoglu, Johnson and Robinson's (2005) study of how the Atlantic

[1] In section 7 we move to the sub-colony (parish) level and find a positive relationship between mortality rates and the share of land under sugar cane cultivation even after controlling for colony-year fixed effects. This implies that our findings of coercive institutions cannot be explained away by unobservables at the colony-year level.

trade affected European property rights institutions and Greif's (2005; 2006a) study of how medieval long-distance trade gave birth to markets characterized by impersonal exchange. Both institutional changes led to improved living standards and, in particular, to rising wages. See also Engerman and Sokoloff (1997), Sokoloff and Engerman (2000), Greif (2006b), La Porta, Lopez-de-Silanes and Shleifer (2008), Levchenko (2007, 2013), Nunn (2008), Nunn and Wantchekon (2011), Acemoglu and Robinson (2012), and Puga and Trefler (2014). Each of these papers postulates an institutional-change channel in which terms-of-trade movements affect the domestic distribution of wealth and power, which in turn leads to institutional changes that potentially affect wages.[2]

The particular institution we examine is 'legal coercion,' by which we mean the use of legislative, judicial, and policing powers to exclude some or most members of society from the full benefits of participating in the market economy. Legal coercion is analyzed in Greif (2005) and frames Acemoglu and Robinson's (2012, ch. 9) study of Apartheid.

Legal coercion is also central to the two papers most closely related to our own, namely, Naidu and Yuchtman (2013) and Bobonis and Morrow (2014). The latter examine coffee in Puerto Rico between 1849 and 1874, a period in which unskilled workers were forced to work for landowners. They show that positive coffee price shocks led to increased coercion by Puerto Rican landowners and to distorted investments in human capital.

Naidu and Yuchtman (2013) is not about international trade, but the analysis is of obvious relevance and elegance. They examine how the British Master and Servant law affected labour demand shocks associated with movements in the prices of industrial goods. Before the law was abolished (1858–1875), positive price shocks did not translate into higher wages. Instead, workers who sought higher-paying jobs were prosecuted for breach of their Master and Servant labour contracts. After abolition (1876–1890), wages rose in counties where prosecutions had been most common and wages became more responsive to demand shocks. We depart from Naidu and Yuchtman (2013) in several meaningful ways. First, their institutional change (abolition of Master and Servant law) is exogenous to their mechanism whereas institutional change is endogenous to ours. Second and related, their time frame is relatively short and their focus is on higher-

[2]Most of these papers deal with per capita incomes rather than wages, but the link is clear. See also the contributions by González de Lara (2008), Naritomi, Soares and Assuncao (2012), and Bruhn and Gallego (2012) as well as the survey by Nunn and Trefler (2014). Additionally, there are related papers on the impact of international trade on financial development, including Rajan and Zingales (2003) and Do and Levchenko (2007).

frequency shocks whereas we are concerned with a longer 76-year time frame. Third, they deal with a specific labour contract (see also Naidu 2010) whereas we deal with a pervasive system of legal coercion.

Any historical paper on the terms of trade and wages must pay homage to the remarkable scholarship of Jeffrey Williamson and his coauthors (O'Rourke and Williamson, 2001; Clemens and Williamson, 2004; Williamson, 2006; Blattman, Hwang and Williamson, 2007). This body of work shows conclusively that the market-forces channel is central for understanding the terms-of-trade impacts on wages. Our work shows that where interest focuses on long-term wage movements in labour markets that are coercive — there are few of these in Williamson's samples — one must additionally consider the institutional-change channel.

Finally, there are several regional literatures on international trade and coercive labour markets. Most famously, the Brenner Debate is about the export-led second serfdom and the corresponding rise of coercion in Eastern Europe (Domar, 1970; Brenner, 1976; Aston and Philpin, 1985). There is also a literature on how Latin American planter interests have dominated governments in order to secure cheap labour through coercion e.g., McCreery (1986) and Paige (1998). Robinson and Baland (2008) document that in the Chilean *inquilinos* system, large landowners controlled the votes of smallholders living on their land and were thereby able to turn control of labor into political capital. Dell (2010) shows how the *mita* system of forced mining in Peru and Bolivia (1573–1812) continues to have negative impacts today. Unlike Dell, our paper is *not* about the persistent effects of institutions. Finally, Dippel (2013) examines transitions from democracy to autocracy in the British West Indies during the 19th century. Such transitions play no role in our analysis.[3]

2 History

26 years separated the abolition of the slave trade (1807) from the passing of *An Act for the Aboli- tion of Slavery* (1833). In the intervening generation, the powerful West Indies Sugar Interest came

[3]Dippel (2013) begins by observing that in the British West Indies franchise eligibility was often based on land ownership. As the sugar economy was gradually replaced by smallhold agriculture, voting patterns turned against the planter elite. In response, the elite in several colonies demanded that parliament abolish itself and reconstitute the colonies as Crown colonies. This took legislative authority out of the hands of voters and put it in the hands of executive councils appointed in London. Our current paper has nothing to do with such transitions from democracy to autocracy, though they complement our study.

to accept the inevitability of emancipation. A few colonies even welcomed emancipation with its promise of a generous compensation package. In Barbados and Antigua the planter elite owned and cultivated almost all of the land, leaving former slaves with no other option than to work on the plantation. Emancipation was therefore not expected to affect labour costs, profitability or the political and social status quo (Merivale 1861, 339–340; Engerman 1984, 134). However, in most colonies, emancipation was anticipated with a sense of impending doom. Where sugar was in the ascendancy, as in Guyana and Trinidad, wages were expected to rise dramatically because labour was scarce and would become scarcer once former slaves started carving out farms from the hinterland. Where sugar was in decline, as in Jamaica, the prognosis was equally gloomy (Merivale 1861, 340–341; Engerman 1984, 134 and table 2) because wages were expected to rise as freed slaves squatted on abandoned estates or purchased small 'freehold' plots in the mountains. Thus, the view held in most colonies was that after emancipation, former slaves would abandon plantation work in favour of subsistence farming on freehold land. Labour shortages would ensue, wages would rise sharply, and planters would be bankrupted.[4]

When emancipation finally came on August 1, 1838, former slaves immediately fled the plantations. In many colonies upwards of one-half were gone by early Fall (e.g., Hall 1978, 58; Riviere 1972, 13) and although many were back by Spring for want of work, wages spiked. This situation did not last long. Across the 14 colonies, *Colonial Blue Book* data indicate that wages remained high only until 1845, and by 1848 wages had fallen back to pre-emancipation levels as planters mastered the use of legal coercion.

2.1 Legal Coercion

In our context, 'legal coercion' means the use of colonial laws, courts, and police to prevent former slaves from farming legally on freeholds or farming illegally on abandoned plantations and Crown land. Legal coercion was the hallmark planter response to emancipation. To understand the forms it took in the British West Indies, one must understand the points of conflict between planters and

[4]The view was held by all Tories (e.g., Sir Robert Peel, 1853, 706) and by many Whigs (e.g., Colonel Leith Hay in Great Britain Parliament 1834, 172). The view was even held by some Abolitionists e.g., Sir Henry Taylor wrote in his autobiography: "I did not believe that, when freed [the negro] would continue to work on the plantations for any wages which the planter could afford to pay." (Taylor, 1885, 125). Finally, it was held by Oxford professor Herman Merivale, the greatest contemporary authority on colonial economics, who argued in his 1839–41 lectures that in Guyana and Trinidad, negroes are "indisposed to labour, to which they can only be tempted by the most exorbitant offers of wages" (Merivale, 1861, 317).

former slaves. The planters wanted low wages as well as a supply of labour that was both steady throughout the year and flexible enough to accommodate the peak demands of harvest during which employees were expected to work about 90 hours a week (Higman, 1984, 182–183). In contrast, the former slaves wanted, among other things, less restrictive labour laws, more freedom of movement, and either title to land with secure property rights or greater access to their pre-emancipation cottages and provision grounds where they grew food and cash crops (Marshall, 1996b).[5]

There were four common types of legal coercion. First, arrangements between planters and peasants came to be interpreted as an implicit contract obliging peasants to work for the entire year and to work long hours at harvest time. As a result, disputes over wages and hours were common (Wilmot, 1996, 50). This implicit contract shared similarities with the Master and Servant law that is the focus of Naidu and Yuchtman (2013), except that the terms were harsher. For one, the hours were extremely long. For another, peak labour demand came during the sugar and provisions harvests and, since these two harvests coincided, the implicit contract forced peasants to neglect their own harvest (Eisner, 1961, 210). Most important historically, the contract often included annual use of a cottage and provision lands. In the view of ex-slaves, these cottages and provision lands were supposed to become theirs after emancipation (Marshall 1996b, 18; Satchell 1990, 68). However, the planter-dominated legal system quickly disabused ex-slaves of any such notions. Instead, cottages and provision grounds were treated by planters as a bond for breach of contract: If a peasant left mid-season or failed to work long hours during the harvest then the planter evicted the peasant from his cottage and destroyed his crops. Smith (2011, 228–229) provides a vivid account of such an eviction. Such punishments were quickly legalized by a body of coercive law called 'tenancy-at-will' e.g., Bolland (1981, 595), Dookhan (1975, 130), and Brizan (1984, 128).

Second, former slaves wanted access to cheap land with full legal title. Planters responded with a host of restrictions. Large tracks of Crown land were either kept off the market, made available only at artificially high prices, or sold only in large lot sizes e.g., Craton (1997, 390– 393). For example, 83% of Trinidad's landmass was owned by the Crown, yet it was kept off

[5] A common misconception is that planters were monopsonists in labour markets. Monopsony power was an exception to the rule: Planters often bargained individually with their workers and workers often organized plantation-level strikes. See Wilmot (1996).

the market until the large-scale arrival of East Indian indentured labourers (Sewell, 1861, 103, 106, 133). Also, to prevent peasants from pooling their resources to buy and either subdivide or collectively administer plantations, these practices were prohibited and planters were pressured socially not to sell e.g., Eisner (1961, 211) and Craton (1997, 390). Not only was land held back, it was actively repossessed by the government. Satchell (1990, ch. 4 and table 4.3) documents that 18,000 acres of Jamaican smallholds were repossessed after 1869 for failure to pay taxes (quitrents). In addition, the tax system was designed to penalize smallholders. Total taxes on a small plot were often substantially higher than on a large estate and export taxes were sometimes higher on the products of provision grounds than on sugar e.g., Underhill (1895, xvii). Holt (1992, 202–213) provides a detailed discussion of Jamaica's regressive taxes.

Third, squatting was so rampant that it seriously undermined the ability of planters to keep peasants on plantations. In Jamaica there were 10,000 squatters by 1844 and this number probably climbed to 40,000 by the mid-1860s (Eisner, 1961, 215–216). Given the size of the problem, the full force of the law was brought to bear on peasants who attempted to squat on abandoned estates or Crown land. The *Colonial Blue Books* list the titles of all colonial statutes and a quick perusal shows that *every* colony repeatedly enacted and strengthened trespass and vagrancy laws in order to prevent squatting. Further, local magistrates, who were often former plantation overseers (McLewin, 1987, 85–87), strengthened enforcement of these statutes by converting trespasses into larcenies so that a peasant who so much as set foot on an abandoned estate could be thrown in jail. This abusive practice was so common that even Jamaica's Governor Eyre complained of it (Morrell, 1969, 407). Of the many types of legal coercion, anti-squatting laws were the ones most likely to cause imprisonment.[6]

Fourth, immigration and emigration policy was used to depress wages by expanding the supply of labour. Authorities in Trinidad, Guyana, and Jamaica funded the immigration of East Indian indentured labour to work on plantations e.g., Laurence (1971). Further, former slaves in many colonies faced restrictions on outmigration (e.g., Bolland 1981, 594), a fact that is reflected in the low number of emigrants recorded in the *Colonial Blue Books*[7]

[6]This will be relevant for the empirics in two ways: It means that legal coercion can be measured by incarceration rates and it means that incarceration rates are an imperfect measure of coercion in that they capture only one of our four dimensions of coercion.

[7]There were some exceptions, such as Montserrat and Nevis (Hall, 1971, tables 1 and 5).

The widespread use of these four types of legal coercion was described and disparaged by many contemporaries, both in the colonies and in Britain. After carefully documenting many of the above practices, William Hancock (1852, 14) wrote:

> [W]e have had a mass of colonial legislation, all dictated by the most short-sighted but intense and disgraceful selfishness, endeavouring to restrict free labour by interfering with wages, by unjust taxation, by unjust restrictions, by oppressive and unequal laws respecting contracts, by the denial of security of [land] tenure, and by impeding the sale of land."

Legal coercion was a fact of life for peasants of the British West Indies.

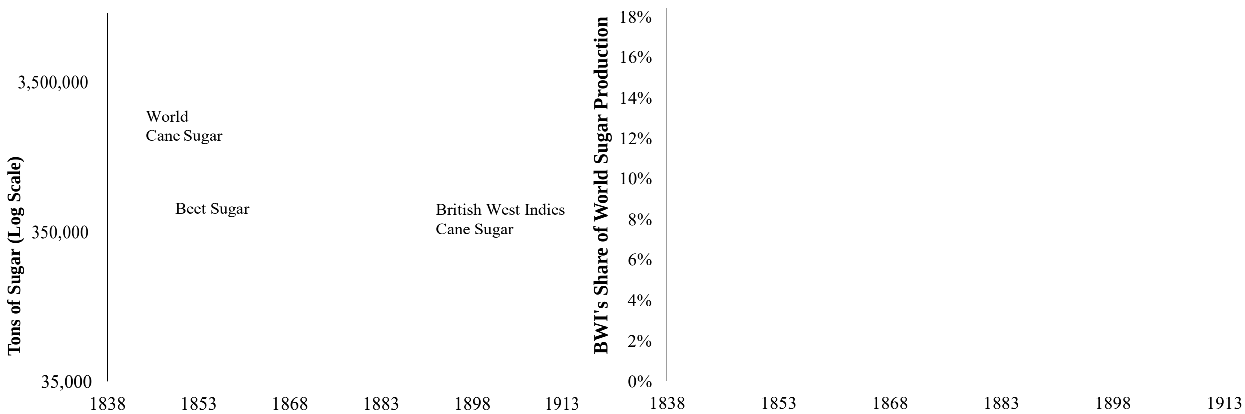
2.2 Terms-of-Trade Shocks and Institutional Change

This portrait of legal coercion represents the state of affairs across the British West Indies at mid-century. Our main thesis is that the secular decline in sugar prices during 1838–1913 weakened the institutions that supported legal coercion and thus raised wages. In this subsection we describe this process.

During the course of the eighteenth century, West Indies sugar faced increased competition from new sugar cane producers and from European beet sugar. See the left-hand panel of figure 3. This had two major impacts. First, the share of world sugar output produced by our 14 West Indies colonies declined from 17% in 1838 to an inconsequential 1% in 1913. See the right-hand panel of figure 3. Second, the price of sugar collapsed. Figure 4 plots the time series of the London price of sugar, which was where almost all British West Indies sugar was sold. In 1913, the price of sugar was just one quarter of what it had been in 1838 ($e^{5.74-4.47} \approx 1/4$). The secular decline in the price of sugar was entirely beyond the control of West Indies planters. Econometrically speaking, it was exogenous. It was also the main cause of the decline of British West Indies sugar e.g., Curtin (1954).

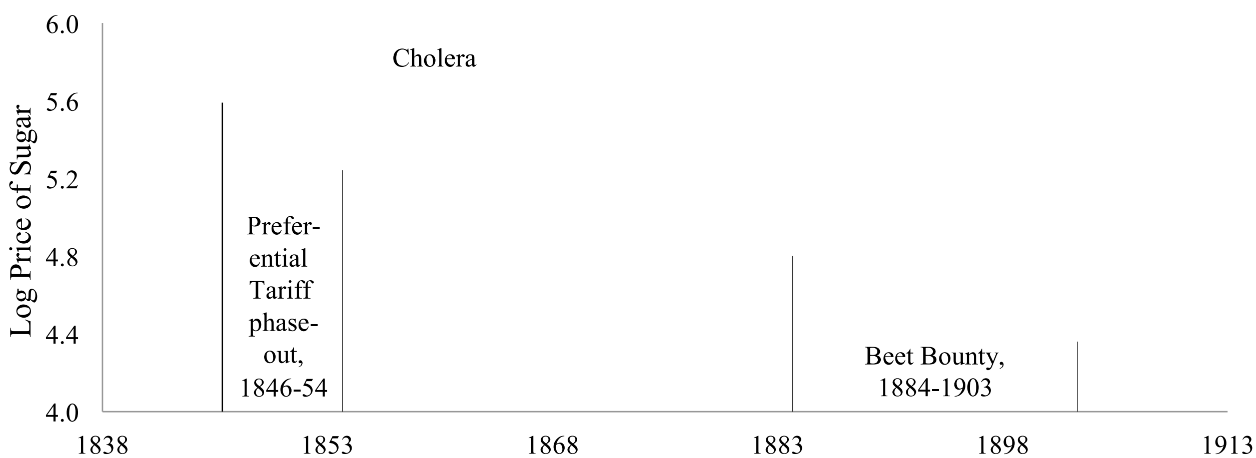
The impact of declining world sugar prices on plantations and legal coercion is graphically illustrated in figure 5 for the case of Jamaica. The black and grey areas are sugar plantations that were active in 1790. The black areas are sugar plantations that were active in 1890. Thus, the grey areas show the very substantial decline of sugar plantations. The grey areas also provide an

Figure 3: World Sugar Production by Region and the British West Indies' Share



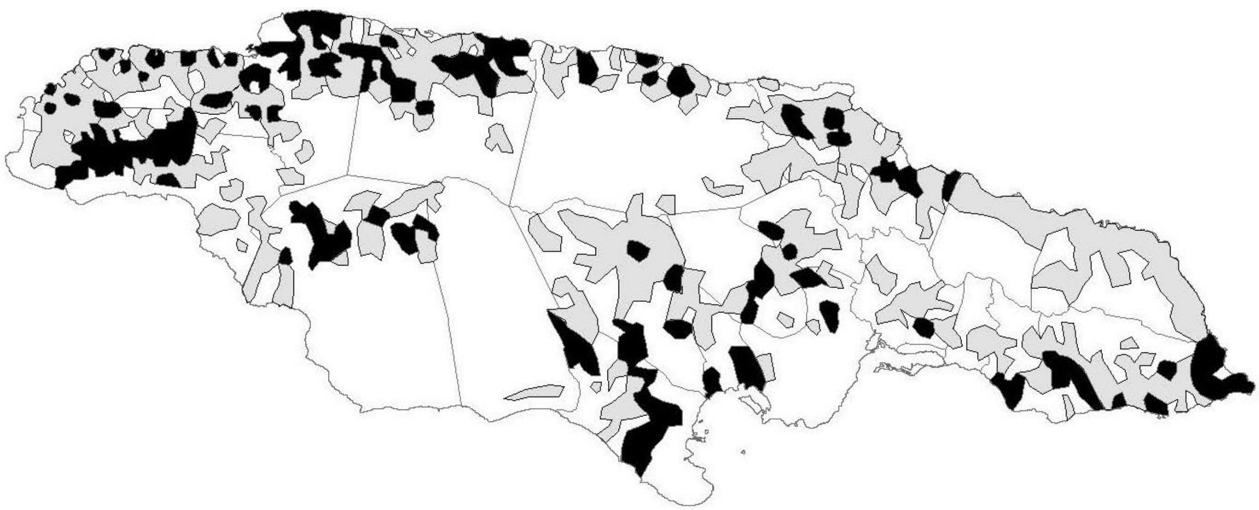
Notes: The left-hand panel is the log output of sugar (measured in tons) by source: (1) cane sugar grown in our sample of 14 British West Indies sugar colonies, (2) cane sugar grown worldwide, and (3) beet sugar. The right-hand panel is the British West Indies' share of world sugar output i.e., (1) divided by (2)+(3). Data are from Deere (1950).

Figure 4: The Secular Decline in Sugar Prices



Notes: This figure plots the log of the London price of sugar. Two events stand out. As part of the repeal of the Corn Laws and the move to Free Trade, Britain's preferential tariff on West Indies sugar was phased out over the period 1846–54 (Curtin, 1954). Second, France and Germany subsidized domestic production of beet sugar during 1884–1903, which further drove down sugar prices.

Figure 5: Jamaican Sugar Plantations in 1790 and 1890



Notes: This map shows the extent of sugar plantations in 1790 (black plus grey areas) and 1890 (black areas). Grey areas are thus plantations that ceased to exist and were therefore potentially available for freeholders and squatters. The map is based on Higman's (2001) remarkable figure 2.9. It is the only map of its kind for any of the West Indies colonies. Parish boundaries are also shown.

important insight into one of two obstacles to legal coercion that planters faced: It was increasingly costly to keep peasants off of the rapidly growing stock of high-quality, unused land. The result was that Jamaican peasants left the plantations in droves and either bought small freeholds or squatted. The number of freeholds was 2,114 in 1838, 19,397 in 1845, 50,000 in 1860 and 111,957 in 1890. This growth created the second obstacle to legal coercion: Peasants were a growing economic and political force.

Trade statistics mirror these two obstacles. Between 1850 and 1890 the share of Jamaican exports originating from freeholds and squatters rose spectacluarly from 10.4% to 39.0%. "Increasing prosperity of the peasantry is thus seen to be mainly due to their growing share in export crops" (Eisner, 1961, 235). The flip side of this was the decline of sugar exports: Between 1850 and 1890 the share of sugar in total exports fell from 77% to 25%.[8]

For our other 13 colonies, there is much less data available on (*i*) the declining acreage of sugar plantations, (*ii*) the rising number of freeholders and squatters, and (*iii*) the growing peasant participation in exports. For colonies where such data are available, all three trends are clearly

[8] Data on freeholds and peasant exports are from Eisner (1961, 220, 221, and 234). Sugar export data are from the *Colonial Blue Books*.

manifest (Riviere, 1972, 15-17). Further, Marshall (1968, 253–254) concludes from his survey of the British West Indies that the period from roughly 1850 to 1900 was one of "continuing expansion of the number of peasants and, more important, a marked shift by the peasants to export crop production." Thus, as in the Jamaican case, the three trends are correlated with the fall in sugar's share of total exports.

We have thus laboriously compiled *Colonial Blue Book* data on sugar exports (including molasses and rum). Figure 6 displays sugar exports as a share of total exports by colony. It is crucial for our paper. The figure is a bit of an eye chart so it is best to focus on the two dominant features. First, in 1838 every colony was highly specialized in sugar. Second, by 1913 there were substantial cross-colony differences in sugar export shares. Colonies roughly divided into three groups.

- Group 1: Five colonies remained heavily involved in sugar for the entire period (Antigua, Barbados, Guyana, St. Kitts, and Nevis).
- Group 2: Three colonies saw sugar decline to less than half of total exports (St. Lucia, Trinidad and Tobago).
- Group 3: Five colonies exited sugar entirely by the end of period (Virgin Islands, Grenada, Dominca, St. Vincent, and Montserrat).

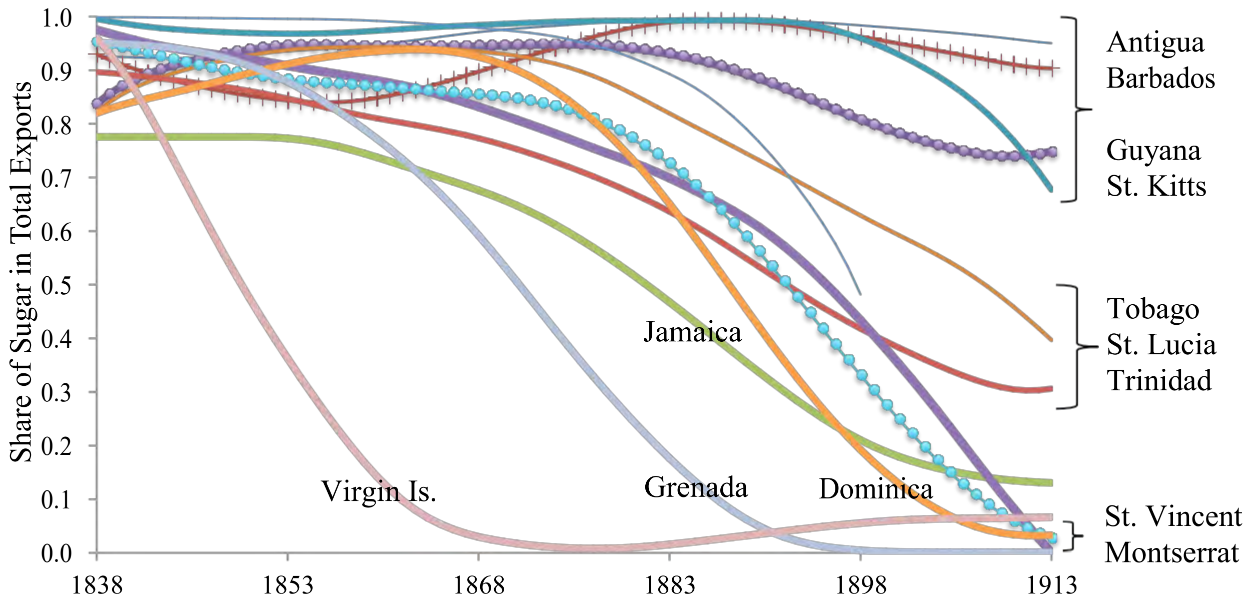
Jamaica had characteristics that are between groups 2 and 3.

The declining power of planters relative to peasant freeholders and squatters was most pronounced in the third group, less pronounced in the second group, and largely absent in the first group. This historical fact will not be obvious except to students of Caribbean history because one might conjecture that planters simply moved into other plantation crops. This was not the case.

Figure 7 displays the major export crops for colonies in groups 2 and 3. The thin dashed line is the export share of sugar and the thick line is the export share of the most important non-sugar crop. A thick dashed line is added where there is a second important non-sugar crop. The title of the panel names the colony and crop. For example, the top left panel shows that in the Virgin Islands sugar was displaced by livestock. Livestock was exclusively a peasant activity in the Virgin Islands (Harrigan and Varlack 1975, 64–65; Dookhan 1975, 138).

The first conclusion to emerge from figure 7 is that sugar *was not* replaced by the other highly lucrative plantation crops of the Western Hemisphere, namely, cotton and coffee. Cotton was only important in Montserrat, and only at the very end of our period. Coffee was grown in Jamaica, but

Figure 6: The Share of Sugar in Total Exports and its Differential Decline

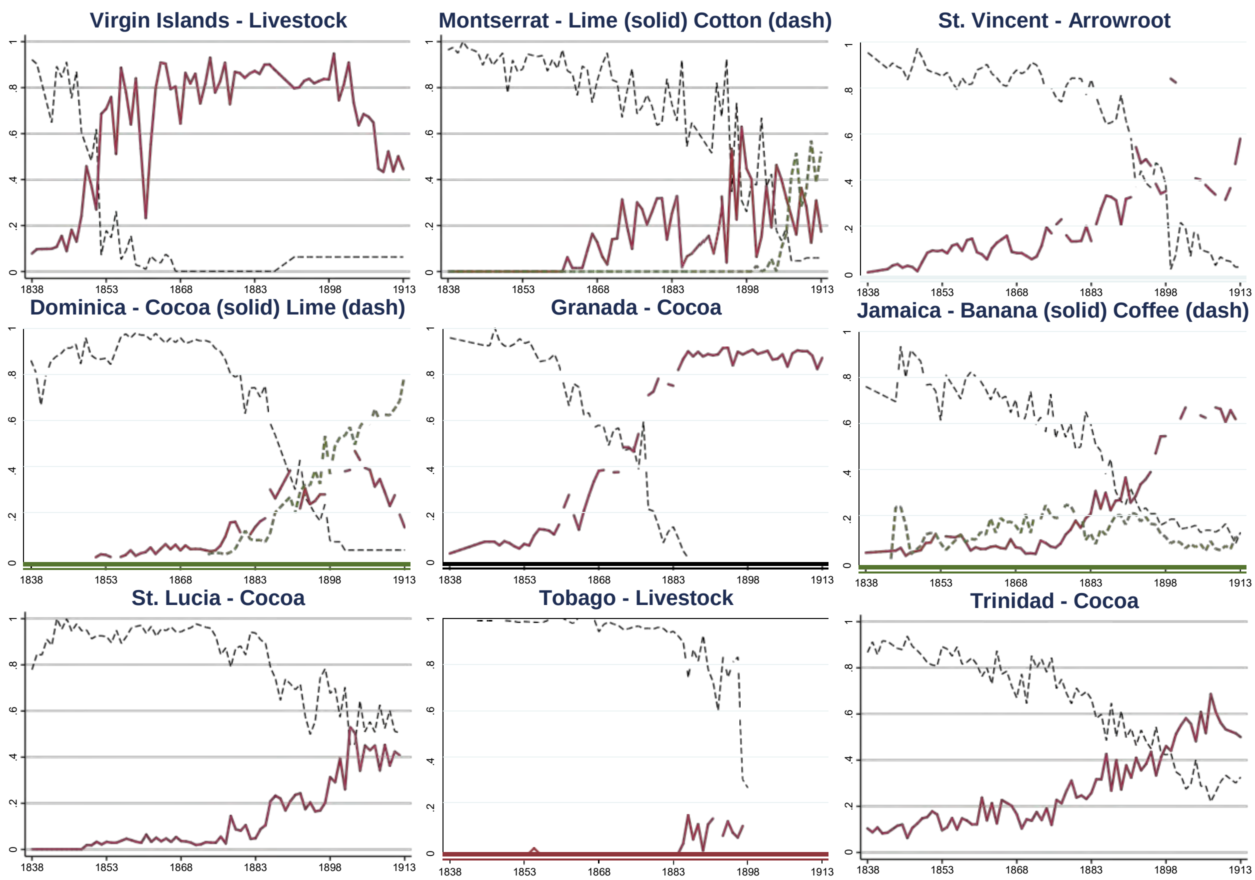


Notes: This figure reports the share of sugar in total exports. Nevis is not reported because it stayed between 0.95 and 1.00 throughout. Also, Nevis merged with larger St. Kitts in 1883 and Tobago merged with larger Trinidad in 1899. Each series is lowess smoothed. (The smoothed data faithfully reproduce trends in the raw data as can be seen by comparing the smoothed data with the unsmoothed data of figure 7.) Data are from the *Colonial Blue Books*.

freeholders and squatters accounted for two-thirds of total production (Eisner 1961, 217; American and Foreign Anti-Slavery Society 1849, 97; Lewis 1986, 72). Figure 7 shows that sugar was replaced by whatever crop was best suited to the local microclimate. These crops were cocoa, limes, livestock, arrowroot and bananas. None of these crops generated the spectacular returns associated with sugar during its heyday. That is, the collapse of sugar prices and the transition out of sugar significantly diminished the economic clout of planters from what it had been on the eve of emancipation.

The second conclusion to emerge from figure 7 relates to the export share of new crops (cocoa, limes, livestock, arrowroot, coffee and bananas). The larger was this share, the greater was peasant involvement in exports. In group-3 colonies, freeholders and squatters were active producers of cocoa in Grenada, arrowroot in St. Vincent, and livestock in the Virgin Islands. In group-2 colonies, planters dominated livestock in Tobago and controlled most but by no means all of cocoa in Trinidad and St. Lucia. In group-1 colonies, sugar was the only major export and it was dominated by planters. These facts are carefully documented in Appendix A. Thus, there was a

Figure 7: Major Export Crops of Colonies in Groups 2 and 3



Notes: The figure displays the major export crops for colonies in groups 2 and 3. (Colonies in group 1 did not have a major non-sugar export crop.) The vertical axis is a crop's share in total exports. The horizontal axis is time (1838–1913). The thin dashed black line is the export share of sugar. The thick solid red line is the export share of the most important non-sugar crop. A thick dashed green line is added where there is a second important non-sugar crop. The title of the panel names the colony and crops. Data are from the *Colonial Blue Books*.

negative correlation between the export share of sugar and peasant participation in export crops.

Putting these two conclusions together, the sharper was the decline in a colony's export share of sugar, the greater was the decline in planter power and the greater was the rise in peasant participation in the market economy.[9]

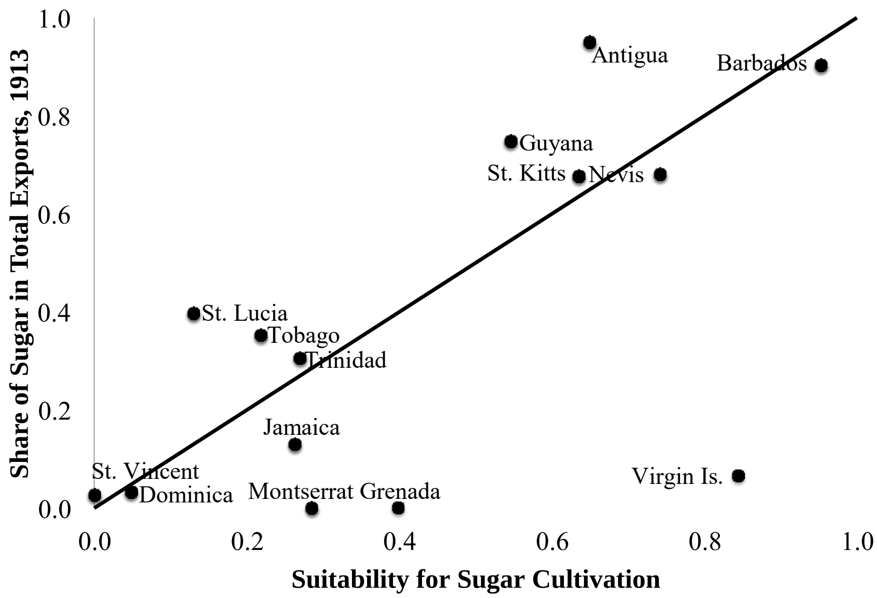
2.3 The Differential Decline of Sugar and Identification of the Institutional Channel

We have argued that on the eve of emancipation our 14 colonies had identical economies (complete specialization in sugar) and identical institutional arrangements (powerful elites using legal coercion). Why then did the sugar economy collapse in some colonies but not in others? Restated, should we think of the evolution of sugar exports as *exogenous or endogenous* to the main processes we wish to describe, namely, the evolution of wages and legal coercion? There are good reasons to think that it may have been endogenous. For example, in some colonies planters mechanized early on and in other colonies planters imported indentured East Indian labour, both of which are endogenous choices that slowed the decline of sugar. However, we now argue that these were secondary factors.

The historical record strongly suggests that the main factors behind the differential collapse of sugar were agro-climactic and hence exogenous. To establish this fact we hired a specialist to develop an index of each colony's suitability for sugarcane cultivation and each colony's incidence of hurricanes. Details are described below in section 6.1. Figure 8 plots each colony's 1913 share of sugar in total exports against its share of land that is suitable for sugar. There is a very tight relationship between the two, which highlights the fact that much of the differential decline in sugar shares can be explained by differences in *exogenous* sugar suitability. Only Grenada and the Virgin Islands have 1913 sugar shares that cannot be explained by sugar suitability. Grenada's exceptionalism is simple: Grenada is good for sugar, but perfect for cocoa (Richardson, 1997, 193) so its sugar decline is explained by exogenous cocoa suitability. The Virgin Islands' early exit from sugar is due to hurricanes in 1848, 1852, 1867 and 1871 which destroyed the colony's sugar

[9] Peasant participation translated into at least some political power. The earnings of urban professionals such as merchants, lawyers and surveyors came from servicing the growing peasant economy. As a result, the fortunes of rural peasants and urban professionals were tied together. Small freeholders voted for these professionals, thus giving peasants at least some political representation. Holt (1992, 217–227) documents this relationship for the case of Jamaica: By mid-century, the Planter Party had lost its parliamentary majority to the Town Party and as many as 38% of legislators were black.

Figure 8: Suitability for Sugar and 1913 Sugar Shares



Notes: Each point is a colony's share of sugar in total exports plotted against its share of land that is suitable for sugarcane cultivation. The 45° provides a benchmark. Sugar shares for Nevis (Tobago) are extrapolated out to 1913 using 1882 (1898) data and growth rates from St. Kitts (Trinidad).

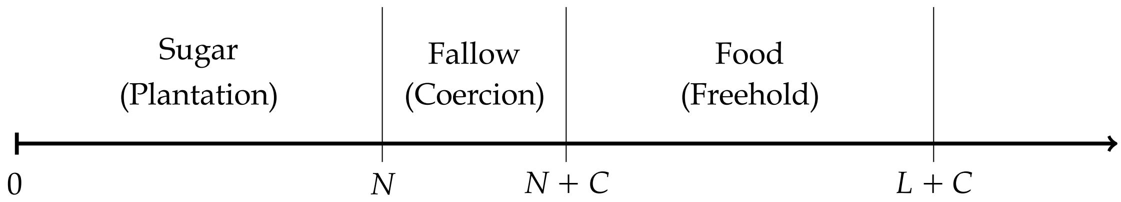
infrastructure and left planters too indebted to rebuild given the low price of sugar. That is, the Virgin Islands' early exit from sugar was due to exogenous hurricanes. Thus, sugar's differential decline is largely explained by *exogenous* agro-climactic factors. This will inform our use of sugar suitability and hurricanes as instruments for the decline of sugar. It will also explain why our first-stage statistics are good and why our IV and OLS estimates are so similar that we can reject endogeneity of the decline of sugar.

3 A Simple Model of Coercive Labor Market Institutions

Before turning to the econometric work, we will need a model to structure our thinking about a host of specification issues, including choice of covariates and the direction of possible endogeneity bias.

We consider a small open economy that produces two goods, sugar with exogenous price $p > 0$ and food (the numeraire good). There is an exogenous measure L of workers (former

Figure 9: Allocation of Land



slaves), an endogenous measure N of planters (members of the planter elite), and a continuum of heterogeneous land indexed by i. Land can be planted in either plantation sugar or freehold food. In plantation sugar, one planter and one worker on 'plot' i produce $\phi x(i)$ units of sugar where i is ordered so that $x < 0$ and ϕ is a productivity shifter. In freehold food one worker on plot i produces $\Phi - i$ units of food.

The mass N of planters occupy the most productive plots ($i \in [0, N]$) and grow sugar. This is the legacy of the slave economy. Since each planter employs one worker, there remains a mass $L - N$ of workers producing freehold food. In principle, these workers could occupy plots $(N, L]$. However, coercion of level C prevents them from using plots $(N, N + C]$ and forces them onto the inferior plots $(N + C, L + C]$. See figure 9. Thus, coercion C worsens the outside options of workers employed by planters. This relationship between outside options and coercion figures prominently in Acemoglu and Wolitzky (2011).

The determination of wages in the colonies was complex so we focus on the two most important features. First, the fall in sugar prices lowered labour demand and hence depressed wages. Second, the availability of outside options, particularly freehold farming, increased wages. We provide the simplest possible model of wage determination that delivers these two features and note that many other models also do so.

On each planter's estate there lives an ex-slave who claims customary rights to a cottage located on the estate. If the planter and worker agree on a wage w then together they generate sugar income $p\phi x(i)$. If they fail to agree on a wage then the worker relocates to the most marginal plot $i = L + C$ where he earns $\Phi - L - C$. For simplicity alone we assume that the planter receives 0. We use generalized Nash bargaining over the surplus $p\phi x(i) - (\Phi - L - C)$. The planter's bargaining weight is $\theta(N)$ where $0 < \theta(0) \leq \theta(\cdot) < 1$. We assume $\theta_N \geq 0$ to allow for the possibility that the stronger is the planter elite (N large) the more each planter receives; however, this is a minor feature of the model. The Nash solution provides the worker with:

$$w(i, C, N) = (1 - \theta(N))\, p\phi x(i) \;+\; \theta(N)\,(\Phi - L - C)\;. \tag{1}$$

Thus, wages w are increasing in the price of sugar p and the outside option $\Phi - L - C$, which are the two features of wage determination we had set out to model.

3.1 The Politics of Coercion

Coercion uses state resources such as passing vagrancy laws and enforcing them to prevent squatting on the fallow lands $(N, N+C]$. We assume that these costs are given by C^{γ} where $\gamma > 1$. These costs are funded by a head tax on planters of C^{γ}/N. Therefore, profits are $p\phi x(i) - w(i, C, N) - C^{\gamma}/N$ or:

$$\pi(i, C, N) = \theta(N)\, p\phi x(i) \;-\; \theta(N)\,(\Phi - L - C) - C^{\gamma}/N\;. \tag{2}$$

We use Grossman and Helpman's (1994) 'Protection for Sale' framework to determine the level of coercion C. We begin by assuming that all sugar is exported and agents only consume food so that we can equate utility with profits and income. C is chosen to maximize a weighted sum of the profits of planters, the wages of plantation workers, and the income of freeholders:

$$W(C) = \alpha(N) \int_0^N \pi(i, C, N)\,di + \int_0^N w(i, C, N)\,di + \int_{N+C}^{L+C} (\Phi - i)\,di \tag{3}$$

subject to $C \geq 0$. $\alpha(N)$ is the weight given to planters' profits. We assume $\partial\alpha(N)/\partial N > 0$ so that the larger is the plantation economy, the more influence planters have over the level of coercion. This is our key assumption. We also assume $\alpha(0) = 1$ so that as the measure of planters becomes small they are treated on par with plantation workers and freeholders.

An increase in coercion C affects W via three channels. First, it forces freeholders onto less productive land, which lowers W. Second, it uses real resources (C^{γ}), which also lowers W. These two channels push the optimal level of coercion towards 0. Third, an increase in coercion transfers income from plantation workers to planters. When $\alpha = 1$ this pure transfer has no effect on W, but when $\alpha > 1$ the pure transfer raises W. It follows that when planters are weak ($N \approx 0$

and $\alpha(N) \approx 1$), the optimal level of coercion is $C = 0$. Conversely, when planters are strong, the third channel dominates and the optimal level of coercion is $C > 0$. As shown in Appendix B.1 where $W(C)$ is written out in full, there is a critical planter strength N^C with $0 < N^C < L$ such that $C(N) = 0$ for $N < N^C$ and

$$C(N) = \left(N \frac{\theta(N)}{\gamma} \frac{\alpha(N) - 1}{\alpha(N)} - \frac{L - N}{\gamma\alpha(N)} \right)^{\frac{1}{\gamma-1}} \quad \text{for } N \geq N^C . \tag{4}$$

Further, $C_N > 0$ for $N > N^C$. The insight is simple: the stronger is the planter elite, the greater is its political influence (as measured by α) and hence the higher is the level of coercion.

3.2 The Marginal Planter N^*

A measure M of potential English planters are randomly assigned plots $i \in [0, M]$. (The determination of M is described in the next subsection.) Having received a plot, a planter can either plant sugar or return to England and earn $\overline{W}$. The marginal planter $i = N^*$ therefore earns

$$\pi(N^*) \equiv \pi(N^*, C(N^*), N^*) = \overline{W} \tag{5}$$

where the notation builds on equation (2). Appendix B.2 provides restrictions on $x(i)$ and $\overline{W}$ which ensure that there exists a unique solution $N^* \in (0, L)$ to equation (5).[10]

3.3 Free Entry of Planters and General Equilibrium

In this subsection we deal with theoretical issues surrounding general equilibrium, issues that play no role in the empirics to come. All but the most interested readers will want to skim through the following discussion. Closing the model, we must endogenize the mass M of entrants. There is

[10]This footnote gathers together a number of disparate comments about assumptions that may trouble the more theoretical reader. (1) Uniqueness plays no role for our comparative statics: It is assumed in order to avoid mathematical details that do not inform our empirics. This is proven in Appendix B.2 where uniqueness is abandoned. (2) We can allow the planter to also plant food. In that case we must assume that $\Phi < \overline{W}$ so that an Englishman who plants food receives $\Phi - \tau < \Phi < \overline{W}$ and hence prefers returning to England over planting food. (3) The planter's outside option need not be 0. More generally, we can assume that in the event of disagreement the planter produces a fraction δ of $\phi x(i)$ and so receives the outside option $\delta p\phi x(i)$. This generalization requires only one very minor modification of our model, namely, that the Nash bargaining weight θ be replaced by $\delta + (1 - \delta)\theta$. (4) All our results hold with C^γ/N replaced by the more general cost function $\chi(C, N)$ where $\chi_C > 0$, $\chi_{CC} > 0$ and $\chi_{CN} < 0$. (5) We need to assume that the surplus in any planter-worker pair is positive. That is, $p\phi x(i) > \Phi - L - C$ for all i. Noting that $p\phi x(i) > p\phi x(L)$ and $\Phi > \Phi - L - C$, a sufficient condition for a positive surplus is $p\phi x(L) > \Phi$.

an infinite pool of potential planters, each of whom chooses between two alternatives. (1) Stay in England and earn $\overline{W}$. (2) Pay a fixed cost f and be randomly assigned a plot $i \in [0, M]$ where M is the mass of potential planters who pay the fixed cost. (M corresponds to M_e in Melitz (2003).) Fixed costs use English resources, not Caribbean resources.

In equilibrium, each entrant must be indifferent between alternatives (1) and (2) so that:

$$\left(\frac{N^*}{M^*}\right)\frac{1}{N^*}\int_0^{N^*}\pi(i, C(N^*), N^*)di + \left(1 - \frac{N^*}{M^*}\right)\overline{W} - f = \overline{W}. \tag{6}$$

That is, an entrant pays f and randomly draws a plot i. With probability N^*/M^* the entrant draws a plot $i < N^*$, plants sugar and earns on average $(N^*)^{-1}\int_0^{N^*}\pi(i, C(N^*), N^*)di$. With probability $1 - N^*/M^*$ the entrant draws a plot $i > N^*$, returns to England and earns $\overline{W}$.

An equilibrium is a mass of entrants M^*, a mass of planters N^*, and a level of coercion $C(N^*)$ such that plantation-worker earnings satisfy equation (1), a worker on freeholder plot i earns $\Phi - i$, planter profits satisfy equation (2), the maximizer of $W(C)$ in equation (3) is $C(N^*)$ of equation (4), the planter on the marginal estate $i = N^*$ is indifferent between staying and leaving (equation 5), and entrants M^* are indifferent between entering and not entering (equation 6). Appendix B.3 proves that an equilibrium exists, is unique, is interior in the sense that $0 < N^* < L$ and is characterized by figure 9.

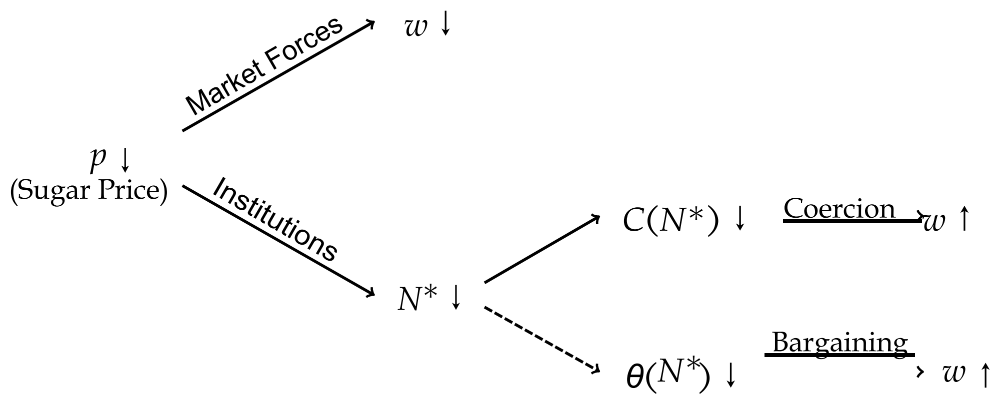
3.4 Comparative Statics

We now consider how the comparative statics of the model can inform the empirical specification. Totally differentiating equation (1) yields:

$$dw = \underbrace{(1-\theta)\phi x}_{+}\,dp - [\underbrace{\theta C_N}_{+} + \underbrace{(p\phi x - \Phi + L + C)\theta_N}_{+}]dN + \underbrace{(1-\theta)px}_{+}\,d\phi + \underbrace{\theta}_{+}\,d(\Phi - L). \tag{7}$$

That is, wages are increasing in the price of sugar p, in sugar productivity ϕ and the exogenous component of the outside option $(\Phi - L)$. In contrast, wages are decreasing in the size of the plantation elite N because N influences both the level of coercion ($C_N > 0$) and the share of the

Figure 10: The Impact of Sugar Prices, Productivity, and the Outside Option on Wages



surplus that goes to the planter ($\theta_N > 0$). Totally differentiating equation (4) yields:

$$dC = \underbrace{C_N}_{+} dN. \tag{8}$$

Equations (7)–(8) are illustrated in figure 10. A fall in the price of sugar sets off market forces that lower the value of the marginal product of labour and hence depress wages. The fall in the price of sugar also sets off institutional forces by weakening the planter elite ($N^* \downarrow$). This reduces coercion ($C(N^*) \downarrow$) and hence raises wages. If in addition $\theta_N > 0$ then there is a secondary mechanism whereby the fall in N reduces θ, which directly reduces wages.

Equations (7)–(8) and figure 10 motivate our core regressions:

$$\ln w_{it} = \beta^w N_{it} + \gamma^w \ln p_t + \delta^w X_{it} + \lambda^w_i + \lambda^w_t + \varepsilon^w_{it} \tag{9}$$

$$C_{it} = \beta^c N_{it} + \delta^c X_{it} + \lambda^c_i + \lambda^c_t + \varepsilon^c_{it} \tag{10}$$

where i indexes colonies, t indexes years, N_{it} is our measure of the strength of the plantation economy (the share of sugar in total exports), X_{it} is a vector of observed measures of productivity and outside options, and the λs are fixed effects.[11] As in figure 10, our core predictions about the institutional-change channel are $\beta^w < 0$ and $\beta^c > 0$. Our core predictions about the market-forces

[11]We cannot include both $\ln p_t$ and year fixed effects λ_t.

channel are $\gamma^w > 0$ and the restriction that $\ln p_t$ does not belong in the coercion equation.

4 Data Sources

4.1 *Colonial Blue Books*

Starting in the mid-1830s, the colonial administration began collecting statistics on local conditions in its colonies. Each colony filled out an annual *Blue Book* and sent it to London where it is now stored in the British National Archives. We photographed the relevant pages of the archived *Blue Books*, manually entered the relevant data into spreadsheets, and built a detailed panel data set on wages, legal coercion, and exports. The panel runs from 1838 to 1913 and includes our 14 colonies. The *Blue Books* report daily wages for 'predial' workers i.e., for agricultural workers who might move from plantation to plantation without a contract and without transfers in kind such as rental of a cottage or use of provision lands. In a handful of cases, wages were reported as weekly or monthly, in which case we divided them by 5 or 20. In a few other cases, wages were reported as a range, in which case we used the midpoint. Where possible we have compared our wage data to wages cited in contemporary sources such as Sewell (1861). Wages are very sticky and as a result we also considered smoothing them using moving averages of 1 to 3 years. Smoothing strengthens our results, but we do not report these. Since wages are nominal, we attempted to construct a cost-of-living index, but key components of such an index (food and clothing) were imported from Britain and so had the same price in every colony. As a result, the cost of living moved in tandem across colonies and is absorbed by year fixed effects. (Import data by origin of imports are from the *Blue Books*.)

The *Blue Books* report extensive data on the value of exports by crop. For 1838–1854 and 1913, our export data come directly from the *Blue Books*. For 1854–1912, export data are from the annual *Statistical Tables Relating to the Colonial and Other Possessions of the United Kingdom*. These Statistical Tables – available on line at the *House of Commons Parliamentary Papers Online Database* – report on a subset of the *Blue Books* data, allowing us to economize on trips to the National Archive. We verified that data in the *Statistical Tables* and *Blue Books* are identical.

Sugar prices, and indeed all export prices that we use, are from Blattman et al. (2007). Because of sugar's importance to our study, we verified that the prices in Blattman et al. (2007) are practically identical to Deere (1950), the seminal work on the subject. The *Blue Books* sometimes report sugar exports in quantities, which allowed us to compute short series on sugar prices. These short series all moved in exactly the same way as the sugar-price series in Blattman et al. (2007) and Deere (1950). Finally, the main cross-sectional characteristics of our 14 colonies in 1838 appear in online appendix table 1.

4.2 Legal Coercion

Ideally, we want four measures of legal coercion, one for each of the four types of legal coercion documented above. Despite our best efforts, we were unable to find long time series on (1) statutes governing tenancy-at-will or related legal cases, (2) land-use restrictions or land-price data, (3) statutes on trespass or related convictions, or (4) restrictions on emigration or related emigration statistics. We do have data on immigration of indentured East Indian workers from Roberts and Byrne (1966).

The one series that we consistently have across colonies and time is the *Blue Book* data on incarceration rates per capita. This is the flow of new incarcerations per year divided by the population. While the data are consistently available, they have two shortcomings. First, they reflect only one of our four types of legal coercion. Second, we do not know the reason for the incarceration i.e., they include incarcerations for reasons other than trespass and vagrancy.[12]

Nevertheless, Brizan (1984, 134) reports that in Grenada, two-thirds of court cases from 1850 to as late as 1890 involved legal coercion. Grenada was likely typical in this respect. Further, the history of West Indies riots indicates that legal coercion was often behind increases in incarceration rates. By far the most important rebellion in the British West Indies during 1838–1913 was Jamaica's Morant Bay Rebellion (1865). At the time, a number of villages had illegally been established on Crown lands in the hills above Morant Bay. Tensions ran high as the government sought to limit any further expansion of these villages. Things came to a head during a trespass case involving a villager who had been pasturing on an abandoned estate (Underhill, 1895, page 59). A crowd gathered at the courthouse, violence broke out and quickly spread throughout Jamaica. 600 people died and many more peasants were imprisoned (Underhill, 1895; Craton, 1988).

Another example is the 1853 riots in the Virgin Islands. As a result of hurricanes, the colony

[12]In contrast, Naidu and Yuchtman (2013) use incarceration rates that are specific to Master and Servant cases.

was carrying a large public debt. The government responded by shifting the tax burden onto peasants, which is our second form of legal coercion. Specifically, in 1853 the government doubled the head tax on livestock, the most important peasant activity. This led to escalating tensions, a major riot and many incarcerations (Dookhan, 1975, ch. 7 and especially 156).

Other examples of how increased legal coercion translated into increased incarcerations can be found in each and every one of our colonies. Thus, our incarceration-rate data are informative about legal coercion.

5 OLS Evidence

Table 1, a stripped-down OLS specification, is our single most important table. It reports our baseline specifications for the wage and incarceration-rate equations (equations 9–10). There are a very large number of specification choices built into the table and we will consider many alternative specifications in subsequent sections, but it will turn out that the results in table 1 are representative. We therefore ask for the reader's indulgence in temporarily suspending any disbelief about robustness so as to put forward our key results as quickly as possible.

Consider panel A. The sample is 14 colonies in 1838–1913. The dependent variable is log wages $\ln w_{it}$. 944 observations have non-missing wage data, which is 93% of all possible observations. In column 1, we regress $\ln w_{it}$ on the log of the London price of sugar. The coefficient is zero, which is the puzzle discussed in the introduction. In column 2, we add the figure 6 lowess-smoothed share of sugar in total exports, which is our measure of relative planter power N_{it}. The coefficient on the price of sugar is now positive and the coefficient on sugar shares is negative. This is precisely as predicted in figure 10.

The novel aspect of the paper is the institutional-change channel (N_{it}). We therefore want to ensure that the coefficient on N_{it} is not an artifact of some unmodelled omitted trend. In column 3 we thus add year fixed effects. Since $\ln p_t$ only varies across years it disappears from the regression. Reassuringly, the coefficient on N_{it} does not change at all.

Panel B has the same structure as panel A except that the dependent variable is incarceration rates per capita C_{it}. There are 856 observations with non-missing data on incarceration rates, which is 84% of all possible observations. As predicted in figure 10, the column 2 coefficient on

Table 1: Baseline Regressions

Panel A. Dependent Variable: Log Wages $\ln w_{it}$

	Static				Lagged Wages (Dynamic)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
N_{it}: Sugar exports as a share of total exports		-0.44***	-0.44***	-0.44***		-0.58***	-0.42***	-0.47***
		(-3.11)	(-3.25)	(-3.16)		(-4.21)	(-4.01)	(-4.03)
$\ln p_t$: Price of sugar in London	0.03	0.19***			0.09	0.28***		
	(0.58)	(3.42)			(1.22)	(3.68)		
$\ln w_{i,t\text{-}1}$: Lagged wages					0.79***	0.76***	0.75***	0.75***
					(15.68)	(15.68)	(16.41)	(14.27)
Colony FE	y	y	y	y	y	y	y	y
Year FE	n	n	y	y	n	n	y	y
Observations	944	944	944	803	893	893	893	768
R^2	0.65	0.68	0.75	0.69	0.87	0.88	0.90	0.87

Panel B. Dependent Variable: Incarceration Rates per Capita C_{it}

	Static				Lagged Incarceration Rates (Dynamic)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
N_{it}: Sugar exports as a share of total exports		0.47**	0.59***	0.57***		0.41**	0.47***	0.50***
		(2.46)	(3.61)	(4.09)		(2.46)	(3.52)	(3.65)
$\ln p_t$: Price of sugar in London	0.08	-0.10			0.07	-0.09		
	(0.97)	(-0.97)			(0.96)	(-0.99)		
$C_{i,t\text{-}1}$: Lagged incarceration rates					0.65***	0.64***	0.63***	0.62***
					(10.86)	(10.89)	(11.10)	(10.40)
Colony FE	y	y	y	y	y	y	y	y
Year FE	n	n	y	y	n	n	y	y
Observations	856	856	856	803	783	783	783	737
R^2	0.48	0.49	0.58	0.60	0.71	0.71	0.75	0.76

Notes: Panel A presents estimates of the wage equation (9). Panel B presents estimates of the coercion equation (10) where coercion is measured as incarceration rates per capita. N_{it} is the lowess-smoothed share of sugar in total exports as displayed in figure 6. (*a*) There are two differences between the 'static' and 'dynamic' columns. The latter includes the lagged dependent variable. It also reports the long-run coefficients on N_{it} and $\ln p_t$. (*b*) All specifications include colony fixed effects. Year fixed effects are added in columns 3, 4, 7, and 8 and, as a result, $\ln p_t$ is suppressed. (*c*) Sample sizes vary across columns. There are 944 observations with wage data, 856 observations with incarceration-rate data, and 803 observations with both wage and incarceration-rate data. Columns 5–8 use the same samples as columns 1–4, respectively, except for observations lost through missing lags. (*d*) Standard errors are clustered by colony. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. *t*-statistics are in parentheses.

Table 2: The Impact of Declining Sugar Prices on Wages and Incarceration Rates per Capita

	Change in Log Wages			Change in Incarceration Rates
	Market-Forces Channel	Institutional Channel	Total	Institutional-Change Channel
Colony Type	(1)	(2)	(3)	(4)
Group 1- Completely stayed in sugar: $\Delta N_{it} = 0.00$	-0.24	0.00	-0.24	0%
Group 2 - Patially stayed in sugar: $\Delta N_{it} = -0.54$	-0.24	0.24	0.00	-29%
Group 3 - Completely exited sugar: $\Delta N_{it} = -1.00$	-0.24	0.44	0.20	-54%

Notes: Column 1 is $\gamma^w \Delta \ln p_t$ where $\gamma^w = 0.19$ (from table 1, panel A, column 2 1) and $\Delta \ln p_t = \ln p_{1913} - \ln p_{1838} = -1.27$. Column 2 is $\beta^w \Delta N_{it}$ where $\beta^w = -0.44$ (from table 1, panel A, column 2 1) and ΔN_{it} is indicated in the row name. Column 3 is columns 1 plus 2. Column 4 is $\beta^w \Delta N_{it}$ where $\beta^w = 0.59$ (from table 1, panel B, column 3) and ΔN_{it}. The column is expressed as a percentage of the sample's average incarceration rate per capita.

$\ln p_t$ is zero and the coefficient on N_{it} is positive. Further, the latter coefficient is slightly larger with year fixed effects. Nothing in standard trade models would lead one to consider such a regression or expect the observed sign pattern.

We turn next to the magnitudes of the wage equation coefficients in column 2 and the incarceration rate coefficient in column 3. During 1838–1913 the log price of sugar fell by 1.27 points. Further, N_{it} fell on average by 0.54 so that, roughly speaking, $\Delta N_{it} = -0.54$ for group-2 colonies (colonies that had an average decline in sugar), $\Delta N_{it} = 0$ for group-1 colonies (colonies that stayed completely in sugar), and $\Delta N_{it} = -1.00$ for group-3 colonies (colonies that completely exited sugar). Table 2 translates our coefficients into more meaningful magnitudes. The market-forces impact of declining sugar prices was a 0.24 log point fall in wages. The institutional-change impact of declining relative planter power was a 0.24 log point increase in wages for the average colony ($\Delta N_{it} = -0.54$) and a much larger 0.44 log point increase for the group-3 colonies where sugar completely collapsed. The net impact of these two channels varies by group, but the interesting thing is that where sugar collapsed entirely, the institutional-change channel dominated the market-forces channel ($-0.24 + 0.44 = 0.20$). This illustrates the central thesis of the paper.

5.1 Robustness of the OLS Estimates

1. A Dynamic Model: While our colony-level clustering controls for serial correlation in the residuals, given the persistent time-series properties of wages, incarceration rates, and institutions it is wise to model this persistence in a more structured way. To this end we include a lagged dependent variable.[13] Columns 5–8 of table 1 report the results with one-year lagged dependent variables e.g.,

$$\ln w_{it} = \gamma^w \ln p_t + \beta^w N_{it} + \rho^w \ln w_{i,t-1} + \lambda_i^w + \lambda_t^w + \varepsilon_{it}^w .$$

For comparability, we report the long-run coefficients $\gamma^w/(1-\rho^w)$ and $\beta^w/(1-\rho^w)$. In table 1, comparison of columns 1–4 with columns 5–8 shows that the static and dynamic models generate similar estimates.

2. The Common Sample: In columns 4 and 8 of table 1, we restrict the sample to observations where there are data for both log wages and incarceration rates. Comparing columns 3 with 4 or 7 with 8, it is clear that the different samples yield similar conclusions.

3. Alternative Prices: It reasonable to argue that we should be using the price of the export basket rather than just the price of sugar. For one, what matters is how exports impact labour demand in total, not just labour demand in sugar. For another, once a colony stops producing sugar, the sugar price is no longer relevant. Blattman et al. (2007) report world prices for a large number of commodities. Combining these with export data from the *Blue Books*, we computed the export price index $PE_{it} \equiv \sum_j \theta_{ijt} \ln p_{jt}$ where j indexes crops, p_{jt} is the world price of crop j, and θ_{ijt} is the share of crop j in the total exports of colony i. Table 3 reports results using PE_{it}. Consider the wage equation (panel A). In column 1, PE_{it} is by itself and is insignificant, which is another example of the zero-correlation puzzle. In column 2, N_{it} is added and both regressors are significant, just as we saw in table 1. In column 3, both PE_{it} and the log price of sugar $\ln p_t$ are included, but only $\ln p_t$ is significant. Further, the coefficient on N_{it} (-0.43) is the same as in column 3 of table 1 (-0.44). Similar results obtain for the dynamic specification in columns 5–7.[14] The results for incarceration rates (panel B of the table) are similar to what we saw earlier. The theory states that prices should not matter and this is what we find. Further, adding PE_{it} barely affects the coefficient on N_{it}.

4. Interactions: One way of reformulating our argument is to say that the stronger is the

[13] Lagged dependent variables with fixed effects can be a problem, but as Nickell (1981) shows, the bias is of order $O(1/T)$ where $T \approx 76$ is the number of years. Hence the bias is only $1/76$ or 1.3%, which is to say tiny.

[14] We do not report results with year fixed effects because then PE_{it} is statistically insignificant. Despite the fact that PE_{it} varies by colony, most of its variance is driven by time series variation and this is swept out by the year fixed effects.

Table 3: Alternative Prices and Interactions

Panel A. Dependent Variable: Log wages ln w_{it}

	Static				Lagged Wages (Dyanmic)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
N_{it}: Sugar exports as a share of total exports		-0.34***	-0.43***			-0.44***	-0.56***	
		(-3.07)	(-3.32)			(-3.84)	(-4.39)	
PE_{it}: Export price	-0.00	0.12***	-0.11		0.05	0.20***	-0.13**	
	(-0.00)	(3.40)	(-1.56)		(0.59)	(3.20)	(-2.43)	
$\ln p_t$: Price of sugar in London			0.27***				0.38***	
			(3.60)				(4.89)	
$\ln p_t N_{it}$: Interaction				-0.10***				-0.09***
				(-3.38)				(-4.15)
$\ln w_{i,t-1}$: Lagged wages					0.79***	0.77***	0.76***	0.75***
					(15.73)	(15.32)	(15.63)	(16.14)
Colony FE	y	y	y	y	y	y	y	y
Year FE	n	n	n	y	n	n	n	y
Observations	944	944	944	944	893	893	893	893
R^2	0.65	0.67	0.68	0.75	0.87	0.88	0.88	0.90

Panel B. Dependent Variable: Incarceration Rates per Capita C_{it}

	Static		Lagged Incarc. Rates (Dynamic)	
	(1)	(2)	(3)	(4)
N_{it}: Sugar exports as a share of total exports	0.49**		0.44***	
	(2.52)		(2.83)	
PE_{it}: Export price	-0.10		-0.22	
	(-1.02)		(-1.39)	
$\ln p_t$: Price of sugar in London	-0.02		0.08	
	(-0.26)		(0.68)	
$\ln p_t N_{it}$: Interaction		0.12***		0.10***
		(3.44)		(3.25)
$C_{i,t-1}$: Lagged incarceration rates			0.64***	0.63***
			(10.83)	(11.26)
Colony FE	y	y	y	y
Year FE	n	y	n	y
Observations	856	856	783	783
R^2	0.49	0.58	0.71	0.75

Notes: Panel A presents estimates of the wage equation (9). Panel B presents estimates of the coercion equation (10) where coercion is measured as incarceration rates per capita. Standard errors are clustered by colony. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. *t*-statistics are in parentheses. See notes (*a*)–(*c*) to table 1 for details.

planter elite, the smaller is the impact of $\ln p_t$ on wages. Mathematically, the larger is N_{it}, the less positive should be the coefficient on $\ln p_t$ in the wage equation. This suggests that we should include the interaction $N_{it} \times \ln p_t$ as a regressor and expect it to have a negative coefficient in the wage equation. Arguing symmetrically, $N_{it} \times \ln p_t$ should have a positive coefficient in the coercion equation. The results appear in columns 4 and 8 of panel A and columns 2 and 4 of panel B. The coefficients have the expected signs and are statistically significant. It turns out that there is nothing empirically new in using $N_{it} \times \ln p_t$ in place of N_{it}. This is because, after controlling for colony and year fixed effects, N_{it} and $N_{it} \times \ln p_t$ are almost perfectly correlated. Restated, N_{it} and $N_{it} \times \ln p_t$ explain exactly the same sample variation so that it does not matter which we include.[15] Further, conclusions about magnitudes are also the same for the N_{it} and $N_{it} \times \ln p_t$ models.[16]

5. Labour Supply Shocks: The model sketched one specific market-forces channel, but there are others of interest and here we consider one of them. During 1838–1913 the most significant international movement of people was the arrival of indentured immigrants, mostly from India. According to Roberts and Byrne (1966), between 1838 and 1913, cumulative net immigration was 230,000 for Guyana, 124,000 for Trinidad, 37,000 for Jamaica and smaller amounts for Grenada, St. Lucia, Antigua and Dominica. Restated after crudely controlling for colony size, the ratio of cumulative net immigration to 1913 population exceeded 0.15 for only two colonies, Trinidad where it was 0.37 and Guyana where it was 0.77. This illustrates that immigration was important in only two colonies and so cannot be expected to influence our conclusions.

The other labour supply shock was much smaller. British West Indies workers left for Guyana during the post-1880 gold rush and for Panama during the building of the canal by the French (1881-1889) and Americans (1908–1913).

We consider these labour-supply variables in table 4. Column 1 is the same specification as in column 2 of table 1, except that we have added five labour-supply variables. 'Indentured immigrants' is either the log of cumulative net immigration from 1838 to year t or, where there was no immigration, 0. Not only is it statistically significant, but it is also economically large. It depressed wages by 0.23 log points in Guyana ($-0.019 \times \ln(230,000)$) and by about 0.15 log points in colonies that received smaller numbers of immigrants. The remaining regressors in column 1

[15]Specifically, the regression $N_{it} \times \ln p_t = \beta N_{it} + \lambda_i + \lambda_t + \varepsilon_{it}$ has an R^2 of 0.98.

[16]In table 3, panel A, column 4, the derivative of log wages with respect to N_{it} is $(-0.10) \times \ln p_t$. The mean of $\ln p_t$ is 5.1 so the derivative is $-0.10 \times 5.1 = -0.51$. This is very similar to the table 1, column 3 coefficient on N_{it} of -0.44.

Table 4: Labour Supply Shocks: East Indian Emmigration and Out-Immigration

	Dependent Variable: Log Wages $\ln w_{it}$				
	Static			Dynamic	
	(1)	(2)	(3)	(4)	(5)
N_{it}: Sugar exports as a share of total exports	-0.41**	-0.44***	-0.44***	-0.56***	-0.42***
	(-2.63)	(-3.09)	(-3.49)	(-4.06)	(-3.92)
$\ln p_t$: Price of sugar in London	0.20***	0.19***		0.28***	
	(4.44)	(3.53)		(3.72)	
Indentured immigrants (East Indians)	-0.019***	-0.018***	-0.024**	-0.027	-0.028**
	(-3.12)	(-3.30)	(-2.94)	(-1.64)	(-2.27)
Panama Canal	-0.033				
	(-0.44)				
(Panama Canal)^2	0.006				
	(0.55)				
Guyana gold rush	0.076				
	(0.62)				
(Guyana gold rush)^2	-0.011				
	(-0.62)				
$\ln w_{i,t-1}$: Lagged wages				0.76***	0.74***
				(15.31)	(15.94)
Colony FE	y	y	y	y	y
Year FE	n	n	y	n	y
Observations	944	944	944	893	893
R^2	0.69	0.69	0.76	0.88	0.90

Notes: This table presents estimates of the wage equation (9), but with added regressors that are described in the text. Columns 2, 3, 4, and 5 correspond to table 1, columns 2, 3, 6, and 7, respectively, but with the inclusion of 'Indentured immigrants.' Standard errors are clustered by colony. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. *t*-statistics are in parentheses. See notes (*a*)–(*c*) to table 1 for additional information.

are insignificant. 'Panama Canal' is the interaction of the log of a colony's distance from Panama with a dummy that is 1 when the canal was being built (1881–1889 and 1908–1913) and 0 in all other years. 'Guyana gold rush' is the interaction of the log of one plus a colony's distance from Guyana with a dummy that is 1 after gold was discovered (1880) and 0 in all other years. (We add one before taking the log of distance so that Guyana is at 0 distance.) These four regressors are not statistically significant either individually or jointly ($F_4 = 1.45$, $p = 0.27$). We therefore drop them in the remaining specifications. Columns 2–5 repeat the main specifications of our baseline table 1 except for the inclusion of indentured immigrants. The key conclusion is that *all* of the estimated coefficients on N_{it} and $\ln p_t$ are unchanged.[17]

6. Destructive Regression Diagnostics: In the online appendix we examine whether our results are sensitive to outliers or other features of the data. In online appendix table 3 we drop one decade at a time, re-estimate our main specifications and report the results. None of our results are changed. In online appendix table 4 we revisit the year fixed effects out of concern that we may be overfitting the data, which might lead to unanticipated results. We replace year fixed effects with decade fixed effects. We also replace year fixed effects with polynomials in time of the form $\sum_{k=1}^{n} \alpha_k (year - 1837)^k$ for $n = 2, 4, 6$. Again, none of our results are changed.[18]

7. A Placebo Test: One can ask whether similar results would obtain no matter what crop we used. While our historical analysis surrounding figure 7 suggests not, we can examine this directly. We re-run our regressions by replacing the sugar export share with an export share of some other crop. Consider column 1 of table 5 where the dependent variable is log wages. The first row ('sugar') is our baseline result from table 1, panel A, column 3. The next row ('cocoa') replaces the sugar export share with the cocoa export share. Thus, each element of the column is a separate regression with a different crop share. Looking down the column, only sugar has a statistically significant negative coefficient. Further, a number of the coefficients are statistically positive. Thus, our results for sugar do not hold for any of the placebo crops.[19]

[17]The five labor-supply variables in table 4 deal with the market-forces channel and so should be insignificant in the incarceration-rate equation. This is indeed the case, as shown in online appendix table 2.

[18]We can also omit colonies one at a time. All the coefficients in table 1 are robust to this omission: coefficients are stable and always significant *at least* at the 5% level (usually at the 1% level). For example, in our preferred specification of table 1 column 7, the coefficient on N_{it} in the wage equation varies between -0.34 and -0.47 and is always significant at the 1% level while the coefficient on N_{it} in the incarceration-rate equation varies between 0.41 and 0.57 and is always significant at the 1.5% level.

[19]The result for fruits, the most negative of the non-sugar coefficients, is telling. Starting in the 1890s, the United Fruit Company emerged as a major buyer and then major producer of fruit (bananas) in Jamaica. When we delete post-

Table 5: Regressions with Other Export Crops

	Export Shares				Log Exports	
	Log Wages		Incarceration Rates		Log Wages	Incarc. Rate
Crop	(1)	(2)	(3)	(4)	(5)	(6)
Sugar	-0.44***		0.59***		-0.054***	0.04
	(-3.25)		(3.61)		(-5.05)	(1.77)
Cocoa	0.33**	0.33**	-0.09	-0.26	-0.007	0.02
	(2.56)	(2.82)	(-0.36)	(-1.32)	(-0.88)	(0.67)
Coffee	0.73	0.58	-2.19***	-2.78***	0.006	-0.02
	(0.99)	(1.21)	(-3.66)	(-3.50)	(1.20)	(-1.31)
Limes	0.61***	0.59***	0.29**	0.15	0.029***	-0.01
	(4.92)	(3.85)	(2.49)	(1.47)	(3.42)	(-0.70)
Livestock	0.64***	0.70***	-0.80***	-0.83***	-0.005	-0.00
	(5.25)	(6.68)	(-3.27)	(-3.37)	(-0.53)	(-0.13)
Arrowroot	-0.12	0.01	-0.32	-0.40*	0.054**	0.04
	(-1.00)	(0.17)	(-1.53)	(-2.07)	(2.69)	(0.55)
Fruit (Bananas)	-0.33	-0.18	-0.56	-0.82**	0.018*	-0.02
	(-1.49)	(-0.88)	(-1.48)	(-2.68)	(2.03)	(-0.58)
Fruits (Bananas)[a]	0.18					
	(0.70)					
Colony FE	y	y	y	y	y	y
Year FE	y	y	y	y	y	y
Observations		944		856	944	856
R-squared		0.76		0.59	0.78	0.57

Notes: The dependent variable is listed in the header. In column 1, each entry is a separate regression. The specification of each is the same as in column 3 of table 1, but with the sugar export share N_{it} replaced by the indicated crop export share e.g., the cocoa regressor is exports of cocoa as a share of total exports. Column 2 is a single regression that includes all the crop shares. Since crop shares sum to unity, we omit one crop (sugar). Columns 3–4 repeat columns 1–2, but with incarceration rates per capita as the dependent variable. In columns 5–6 we regress log wages and incarceration rates per capita on log exports, $\ln(1 + x_{ijt})$ where x_{ijt} is exports of crop j by colony i in year t. Standard errors are clustered by colony. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. t-statistics are in parentheses.

a) Post-1890 Jamaica is omitted. See text.

Column 3 of table 5 repeats the exercise for incarceration rates per capita. Again, the first entry is our baseline results from table 1, panel B, column 3. All of the remaining coefficients are negative with the exception of limes.[20] Again, the results for sugar do not extend to other placebo crops.

Alternatively, we can include all the crop export shares together, as is done in columns 2 and 4. Since export shares sum to unity, we must omit one crop (sugar). Comparing columns 1 and 2 or 3 and 4, the results do not change. In short, our sugar results pass the placebo test.

8. Is Sugar Really Special?: One can ask whether a different specification might offer a more conventional market-forces explanation for our sugar result. Agriculture is labour-intensive so that an increase in agricultural exports increases the demand for labour and hence increases wages. Therefore, a regression of wages on log exports of each crop should yield positive coefficients. This regression appears in column 5 of table 5. As expected from the market-forces channel, the coefficients on all the non-sugar crops are either significantly positive or very close to zero. In contrast, the coefficient on sugar has the wrong sign: an increase in sugar exports reduces wages. Clearly, sugar is special.[21]

9. Adding Additional Structure: According to the model, wages should depend on coercion and coercion should depend on the strength of the planter elite. See figure 10. We can thus consider regressing $\ln w_{it}$ on C_{it} and instrumenting C_{it} with N_{it}. We implement this in a model with both colony and year fixed effects. The resulting IV coefficient on C_{it} is -0.77 ($t = -2.55$) for the static model and -0.86 ($t = -2.85$) for the dynamic model. That is, high levels of coercion lead to low levels of wages, just as predicted by the model. Further, exogeneity of C_{it} is rejected. Online appendix table 5 reports the full results. We do not emphasize these results for three reasons. First, our measure of coercion (incarceration rates per capita) captures just a small part of the four aspects of legal coercion discussed in the history section. It should therefore be more weakly correlated with wages than a fuller measure of coercion would be. Second, and reflecting

1890 Jamaica from our sample and re-estimate fruit, the coefficient becomes positive (0.18). Thus, the largest negative placebo coefficient can be traced directly to power over workers.

[20] This is associated with the post-1890 coincidence in Dominica of tax riots and increased lime production. When we delete post-1890 Dominica from our sample the coefficient on lime becomes small and insignificant (0.10 with $t = 0.25$).

[21] The political economy of legal coercion is about the strength of planter interests *relative* to peasant interests, which in turn depends on export *shares*. The *absolute* level of exports should not matter for the political economy of incarceration rates. In column 6, we regress incarceration rates on log exports and find that none of the coefficients is significant, as predicted.

this first drawback, these IV results tend to be more sensitive to the choice of specification. Third, the instrument N_{it} is itself arguably endogenous, a point we will examine shortly.

10. Clustering: In the tables above we reported results clustered by colony. This addresses our largest concern and one raised by Bertrand, Duflo and Mullainathan (2004), namely, serial correlation within a cross-sectional unit, i.e. a colony. Another concern is correlation across colonies within a given year due to common shocks such as the repeal of the preferential sugar tariff (see figure 4) or the cholera epidemic of 1854–1856 (Salmon, 1888). To address these concerns we also ran all our main specifications with two-way clustering (Cameron, Gelbach and Miller, 2011) that allows for arbitrary correlations within colony and, separately, for arbitrary correlations within year.

An additional issue is that the theory underlying standard clustering relies on asymptotics in the number of clusters and these asymptotics do not hold with 14 clusters (colonies). One solution is the standard bias correction. All the standard errors reported in this paper are bias-corrected for small numbers of clusters. Cameron and Miller (2015) suggest the more radical wild bootstrap method. This method does not rely on asymptotic theory and has been shown in simulations to be the most conservative approach to dealing with small numbers of clusters.

Turning to implementation of these alternative clustering methods, consider our static specification with colony and year fixed effects and consider the coefficients on N_{it} in the wage and incarceration-rate equations. With our baseline approach to clustering, the coefficient p-values are 0.005 and 0.003, respectively. With two-way clustering (colony- and year-level clustering), the p-values are 0.005 and 0.007. With the conservative wild bootstrap, the p-values are 0.010 and 0.025. In short, our results survive more conservative approaches to standard errors.[22]

To conclude this section, our OLS results in table 1 are robust.

[22] Standard errors can also be biased downwards when the numbers of observations per cluster vary dramatically across clusters (MacKinnon and Webb, 2014). This is not a concern here because we have 93% and 84% of all potential wage and incarceration-rate observations, respectively. Also, Brewer, Crossley and Joyce (2013) suggest using FGLS to improve efficiency in handling serial correlation with small numbers of clusters. We estimated the AR(1) coefficient ρ using Hsiao (1986, 55), then generalized-differenced the data ($\Delta x_{it} = x_{it} - \rho x_{i,t-1}$ for each variable x), and re-estimated the model with generalized differences and clustered standard errors. The resulting coefficients changed very little and had p-values of 0.001 and 0.003 for wages and incarceration rates, respectively.

6 Endogeneity of N_{it} and Instrumental Variables

Of course, N_{it} may be endogenous. A first-stage equation is arrived at by totally differentiating equation (5). This yields $\pi_N\ dN + \pi_p\, dp + \pi_\phi\, d\phi + \pi_{\Phi-L}\, d(\Phi - L) = 0$ where we have set $d\overline{W} = 0$ and substituted in equation (2). Solving for dN:

$$dN = \underbrace{(-\theta\phi x/\pi_N)}_{+}dp + \underbrace{(-\theta p x/\pi_N)}_{+}d\phi + \underbrace{(\theta/\pi_N)}_{-}d(\Phi - L) \tag{11}$$

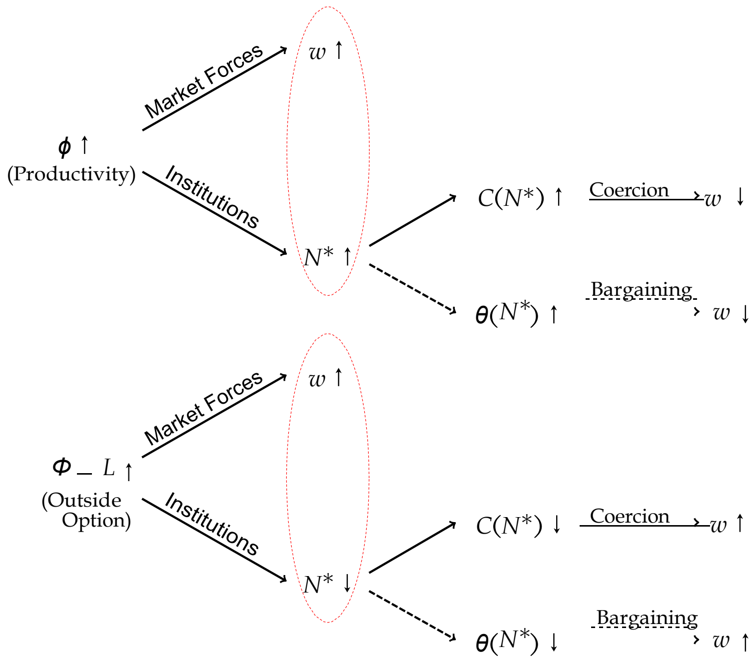
where we have used the fact that in a stable equilibrium $\pi_N < 0$. See Appendix B.2. That is, the size of the plantation elite is increasing in the price of sugar, increasing in productivity and decreasing in the outside options of workers.

Equation (11) highlights the endogeneity concern, namely, unobserved productivity shocks and unobserved outside-option shocks can induce a spurious correlation between $\ln w_{it}$ and N_{it}. The theory gives the direction of potential estimation bias. Figure 11 displays the theoretical impact of shocks to productivity and the outside option. The dashed ovals highlight the biases caused by unobserved shocks. The presence of productivity shocks in the residual of the wage equation will induce a spurious positive correlation between $\ln w_{it}$ and N_{it} i.e., $\beta^w < \text{plim}\beta^{w,OLS} < 0$. Restated, OLS will *under*estimate the impact of institutions on wages. In contrast, the presence of outside-option shocks in the residual will induce a spurious negative correlation between $\ln w_{it}$ and N_{it} i.e., $\text{plim}\beta^{w,OLS} < \beta^w < 0$. The intuition is simple. Productivity shocks are positive labour demand shocks and so raise both price (w_{it}) and quantity (N_{it}). This pushes up $\beta^{w,OLS}$. Outside-option shocks are negative labour supply shocks and so raise w_{it} and lower N_{it}. This pushes down $\beta^{w,OLS}$. It follows that our inference about the importance of the institutional-change channel is threatened by unobserved outside-options shocks, but not be unobserved productivity shocks.

6.1 Instruments: Sugar Suitability and Hurricanes

As discussed in section 2.3, cross-colony variation in the decline of sugar is explained by cross-colony variation in the suitability of soil for sugar cane cultivation and, in the case of the Virgin Islands, by hurricanes. In this section we describe our two instruments.

Figure 11: The Impact of Productivity (ϕ) and Outside Options ($\Phi - L$) on Wages



6.1.1 Sugar Suitability

Standard sources for crop-suitability data are too coarse for our colonies. For example, each grid cell in the *Geographically Based Economic Data* database (Ramankutty, Foley, Norman and McSweeney, 2002) – used, for example, in Michalopoulos (2012) and Alesina, Michalopoulos and Papaioannou (2013) – has a resolution of 0.5 degrees latitude by 0.5 degrees longitude, which, at the equator, is over 3,000 square kilometers. To give another prominent example, the crop suitability data compiled by the Food and Agriculture Organization (FAO) in the Global Agro-Ecological Zones (GAEZ) project – used, for example, in Costinot, Donaldson and Smith (forthcoming) – is at the 5 arc-minute level, which, at the equator, is 86 square kilometers. The smallest island in our data, Nevis, is as big as one cell in the FAO GAEZ data. The ten smallest islands in our data together fit into a single cell in the Ramankutty et al. (2002) database.

We therefore hired an expert to develop a suitability index with finer spatial resolution. The index uses six factors known to be crucial for sugar (temperature, rainfall, elevation, soil pH, slope, and soil texture). For example, sugar grows well with rainfall in the range of 1100–1500 millimetres per year, grows marginally in the ranges of 950–1100 or 1500–1990, grows poorly in the ranges of

800-950 or 1990–2500, and does not grow in the ranges below 800 or above 2500. Weights for the six factors were estimated using the artifical neural network described in Jayasinghe and Yoshida (2010). The estimation makes no use of Caribbean land use patterns (it is based on Sri Lankan data) so that the weights and therefore the index are entirely exogenous.

The six factors are available at the grid-cell size of 604 square-meters so that our 14 colonies have 643,025 cells. The model places each cell into one of four categories (highly suitable, marginally suitable, marginally unsuitable, and highly unsuitable). A sensible empirical feature of this model is that almost all the land in our sample is either highly suitable or marginally suitable. We therefore define our suitability index $Suit_i$ as the share of a colony's land that is highly suitable. Appendix C.1 provides more details.[23]

We use $Suit_i$ as follows. As the price of sugar p_t fell during 1838–1913, most of the contraction of sugar came at the extensive margin, meaning that less-suitable land was removed from production.[24] We therefore expect that a rise in sugar prices will raise production more at the extensive margin (where $Suit_i$ is low) than at the intensive margin (where $Suit_i$ is high). Restated, we expect N_{it} to increase with $\ln p_t$ and especially so where $Suit_i$ is low. We capture this by instrumenting N_{it} with $Suit_i \times \ln p_t$ and expect this instrument to have a negative coefficient.

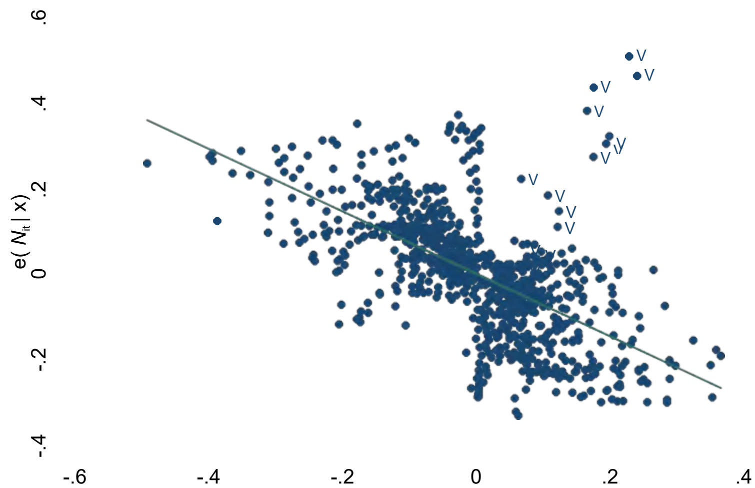
To get a sense of the power of this instrument, figure 12 displays the partial regression plot from the regression $N_{it} = \theta(Suit_i \times \ln p_t) + \lambda_t + \lambda_i + \varepsilon_{it}$ i.e., a plot of N_{it} against $Suit_i \times \ln p_t$ after sweeping out the year fixed effects (λ_t) and colony fixed effects (λ_i). Three features stand out. First, $\hat{\theta} < 0$ as expected. Second, the fit is good: $\hat{\theta} = -0.72$ ($t = -5.50$, $p = 0.000$). Further, the R^2 with just fixed effects is 0.80 and rises to 0.88 with the inclusion of $Suit_i \times \ln p_t$ i.e., the instrument explains 40% ($= 0.08/0.20$) of the relevant sample variation. Third, there are a large number of outliers to the top right. These are labelled 'V' and are the Virgin Islands in the early years of 1838–1854. This is the early collapse of Virgin Islands sugar that we will now explain by reference to hurricanes.[25]

[23] Online appendix figure 1 discusses the index in greater detail with particular reference to Jamaica. Jamaica is interesting because it illustrates at fine geographic detail that our highly suitable cells coincide with those areas that were under sugar cane cultivation in 1790 (as displayed in figure 5).

[24] We saw this in figure 8 at the colony level: Sugar output fell most in colonies that were least suitable for sugar. We can also see this at the sub-colony level by juxtaposing figure 5 with online figure 1 : The decline of Jamaican sugar production was associated with a decline in the amount of land under sugar cane cultivation and the land which came out of cultivation tended to be marginally suitable land.

[25] A fourth and more subtle feature of the figure is the series of observations located vertically at 0. These are Grenada and are vertical because $\mu_t \equiv \sum_i Suit_i/14$ almost exactly equals $Suit_{Grenada}$ so that, after sweeping out year fixed

Figure 12: Suitability of Sugar as an Instrument



Notes: This is a partial regression plot for the regression $N_{it} = \theta(Suit_i \times \ln p_t) + \lambda_t + \lambda_i + \varepsilon_{it}$ i.e., a plot of N_{it} against $Suit_i \times \ln p_t$ after sweeping out the year and colony fixed effects. θ = 0.72 (t = 5.50, p = 0.000, 944 observations). Observations labelled 'V' are the Virgin Islands in the years 1838–1854.

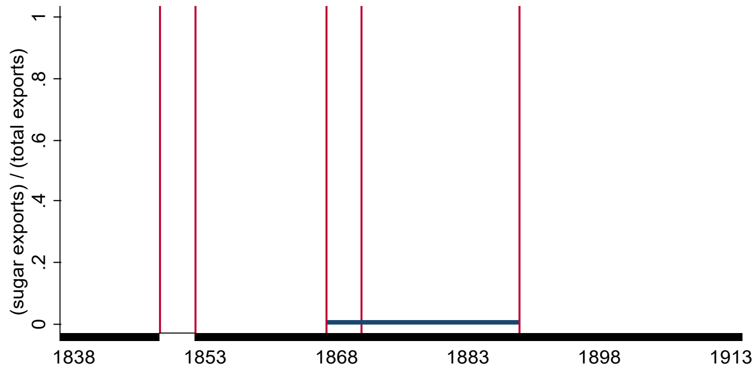
6.1.2 Hurricanes

Data on hurricane landfalls are from the United States National Hurricane Center (2014) and, for the pre-1851 period, from Tannehill (1938). Hurricane tracks were digitized and GIS software used to identify landfalls. The data distinguish between 'hurricanes' (categories 1 and 2) and 'major hurricanes' (categories 3, 4 and 5).

Hurricanes do two types of damage: They destroy crops and they destroy structures such as sugar mills. Since sugar cane must be processed within hours of harvesting and since cane is difficult to transport, there was always a sugar mill either on the plantation or nearby e.g., Higman (2001, figure 2.5). Sugar mills were unique in Caribbean agriculture in that they were expensive and long-lived assets that were prone to hurricane damage. Further, financing of mills was difficult, especially in the less successful colonies where planters were cashed-strapped (groups 2 and 3). See Marshall (1996a, 73) and Lobdell (1996, 322, 326). In a period of falling sugar prices, price covered a marginal planter's variable costs but not his fixed costs. It thus made sense for a marginal planter to operate an existing mill, but not to rebuild a destroyed mill. As a result,

effects, $(Suit_{Grenada}\ \mu_t) \ln p_t$ almost exactly equals zero. This is a feature of the data that affects the first-stage fit, but does not affect the second-stage results. Specifically, omitting Grenada does not affect our conclusions.

Figure 13: Hurricanes and the Decline of Virgin Islands Sugar



Notes: Vertical lines are hurricane dates.

hurricane strikes had long-lasting effects.

The experience of the Virgin Islands is illustrative. Hurricanes in 1848 and 1852 decimated the industry and hurricanes in 1867 and 1871 destroyed most of the remaining mills, including every single mill on the main island of Tortola (Dookhan, 1975, 126).[26] Figure 13 shows the evolution of sugar as a share of total exports in the Virgin Islands. The hurricanes of 1848 and 1852 led to permanent reductions in sugar's importance to the economy. Further, even if sugar had recovered after 1852, it would have been totally destroyed by the major hurricanes of 1867 and 1871.

Against this historical backdrop we assign each hurricane a 'damage' index, which is the two-year log change in sugar exports. Let x_{ist} be colony i's sugar exports in year t and let t_0 be the date of a hurricane so that $\Delta_i(t_0) \equiv \max\{0, \ln x_{is,t_0-1} - \ln x_{is,t_0+1}\}$ is the two-year log change in sugar exports. (If sugar exports increased after the hurricane then we set the two-year change to zero.) The logic for using two-year changes is as follows. We know from our data that crops almost always bounced back within a year after a major storm. In the first year there are declines in sugar exports both because of crop damage and because of infrastructure damage. In the second year, the crop comes back only to the extent allowed by the infrastructure damage so it is two years of

[26]Our dating of the earliest hurricane differs slightly from Dookhan, but this does not matter for our results. See Appendix C.2.

depressed exports that speaks to the infrastructure damage.[27]

Looking across the 28 hurricanes that made landfall in the British West Indies during 1838–1913, what stands out is the Virgin Islands: It was hit repeatedly, it was hit early on, and the hits did major damage. Also interesting is the fact that group-3 colonies tended to be hit much more often then other colonies. (The exception is Jamaica, which was hit more frequently but with less impact because of its size.)

Our hurricane-based instrument is the hurricane damage index $HDI_{it} \equiv \Delta_i(t_0)$ for $t \geq t_0$ and $HDI_{it} \equiv 0$ for $t < t_0$. If there were multiple hurricanes that hit before t then we take the sum of the $\Delta_i(t_0)$.

6.1.3 IV Estimates

Table 6 reports the instrumental variables (IV) results. The first-stage regression is:

$$N_{it} = \theta_1 HDI_{it} + \theta_2(Suit_i \times \ln p_t) + \theta_3 \ln p_t + \lambda_i + \lambda_t + \varepsilon_{it} \tag{12}$$

where the first instrument is the price of sugar times the colony's suitability for sugar and the second instrument is the hurricane damage index. The λs are year and colony fixed effects and $\ln p_t$ only appears in specifications without year fixed effects. We expect hurricane damage to reduce N_{it} ($\theta_1 < 0$) and, as discussed earlier, we expect $\theta_2 < 0$ and $\theta_3 > 0$.

Consider table 6. Panel C reports the first stage and shows that both instruments have the expected sign and are statistically significant. Panel A reports the IV second stage. Panel B reports the OLS counterpart which we report for ease of reference. Consider column 1. The IV coeffi- cient of 0.50 is statistically significant and larger than the OLS coefficient (0.44). The row labelled 'Endogeneity test' shows that the difference is not statistically significant ($p = 0.85 > 0.01$). The

[27] What follows is a list of the 28 hurricanes along with the year (t_0), the two-year log change in sugar exports ($\Delta_i(t_0)$), and an indicator for whether it was a major hurricane (*).

- Group-3 colonies (complete collapse of sugar): Virgin Islands 1848 (1.18), 1852 (1.46), 1867* (4.05), 1871* (0.18), 1899 (0.00); Montserrat 1851 (0.64), 1889 (0.15), 1899* (0.00), 1909 (0.13); Grenada 1856 (0.00); Dominca 1883* (0.18), 1903 (0.35); St. Vincent 1886 (0.48), 1898 (0.75).
- Jamaica (near collapse of sugar): 1874 (0.00), 1880 (0.00), 1886 (0.00), 1896 (0.10), 1903* (0.43), 1910 (0.05).
- Group-2 colonies (moderate decline of sugar): Tobago none; St. Lucia 1875 (0.00), 1894 (0.09); Trinidad 1878 (0.08).
- Group-1 colonies (no decline of sugar): Antigua 1910 (0.17); Barbados none; Guyana none; St. Kitts and Nevis 1859 (0.00), 1889 (0.08), 1908 (0.00), 1910 (0.15).

Table 6: IV Estimates

	Log Wages ($\ln w_{it}$)					Incarceration Rates per Capita (C_{it})		
	Static		Lagged Wages (Dynamic)			Static	Lagged Incarceration (Dynamic)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Second-Stage Regression (IV) for:								
N_{it}: Sugar exports as a share of total exports	-0.50**	-0.45**	-0.51***	-0.42***	-0.47***	0.75***	0.48**	0.47***
	(-2.34)	(-2.44)	(-3.27)	(-3.54)	(-4.21)	(3.58)	(2.65)	(3.06)
$\ln p_t$: Price of sugar	0.21**		0.26***					
	(2.93)		(3.81)					
Lagged dependent variable ($\ln w_{i,t-1}$ or $C_{i,t-1}$)			0.77***	0.75***	0.75***		0.63***	0.62***
			(15.51)	(16.72)	(14.37)		(10.80)	(10.20)
Endogeneity test (p value)	0.85	0.83	0.71	0.73	0.85	0.36	0.95	0.81
Hanson J overid (p value)	0.24	0.21	0.20	0.65	0.74	0.45	0.57	0.49
Weak instruments test (F)	68	44	42	38	37	35	32	35
Observations	944	944	893	893	768	856	783	737
Year Fixed Effects	n	y	n	y	y	y	y	y
Panel B: OLS								
OLS N_{it}: Sugar export share	-0.44***	-0.44***	-0.58***	-0.42***	-0.47***	0.59***	0.47***	0.50***
OLS $\ln p_t$: Price of sugar	0.19***		0.28***					
Panel C: First-Stage Regression for Sugar Export Share (N_{it})								
$\ln p_t\, Suit_i$: price × suitability	-0.80***	-0.79***	-0.79***	-0.78***	-0.77***	-0.79***	-0.78***	-0.78***
	(-8.59)	(-8.18)	(-8.53)	(-8.26)	(-8.14)	(-7.58)	(-7.63)	(-7.84)
HDI_{it}: Hurricane Damage Index	-0.09***	-0.08***	-0.08***	-0.06***	-0.07***	-0.08***	-0.07***	-0.07***
	(-8.84)	(-5.85)	(-5.56)	(-4.19)	(-4.15)	(-5.89)	(-4.87)	(-4.68)
$\ln p_t$: Price of sugar	0.64***		0.64***					
	(9.30)		(10.15)					
Lagged second-stage dep. var. ($\ln w_{i,t-1}$ or $C_{i,t-1}$)			-0.09	-0.12**	-0.12**		0.03	0.02
			(-1.41)	(-2.21)	(-2.39)		(1.65)	(1.46)
R^2	0.87	0.90	0.88	0.91	0.91	0.90	0.91	0.91

Notes: Panel C is the first-stage sugar export share equation (12). The instruments are $Suit \times \ln p_t$ and HDI_{it}. Panel A is the IV (second-stage) estimation for the wage equation (columns 1–5) and the coercion equation (columns 6–8). Panel B is the OLS counterpart to Panel A and is reported to make it easier to compare the IV and OLS coefficients. Large p and F values indicate that instruments are valid (excludable from the second stage and correlated with N_{it}) and that endogeneity is rejected. All specifications have colony fixed effects. Dynamic columns include the lagged dependent variable ($\ln w_{i,t-1}$ or $C_{i,t-1}$) and report the long-run coefficients on N_{it} and $\ln p_t$. See notes to table 1 for additional information, including a description of the number of observations. Standard errors are clustered by colony. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. t-statistics are in parentheses.

'Hanson J overid' row shows that the instrument exclusion restrictions are valid ($p = 0.24 > 0.01$) and the 'Weak instruments' row shows that the instruments are correlated with N_{it} ($F = 68 > 10$). In short, we have valid instruments which lead to IV estimates that are both precisely estimated and not statistically different from the OLS estimates. This is not surprising: We have argued that the differential decline of sugar is largely explained by exogenous agro-climactic factors.

Looking across the five log wage columns, it is clear that the same conclusion applies to all the wage specifications. Column 2 adds year fixed effects, columns 3–4 repeat columns 1–2 but with lagged wages included, and column 5 repeats column 4 but for the common sample. It is remarkable how in the specifications with year fixed effects the OLS and IV estimates are virtually identical.

Columns 6–8 are the same as columns 2, 4 and 5, respectively, except that the dependent variable is now incarceration rates per capita. (All the incarceration rate specifications include year fixed effects because, as usual, $\ln p_t$ is not significant. There is therefore no need to consider counterparts to columns 1 and 3.) Looking at columns 6–8, we again conclude that the instruments are valid and that we can reject endogeneity because the IV and OLS estimates are precisely estimated to be equal.

6.1.4 IV Sensitivity

We made a number of specification choices in constructing the hurricane damage index. First, a concern about hurricanes is measurement error in the historical hurricane data. To deal with this we consider a subset of hurricanes that were *a priori* likely to be the most damaging. We use two criteria for identifying these. The first is that the hurricane was a 'major hurricane.'[28] The second is the colony's vulnerability to storm surges. Hurricanes can generate storm surges in excess of 10 feet. For example, Longshore (2009, 419) reports that an 1876 U.S. Virgin Island hurricane had a 10-foot storm surge. We define storm-surge vulnerability as a hurricane landfall on a colony that has a high proportion of low-lying coastal land. Antigua and the Virgin Islands stand out here: The percentage of land with elevation of 10 feet or less is 35% in the Virgin Islands, 29% in Antigua, and less than 10% everywhere else. Online appendix figure 2 shows the distribution of elevations for each colony in our sample. (This is based on authors' calculations using GIS

[28]Major hurricanes are indicated by a * in footnote 27.

data.) We therefore code all Antiguan and Virgin Island hurricanes as storm surges. The results of defining HDI_{it} using major hurricanes and storm surges appear in panel A of table 7. This has virtually no affect on our conclusions.

Second, $\Delta_i(t_0)$ can be large even when the importance of sugar is small. For example, the 1867 Virgin Islands hurricane caused a large log change decrease in sugar exports, but at a time when sugar was already all but gone. To deal with this we modify our instrument by using $\Delta_i(t_0)\frac{x_{is,t_0-1}}{x_{i,t_0-1}}$ where x_{it} is total exports i.e., by multiplying $\Delta_i(t_0)$ by sugar's share of total exports before the hurricane strike. The results appear in panel B of table 7. This leads to larger IV coefficients, but does not change our conclusions because endogeneity continues to be rejected with high levels of confidence.[29]

Third, $\frac{x_{is,t_0-1}}{x_{i,t_0-1}}$ is arguably endogenous (see the low over-identification p values in panel B). Since this ratio depends on sugar prices, to avoid potential endogeneity this ratio can be replaced with p_{t_0-1}. This is done in panel C of table 7 where we redefine the hurricane instrument as $HDI_{it} = \Delta_i(t_0)p_{t_0-1}$. Again, the estimates are virtually identical to our baseline estimates of table 6.

Summarizing, the decline of sugar was largely exogenous to the wage and legal-coercion processes that interest us here. As a result, our OLS estimates are consistent.

7 Parish Level Results

At the start of the previous section we observed that the biggest threat to the interpretation of our results comes from unobserved shocks to outside options. While we saw no evidence of this in our examination of the Guyana gold rush or the Panama Canal construction (table 4), in this section we dig even deeper. Outside-option shocks likely affected all parishes within a colony in the same way and so can be controlled for at the parish level with colony-year fixed effects. Therefore, we gathered *Blue Book* data at the parish level on the closest counterparts to N_{it} and w_{it} that are available. We measure parish-level N_{it} as the percentage of cultivated land that is planted in sugar cane. We do not have parish-level wages, but we have parish-level mortality, which is both a proxy

[29] There is a slight difference between N_{it} and $\frac{x_{is,t_0-1}}{x_{i,t_0-1}}$. The former is lowess-smoothed and the latter is not smoothed. For example, figure 13 uses the latter.

Table 7: Alternative IV Specifications

	Log Wages ($\ln w_{it}$)					Incarceration Rates per Capita (C_{it})		
	Static		Lagged Wages (Dynamic)			Static	Lag Incarc. (Dynamic)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: HDI_{it} Defined Using Major Hurricanes and Storm Surges								
N_{it}: Sugar exports as a	-0.49**	-0.43**	-0.49***	-0.40***	-0.46***	0.78***	0.51**	0.50***
share of total exports	(-2.35)	(-2.37)	(-2.99)	(-3.29)	(-4.12)	(3.65)	(2.71)	(3.07)
$\ln p_t$: Price of sugar	0.20**		0.25***					
	(2.93)		(3.85)					
Lagged dependent variable			0.77***	0.75***	0.75***		0.63***	0.62***
($\ln w_{i,t-1}$ or $C_{i,t-1}$)			(15.36)	(16.65)	(14.30)		(10.81)	(10.19)
Endogeneity test (p value)	0.90	0.98	0.44	0.71	0.84	0.30	0.85	0.93
Hanson J overid (p value)	0.27	0.26	0.31	0.98	0.96	0.34	0.42	0.38
Weak instruments test (F)	80	45	40	36	35	37	34	35
Panel B: $HDI_{it} = \otimes_{it}(t_0)\ (x_{is,t0-1} / x_{i,t0-1})$								
N_{it}: Sugar exports as a	-0.61**	-0.58**	-0.67***	-0.57***	-0.63***	0.71***	0.52***	0.53***
share of total exports	(-2.38)	(-2.52)	(-3.03)	(-3.37)	(-3.37)	(3.87)	(3.16)	(3.80)
$\ln p_t$: Price of sugar	0.25**		0.31***					
	(2.82)		(3.24)					
Lagged dependent variable			0.76***	0.74***	0.74***		0.63***	0.62***
($\ln w_{i,t-1}$ or $C_{i,t-1}$)			(15.67)	(16.65)	(14.18)		(10.85)	(10.29)
Endogeneity test (p value)	0.78	0.79	0.78	0.56	0.47	0.36	0.80	0.95
Hanson J overid (p value)	0.15	0.11	0.11	0.08	0.12	0.51	0.49	0.37
Weak instruments test (F)	66	36	42	35	35	29	28	31
Panel C: $HDI_{it} = \otimes_{it}(t_0)\ p_{t0-1}$								
N_{it}: Sugar exports as a	-0.51**	-0.45**	-0.51***	-0.42***	-0.47***	0.75***	0.49**	0.48***
share of total exports	(-2.37)	(-2.45)	(-3.28)	(-3.56)	(-4.24)	(3.62)	(2.69)	(3.12)
$\ln p_t$: Price of sugar	0.21**		0.26***					
	(2.95)		(3.82)					
Lagged dependent variable			0.77***	0.75***	0.75***		0.63***	0.62***
($\ln w_{i,t-1}$ or $C_{i,t-1}$)			(15.49)	(16.71)	(14.36)		(10.81)	(10.20)
Endogeneity test (p value)	0.83	0.81	0.72	0.70	0.82	0.34	0.91	0.86
Hanson J overid (p value)	0.24	0.21	0.19	0.64	0.71	0.42	0.53	0.45
Weak instruments test (F)	68	44	41	37	37	35	32	35

Notes: The specifications in columns 1–8 are identical to those in columns 1–8 of table 6. The only difference is in the definition of the hurricane damage index HDI_{it}. Each panel uses a different definition of HDI_{it}. See the text for a discussion.

Table 8: Parish Level Mortality Regressions

	Deaths per Thousand$_{parish,t}$			
	(1)	(2)	(3)	(4)
$N_{parish,t}$: Sugar land as a share of cultivated land		75.4***	83.3***	61.3***
		(4.55)	(3.63)	(3.48)
$\ln p_t$: Price of sugar in London	-2.80*	-4.67***		
	(-2.01)	(-3.60)		
Parish FE	y	y	y	y
Year FE	n	n	y	n
Colony-year fixed effects	n	n	n	y
Observations	383	383	383	383
R^2	0.26	0.28	0.75	0.80

Notes: The dependent variable is deaths per thousand. The unit of observation is a parish in a year. Fixed effects are as indicated and the key fixed effects are the colony-year fixed effects. These allow us to exploit within-colony sample variation.

for wages and an outcome of interest in its own right.[30] Parish-level data are available for only three colonies: Grenada (1866–1891), Jamaica (1883–1913), and Nevis (1901–1905).

Table 8 reports the results. Columns 1–3 have the same structure as our baseline results in columns 1–3 of table 1 except that we replace colony fixed effects with parish fixed effects. The key result is in column 2. The sugar price term $\ln p_t$ captures the market-forces channel and shows that as the price of sugar fell worker outcomes deteriorated i.e., mortality rose. The sugar-share term N_{it} captures the institutional-change channel and shows that as planter power waned worker outcomes improved i.e., mortality fell. This institutional-change channel holds with year fixed effects (column 3) and, more importantly, with colony-year fixed effects (column 4).[31]

The parish-level analysis implicitly assumes that legal coercion operated at least in part at the parish level. While laws were decided at the colony level, their enforcement was by parish-level judges and constables, both of whom were typically former overseers (McLewin, 1987, 85–87).

[30]While high mortality could in principle be compensated with high wages, we have already seen that this is not the case: Wages were low precisely where sugar was king.

[31]We make three more detailed observations about table 8. First, the results hold even when dropping any one of the three colonies. Second, the increase in the R^2 from column 2 to 3 is explained by epidemics such as cholera which hit all colonies at the same time and so are 'explained' by the year fixed effects. Third, the sign of the price term in column 1 captures the offsetting effects of the market-forces channel (a negative sign) and the institutional-change channel (a positive sign).

In addition, workers could not easily migrate to jurisdictions with low levels of local coercion because of vagrancy laws (Craig-James 2000, 65).

Summarizing, this section provides additional evidence that our results cannot be explained away be appeal to unobserved shocks to outside options. Further, not only did sugar pay lower wages, it also killed.

8 Conclusion

According to standard international trade theories, the 19th century collapse of world sugar prices should have reduced wages in each of the 14 British West Indies sugar colonies. It did not. In colonies that were either marginally suited for sugar cane cultivation or impacted by hurricanes, the fall in sugar prices reduced the power of the planter elite and led to a slow dismantling of coercive institutions. This improved the opportunities available to peasants for employment off the plantation and, as a result, wages were bid up. Correspondingly, incarceration rates per capita fell dramatically.

Remarkably, British West Indies coercion was *legal* coercion. That is, it operated through the planter-dominated legislature, judiciary, and police.

Our analysis highlights the fact that movements in the terms of trade can induce changes in coercive institutions, changes that can be central for understanding how the terms of trade affect wages.

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Appendix A Sugar Exports and Off-Plantation Options by Colony

In this appendix we review how the *relative* strength of planters versus peasants changed with changes in the export shares of non-sugar crops.

A. Group-3 Colonies and Jamaica: Weakened Planter Elite

General Considerations: First, sharecropping was common in Grenada, St. Vincent, Montserrat, and Dominica. Sharecropping, or *metayage* as it was called in the Caribbean, was adopted only reluctantly by planters and usually only by planters who were so weak financially that they could not afford to pay wages until after the harvest (Marshall, 1996a, 64–66). The use of sharecropping is thus a clear sign that planters were being forced to make significant concessions to peasants. Second, in Grenada, St. Vincent, Montserrat, the Virgin Islands, and Jamaica, the phase-out of the preferential tariff by 1853 led to the collapse of sugar and to the collapse of all exports. It would be decades before sugar was replaced by another major export crop. Thus, in these colonies, planters were financially devastated and abandoned estates were commonplace.

Grenada: In Grenada, cocoa was produced both by peasants and planters. It was "the ideal crop for smallholders" (Richardson, 1997, 194). While exact numbers on peasant production are hard to come by, the 1853 Blue Book and the 1897 Royal Commission report that peasant production was substantial. What is clearer is that the same highland geography that allowed cocoa to thrive also fostered the rapid growth of peasant farms and villages, which in turn provided ample work off the plantation. See Brizan (1984, chapter 10), Richardson (1997, chapter 6) and the 1911 *Blue Book* for the Leewards (Great Britain, 1911, chapter 9). Turning to cocoa grown by planters, these usually used sharecropping contracts, an indication of planter weakness relative to peasants.

St. Vincent: Richardson (1997, 156–157) writes that "in the decades after slavery ... [arrowroot] was grown mainly by small-scale black cultivators on the margins of sugar cane estates. ... In the 1870s and 1880s, the success and prosperity of small-scale arrowroot producers on St. Vincent had inspired several owners of large estates to cultivate it." See also Handler (1971). Thus, for the first many decades after emancipation, arrowroot was primarily a peasant crop.

Montserrat: Sugar collapsed very early on and was not replaced by another export crop until much later when lime came on the scene (circa 1870). As a result, the government allowed former slaves to control both their cottages and their unusually extensive provision grounds. Further, planters had little need for their tenants' time. Thus, even though both lime and, later, cotton, were plantation crops, provision grounds provided former slaves with an excellent outside option. See Hall (1971, 49–53).

Virgin Islands: Sugar collapsed extremely early in the Virgin Islands, in part because of hurricanes, and was replaced by livestock, a peasant crop (Harrigan and Varlack 1975, 64–65; Dookhan 1975, 138). There were also opportunities for former slaves who made their way to work in the increasingly prosperous Danish Virgin Islands. (The latter's capital of St. Thomas was only two kilometres from Tortola, the main island in the British Virgin Islands.) This proximity drove livestock exports.

Dominica: In Dominica, cocoa was primarily a freehold crop. Trouillot (1988, 95) cites testimony given to an 1884 Royal Commission that seven-eighths of the cocoa crop was produced on freeholds. Though this strikes us as an exaggeration, it does indicate a substantial peasant presence. Lime was sharecropped, which as noted above, indicates that planters were making substantial concessions to peasants.

Jamaica: Two-thirds of coffee production was accounted for by peasants (Eisner 1961, 217; American and Foreign Anti-Slavery Society 1849, 97). Bananas in Jamaica were initially a peasant crop (Lewis, 1986, 72). In 1883–84, 90% of land holdings in the core of banana country were smallholds and during the 1880s there was a major increase in the number of local bank accounts, an indication of the rising prosperity of smallholders (Soluri, 2006, 146). However, in the 1890s, the United Fruit Company emerged first as a monopsony buyer and then as a grower, which weakened both the peasantry and the existing planter elite.

B. Group-2 Colonies: Modestly Strong Planter Elite

Trinidad: In Trinidad, cocoa was split between freeholds and plantations e.g., Sewell (1861, 102) and Bekele (2004), though plantations were substantially more important. The importation of East Indians is indicative of planter strength (importation was very costly) and depressed peasant wages.

St. Lucia: In St. Lucia, cocoa was primarily produced by planters, but with a non-trivial peasant presence mildly counterbalancing planter strength. For example, small farmers cultivated 2,500 acres of Crown land, 75% of which was under cocoa. In addition, there were other opportunities for peasant agriculture such as coffee, ginger, nutmeg and kola (Harmsen, Ellis and Devaux, 2012, 240–241).

Tobago: Craig-James (2000, 266-267) argues that planters made every effort to diversify out of sugar, trying a number of crops and placing great emphasis on livestock. Thus, in contrast to group-3 colonies, diversification into other crops was done within the context of the plantation economy.

C. Group-1 Colonies: Very Strong Planter Elite

Barbados and Antigua: The islands of Barbados and Antigua were almost entirely cultivated in large estates. The colonies' remarkable suitability for sugar ensured that these estates continued to be worked profitably until the start of the beet bounty in the 1880s. Further, there was little Crown land. As a result, there was very little room for squatting or freeholding. The plantation elites were famously strong. See, for example, Starkey (1939, ch. IV).

St. Kitts and Nevis: These colonies share a similar history with Barbados, the primary difference being that they were not as suitable for sugar and hence declined as sugar prices fell. Nevertheless, "the opportunity for squatting did not exist, as no public land remained [outside sugar]" (Merril, 1958, 90).

Guyana: Guyana stands out as the colony that experienced the largest sugar boom of our period. Between 1838 and 1882, Guyanese sugar exports increased more than threefold. There was consequently very little scope for peasant export crops. Indeed, to satisfy the huge labour demands of sugar plantations, the government organized the large-scale importation of indentured East Indian labour.

Appendix B Mathematical Appendix

Appendix B.1 Derivation of Equation (4) and $C_N > 0$

As a preliminary, note that

$$\int_{N+C}^{L+C} (\Phi - i)di = -(\Phi - L - C)^2/2 + (\Phi - N - C)^2/2 = -(\Phi - L)^2/2 + (\Phi - N)^2/2 - (L - N)C.$$

Substituting this and equations (1)–(2) into equation (3) yields

$$\begin{aligned} W &= \alpha\left\{\theta p\phi \int_0^N x(i)di - \theta(\Phi - L - C)N - C^\gamma\right\} + \left\{(1-\theta)p\phi \int_0^N x(i)di + \theta(\Phi - L - C)N \right. \\ &\quad \left. + \left[-(\Phi - L)^2/2 + (\Phi - N)^2/2 - (L - N)C\right]\right\} \\ &= -(L - N)C - \alpha C^\gamma + (\alpha - 1)N\theta C + K \qquad (13) \end{aligned}$$

where K collects all terms that are independent of C. Hence

$$W_C = -(L - N) - \gamma\alpha C^{\gamma-1} + (\alpha - 1)N\theta = \gamma\alpha\left(N\frac{\theta}{\gamma}\frac{\alpha - 1}{\alpha} - \frac{L - N}{\gamma\alpha} - C^{\gamma-1}\right)$$

and $W_{CC} = -\alpha\gamma(\gamma-1)C^{\gamma-2} < 0$. $W_C = 0$ if and only if $\tilde{C}(N) \equiv C(N)^{\gamma-1} = N\frac{\theta(N)}{\gamma}\frac{\alpha(N)-1}{\alpha(N)} - \frac{L-N}{\gamma\alpha(N)}$. $\tilde{C}_N > 0$ because θ and $(\alpha - 1)/\alpha$ are increasing in N, $(L - N)/\alpha$ is decreasing in N and both $\alpha - 1$ and $L - N$ are positive. Further, $\tilde{C}(0) = -L/\gamma < 0$ and $\tilde{C}(L) = L\frac{\theta(L)}{\gamma}\frac{\alpha(L)-1}{\alpha(L)} > 0$ so that $\tilde{C}(0) < 0 < \tilde{C}(L)$. Hence, there exists a unique $N^* \in (0, L)$ such that $\tilde{C}(N^*) = 0$ and $\tilde{C}(N) \geq 0$ if and only if $N \geq N^*$. It follows that the C which maximizes $W(C, N)$ subject to $C \geq 0$ satisfies $C^{\gamma-1} = \tilde{C}(N)$ for $N \geq N^*$ and $C^{\gamma-1} = 0$ for $N < N^*$. Equation (4) follows immediately as does $C_N > 0$ for $N > N^*$.

Appendix B.2 Uniqueness of Solutions to Equation (5) and Stability

We assume that $\lim_{i\to 0} x(i) = \infty$ and $\overline{W} > p\phi x(L)$. We also assume that $\partial x(i)/\partial i$ is sufficiently negative that $\pi_N(N) < 0$ for $N \in (0, L)$.

First, we show that under these assumptions there exists a unique $N \in (0, L)$ satisfying $\pi(N) = \overline{W}$ (equation 5). From equation (2), $\pi(N) = \pi(N, C(N), N) = \theta(N)p\phi x(N) - \theta(N)(\Phi - L - C(N)) - C(N)^\gamma/N$. This implies that $\pi(L) < \theta(L)p\phi x(L) < p\phi x(L) < \overline{W}$. From equation (4), $C(N) = 0$ for

N small so that $\lim_{N\to 0} C(N)^{\gamma}/N = 0$ and $\lim_{N\to 0} \pi(N) = \theta(0)p\phi \lim_{N\to 0} x(N) - \theta(0)(\Phi - L) = \infty$. Thus, $\lim_{N\to 0} \pi(N) > \overline{W} > \pi(L)$. It follows from the continuity of π that there is an $N^* \in (0, L)$ satisfying equation (5). The uniqueness of N^* follows immediately from $\pi_N < 0$.

Second, uniqueness of N^* plays no role for our comparative statics, where all that we use is $\pi_N(N) < 0$ evaluated only at $N = N^*$. (See the start of section 6.) To see this, consider the stability of equilibrium. That is, consider an arbitrarily small measure E of potential planters who deviate by moving from England to the Caribbean. On the one hand, they move to plots $(N^*, N^* + E)$, plots which are less profitable than plot N^*. On the other hand, their presence generates a positive externality for the profits of all planters because their presence increases the strength of the planter elite ($\alpha_N > 0$) and reduces the per planter cost of coercion C^{γ}/N^*. This externality creates the possibility of multiple equilibria and the usual stability considerations come into play. Specifically, a stable equilibrium is one in which, for all arbitrarily small $E > 0$, a measure E of potential planters has no incentive to deviate. This means that the utility from deviating ($\pi(i)$ for all $i \in (N^*, N^* + E)$) is less than the utility from staying ($\overline{W} = \pi(N^*)$). Restated, in a stable equilibrium $\pi(N^* + E) - \pi(N^*) < 0$ or $\pi_N(N) < 0$ for N evaluated at $N = N^*$, which is all that we need for our comparative statics.

Appendix B.3 Existence and Uniqueness of Equilibrium

We consider existence and uniqueness of an equilibrium with $0 < N^* < L$. We assume $\pi_N(N) < 0$ for all $N \in (0, L)$, $\overline{W} > p\phi x(L)$) and $\lim_{N\to 0} x(N) = \infty$. For the following lemma, note that if fixed costs are too high then there will be no entry ($N^* = M^* = 0$).

Lemma 1 *There is a unique fixed cost* $\overline{f}$ *such that for* $f < \overline{f}$ *there exists a unique equilibrium and in equilibrium* $0 < N^* < L$.

Proof: In the main text and Appendix B.2 we established that all of the conditions for a unique equilibrium with $0 < N^* < L$ are satisfied except for the conditions on M^*. It thus remains to show that an M^* exists which satisfies equation (6) and $M^* > N^*$. Solving equation (6) for M^*/N^* yields

$$\frac{M^*}{N^*} = \frac{1}{f}\left(\frac{1}{N^*}\int_0^{N^*} \pi(i, C(N^*), N^*)\, di - \overline{W}\right).$$

Since N^* is unique, we have now solved for the unique M^*. Further, equation (5) implies that N^* is independent of f. Hence M^*/N^* is increasing in f and grows without bound as f approaches 0. It follows that there is an $\overline{f}$ such that $M^*(f) > N^*$ if and only if $f < \overline{f}$. •

Appendix B.4 A Sufficient Condition for $\Phi - L - C(N) > 0$

C must never be so large that the outside option $\Phi - L - C$ is negative. Since $C_N > 0$, a sufficient condition for this is $\Phi > L + C(L)$ where from equation (4) $C(L) = \left[L \frac{\theta(L)}{\gamma} \frac{\alpha(L) - 1}{\alpha(L)}\right]^{1/(\gamma-1)}$. A more rudimentary sufficient condition uses the fact that $L^{1/(\gamma-1)} > C(L)$ so that a sufficient condition is $\Phi > L + L^{1/(\gamma-1)}$.

Appendix C Details of Instrument Construction

Appendix C.1 Soil Suitability

Suitability was calculated at the grid-cell level. We start with spatial data for six factors: (1) elevation, (2) slope, (3) annual mean temperature, (4) mean rainfall, (5) soil Ph, and (6) soil texture. Data on elevation and slope are from the SRTM 90m Digital Elevation Database at `http://www.cgiar-csi.org/data/srtm-90m-digital-elevation-database-v4-1`. Data on temperature and rainfall are from the GPCP Version 2.2 Combined Precipitation Data Set at `http://www.esrl.noaa.gov/psd/data/gridded/data.gpcp.html`. Data on soil texture and pH levels are from the FAO/UNECO World Soil Dataset `http://www.fao.org/climatechange/54273/en/`.

Each factor in each cell takes on a value of 1, 2, 3 or 4, with 1 being highly suitable for sugar and 4 being completely unsuitable for sugar. Temperature is 1 if above 25.5 C°, 2 if in the range 23–25.5, 3 if in the range 21–23 and 4 if below 21. Slope is 1 if less than 15°, 2 if in the range 15–30, and 3 if greater than 30. Elevation is 1 if less than 400 feet, 2 if in the range of 400–700, 3 if in the range of 700–1000, and 4 if above that. pH is 1 if in the range 6.3–6.6, 2 if in the ranges 5.5–6.3 or 6.6–7.5, and 3 if below 5.5 or above 7.5. Soil texture is 1 if sand content is less than 30%, 2 if in the range 30–48.5, 3 if in the range 48.5–68.4, and 4 if above 68.4. Rainfall is 1 if in the range of 1100–1500 millimetres per year, 2 if in the ranges of 950–1100 or 1500–1990, 3 if in the ranges of 800-950 or 1990–2500, and 4 if in the ranges below 800 or above 2500.

We aggregated the six factors into a single index using weights generated by the routine described in Jayasinghe and Yoshida (2010). These weights sum to one so that the aggregate index lies between 1 and 4. We then rounded it to the nearest integer so that the index takes on the values 1 (highly suitable), 2 (marginally suitable), 3 (marginally unsuitable), and 4 (completely unsuitable). In the paper, 'suitable' means an index value of 1 (highly suitable).[32]

Guyana is the only colony that is not an island so that in calculating shares of land care must be given to the denominator. Guyana had a large hinterland of dense jungle and swampland, most of which was unsuitable for agriculture. We define Guyana's historical border using the map in Higman (2000, figure 1.8). We geo-coded this map and calculated Guyana's sugar suitability share based on these borders. The original map and our geo-coding of it is displayed in online appendix figure 3.

Appendix C.2 Hurricanes

The hurricane damage index is $\max[\,0\,,\,(\ln x_{is,t_0-1} - \ln x_{i,s,t_0+1})\,]$ where t_0 is the year of the hurricane and x_{is,t_0-1} and x_{is,t_0+1} are sugar exports by colony i in the years before and after the hurricane. While the year of the hurricane is known, the resulting fall in exports is sometimes

[32]The only Caribbean-specific modification we make to the index is a slight nod to the fact that hauling sugar cane over steep terrain from the field to the mill was far more difficult in our limited-mechanization age e.g., de Beer (1982). To this end, we slightly increase the weight on the slope factor from 0.044 to 0.099 and slightly decrease the weight on the elevation factor from 0.099 to 0.044. (Weights on the six factors sum to 1 so these are very small changes.)

reported in the next *Blue Book* year because *Blue Books* do not necessarily report data on a calendar basis. Where the fall in exports happened in the year after the hurricane, we increment t_0 by one year. This occurs for Jamaica (1874, 1880, 1896), Montserrat (1851), St. Lucia (1875, 1894), and St. Kitts (1910). For example, the Jamaican hurricane of 1896 is associated with sugar exports of £290,000 (1896), £219,000 (1897) and £261,000 (1898) so we set $t_0 = 1897$.

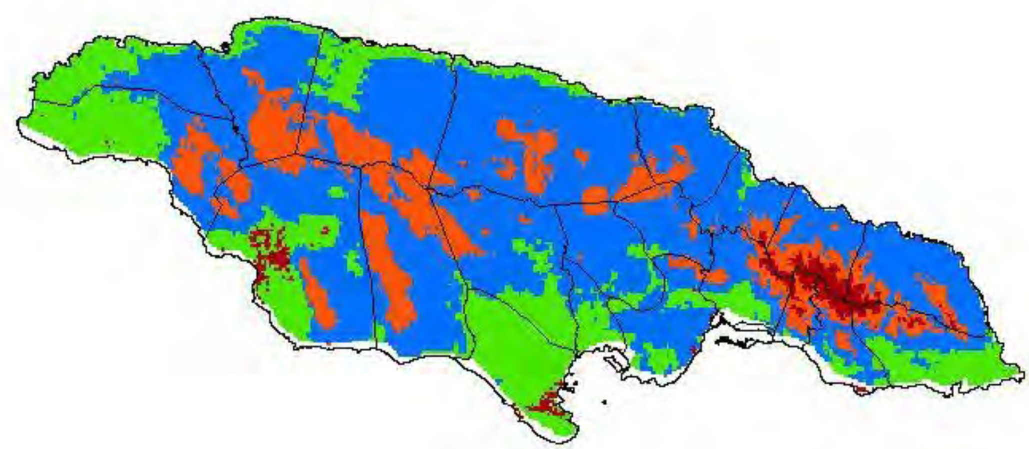
There are four hurricanes with historical ambiguities. (1) Virgin Islands 1848: Dookhan (1975) claims that there was a hurricane in the Virgin Islands in 1842 and makes no mention of the 1848 hurricane. Using his hurricane dating rather Tannehill's (1938) makes no difference to our results. (2) Barbados and Montserrat 1899: This hurricane was extremely powerful, causing many deaths in Montserrat and Barbados. The National Hurricane Centre track for this hurricane shows that it made landfall in Montserrat, but not Barbados. The hurricane had little impact on *Blue Book* exports in either location. To investigate potential measurement error we experimented with coding this hurricane as having a large damage index (1.00) in both colonies. This improves our results. (3) Antigua 1871: This hurricane overlapped with the disastrous drought of 1870–1874. See Berland, Metcalfe and Endfield (2013, figure 4). Contemporaries commented much more on the drought than on the hurricane (Berland et al., 2013, 1338). Indeed, there is no mention of the hurricane in the 1871 Antigua *Blue Book* listing of Parliamentary Acts, but there is a listing of an Act entitled "An Act to raise the sum of £2500 for the Antigua Water Works." Finally, when the drought ended, agricultural output *completely* rebounded: Sugar exports were £228,000 (1870), £239,000 (1871), £136,000 (1872), £153,000 (1873), £96,000 (1874, the worst year of the drought), and £243,000 (1875). In short, the cause of the decline in sugar exports was the drought, not the hurricane. We therefore code it as a 0. (4) Grenada 1856: This hurricane is assigned a small damage index because its impacts are confounded with the massive cholera epidemic that began in mid-June 1854 (too late to affect the 1854 sugar crop) and carried on through 1855. Sugar exports were £130,000 (1854), £82,000 (1855), £90,000 (1856), and £148,000 (1857). Hence $\ln x_{is,1856-1} - \ln x_{i,s,1856+1} < 0$. If we assign this hurricane a large damage index (1.00) our results improve slightly.

Online Appendix

to

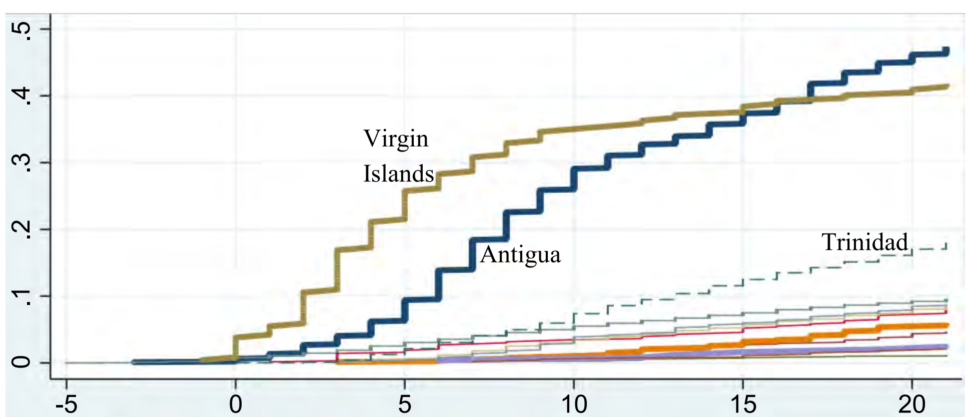
"The Rents From Trade and Coercive Institutions: Removing the Sugar Coating"

Online Appendix Figure 1: Jamaica's Sugar Suitability



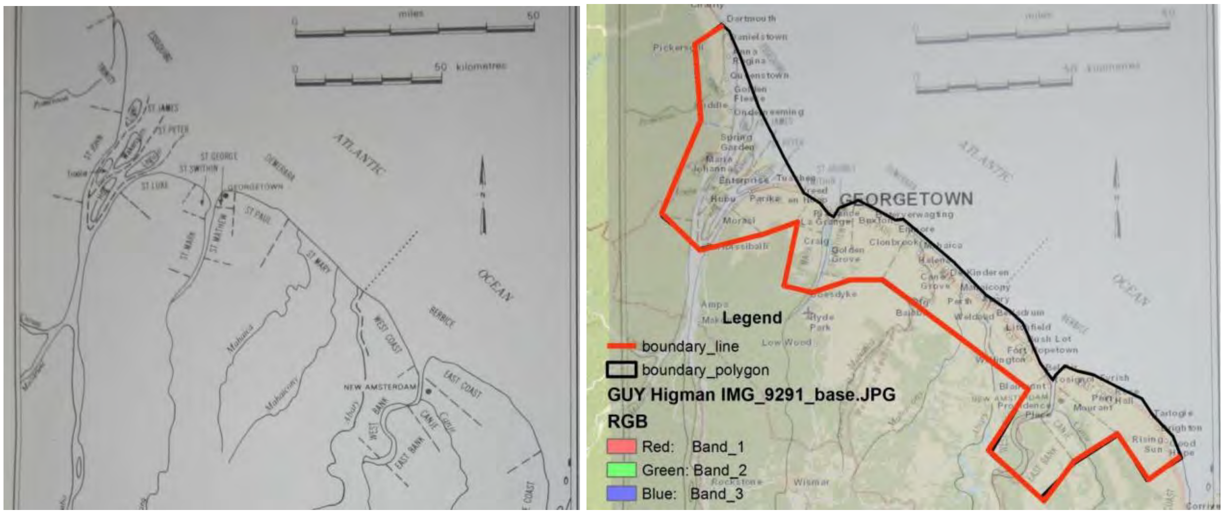
Notes: At the grid-cell level, suitability is scaled from 1 to 4. The top-panel of online appendix figure 1 displays the results of the model for Jamaica, with 1 being highly suitable (displayed in black/green), 2 being marginally suitable (displayed in dark grey/blue), 3 being poorly suited (displayed in light grey/orange), and 4 being entirely unsuited (displayed in very light grey/red). Our measure of sugar suitability fits with the basic facts on the ground, depicted in figure 5, which shows the actual distribution of land under sugar plantations in 1790 (grey) and in 1890 (dark). These areas correspond closely to the distribution of our highly-suitable-for-sugar measure.

Online Appendix Figure 2: Cumulative Distribution of Land by Elevation



Notes: Each line is a colony. The horizontal axis is elevation in feet. The vertical axis is the proportion of a colony's land that is lower than what is indicated on the horizontal axis. For example, the percentage of land that is 10 feet or lower is 35% in the Virgin Islands and 29% in Antigua. The 'steps' are an artifact of using integers (1 foot, 2 feet etc.).

Online Appendix Figure 3: Guyana



Notes: The left panel shows the historical boundaries of Guyana as dashed lines. The panel is from Higman (2000, figure 1.8). The right panel shows the results of geo-coding the map.

Online Appendix Table 1: Initial Conditions at the Time of Abolition

Colony	Slave-price (Pound Sterling)	Sugar-Share Exports 1838	Pop-Share White 1838	Density 1838	Population 1838	Area (sqkm)	Year Founded
Antigua	35	93	5.4	125	35,188	281	1632
Barbados	38.8	94	12.8	246	105,812	431	1629
Dominica	28.7	81	3.9	21	16,207	754	1763
Grenada	41.2	96	2.6	52	17,751	344	1763
Br Guyana	87.4	80	0.7	6	66,561	10,750	1803
Jamaica	31	74	8.2	34	381,951	11,100	1655
Montserrat	25.3	96	4.3	65	6,647	102	1634
Nevis	21.4	95	5.4	80	7,434	93	1623
St Lucia	50.3	79	11.3	27	17,005	620	1803
St Kitts	29.7	99	6.4	113	21,578	191	1628
St Vincent	39.5	96	4.7	69	26,659	389	1763
Tobago	41.7	100	2.3	38	11,456	300	1763
Trinidad	83.6	88	8	7	34,650	4,787	1797
Virgin Islands	23.1	95	12.4	49	7,471	153	1672

Notes: This table shows the main cross-sectional characteristics of the 14 colonies at the time slavery was abolished. Most data are from Martin (1839), which provides a statistical overview of the British Empire at the time of Abolition. Foundation year is the year the colony was founded as a British colony. For instance, St. Vincent and Grenada were ceded from France after the French and Indian Wars. The 1838 slave price is the price from the compensation tables in Martin (1839).

Online Appendix Table 2: Labour Supply Shocks: East Indian Emmigration and Out-Immigration

	Dependent Variable: Incarceration Rates per Capita C_{it}				
	Static			Dynamic	
	(1)	(2)	(3)	(4)	(5)
N_{it}: Sugar exports as a share of total exports	0.48**	0.47**	0.59***	0.41*	0.48***
	(2.27)	(2.34)	(3.57)	(2.14)	(3.26)
$\ln p_t$: Price of sugar in London	0.05	-0.10		-0.10	
	(0.65)	(-0.93)		(-0.98)	
Indentured immigrants (East Indians)	0.014	0.010	-0.000	0.026	0.006
	(0.60)	(0.52)	(-0.01)	(1.09)	(0.25)
Panama Canal	-0.408				
	(-1.22)				
(Panama Canal)^2	0.055				
	(1.17)				
Guyana gold rush	0.103				
	(0.59)				
(Guyana gold rush)^2	-0.011				
	(-0.41)				
$C_{i,t-1}$: Lagged incarceration rates				0.65***	0.63***
				(11.07)	(11.07)
Colony FE	y	y	y	y	y
Year FE	n	n	y	n	y
Observations	856	856	856	783	783
R^2	0.50	0.49	0.58	0.71	0.75

Notes: This table is identical to table 4 in the main text except that the dependent variable is incarceration rates. See the notes to table 4 for details.

Online Appendix Table 3: Sensitivity to Outliers: Omitting One Decade at a Time

Panel A. Dependent Variable: Log wages $\ln w_{it}$

	Include All Decades	Omitted Decade 1838-1847	1848-1857	1858-1867	1868-1877	1878-1887	1888-1897	1898-1907	1908-1913
Static with Colony FEs (table 1, panel A, column 2)									
N_{it}: Sugar exports as a	-0.44***	-0.38**	-0.36**	-0.43**	-0.46***	-0.48***	-0.48***	-0.46**	-0.49**
share of total exports	(-3.11)	(-2.85)	(-2.42)	(-2.98)	(-3.49)	(-3.62)	(-3.07)	(-2.85)	(-2.98)
p_t: Price of sugar	0.19***	0.15**	0.21***	0.17***	0.17***	0.21***	0.21***	0.15**	0.20***
in London	(3.42)	(2.44)	(4.03)	(3.46)	(3.11)	(3.95)	(3.54)	(2.50)	(3.21)
Observations	944	833	818	818	805	812	815	829	878
R^2	0.68	0.69	0.73	0.68	0.69	0.69	0.66	0.67	0.68
Dynamic with Colony FEs (table 1, panel A, column 6)									
N_{it}: Sugar exports as a	-0.58***	-0.48**	-0.45***	-0.58***	-0.63***	-0.61***	-0.63***	-0.58***	-0.61***
share of total exports	(-4.21)	(-2.68)	(-3.01)	(-3.65)	(-5.12)	(-4.54)	(-4.43)	(-3.96)	(-4.07)
p_t: Price of sugar	0.28***	0.23**	0.28***	0.28***	0.27***	0.31***	0.31***	0.24***	0.31***
in London	(3.68)	(2.14)	(4.25)	(3.40)	(3.60)	(3.56)	(4.06)	(3.36)	(3.55)
$\ln w_{i,t-1}$: Lagged wages	0.76***	0.79***	0.75***	0.77***	0.73***	0.75***	0.76***	0.75***	0.76***
	(15.68)	(17.89)	(16.42)	(13.84)	(13.61)	(13.08)	(14.31)	(14.67)	(14.68)
Observations	893	804	773	774	756	764	765	783	832
R^2	0.88	0.89	0.89	0.88	0.87	0.87	0.87	0.87	0.87
Static with Colony and Year FEs (table 1, panel A, column 3)									
N_{it}: Sugar exports as a	-0.44***	-0.35***	-0.45***	-0.40**	-0.46***	-0.44***	-0.47***	-0.45**	-0.47**
share of total exports	(-3.25)	(-3.63)	(-3.31)	(-2.82)	(-3.48)	(-3.37)	(-3.10)	(-2.68)	(-2.89)
Observations	944	833	818	818	805	812	815	829	878
R^2	0.75	0.78	0.76	0.76	0.77	0.76	0.73	0.74	0.75
Dynamic with Colony and Year FEs (table 1, panel A, column 7)									
N_{it}: Sugar exports as a	-0.42***	-0.31**	-0.44***	-0.36***	-0.50***	-0.42***	-0.45***	-0.37**	-0.45***
share of total exports	(-4.01)	(-2.54)	(-3.43)	(-3.29)	(-4.51)	(-3.97)	(-3.61)	(-2.91)	(-3.63)
$\ln w_{i,t-1}$: Lagged wages	0.75***	0.75***	0.78***	0.76***	0.71***	0.74***	0.75***	0.74***	0.74***
	(16.41)	(16.26)	(22.48)	(13.57)	(13.85)	(12.44)	(15.28)	(15.04)	(15.58)
Observations	893	804	773	774	756	764	765	783	832
R^2	0.90	0.91	0.91	0.90	0.90	0.89	0.89	0.89	0.89

Panel B. Dependent Variable: Incarceration Rates C_{it}

	Include All Decades	Omitted Decade 1838-1847	1848-1857	1858-1867	1868-1877	1878-1887	1888-1897	1898-1907	1908-1913
Static with Colony and Year FEs (table 1, panel B, column 3)									
N_{it}: Sugar exports as a	0.59***	0.35**	0.60***	0.52**	0.60***	0.59***	0.54***	0.66***	0.82***
share of total exports	(3.61)	(2.25)	(3.07)	(2.98)	(3.43)	(4.07)	(3.44)	(3.36)	(3.87)
Observations	856	752	731	748	742	734	747	747	791
R^2	0.58	0.65	0.58	0.59	0.61	0.57	0.55	0.57	0.59
Dynamic with Colony and Year FEs (table 1, panel B, column 7)									
N_{it}: Sugar exports as a	0.47***	0.23**	0.55**	0.31**	0.51***	0.52***	0.46***	0.54***	0.66***
share of total exports	(3.52)	(2.47)	(2.61)	(2.47)	(2.94)	(4.52)	(3.12)	(3.21)	(3.78)
$C_{i,t-1}$: Lagged incar-	0.63***	0.64***	0.65***	0.64***	0.59***	0.59***	0.63***	0.63***	0.62***
ceration rates	(11.10)	(10.99)	(10.79)	(13.05)	(9.40)	(10.51)	(10.12)	(10.04)	(11.52)
Observations	783	697	672	692	680	663	681	675	721
R^2	0.75	0.79	0.76	0.77	0.76	0.72	0.73	0.74	0.75

Notes: This table reports on the sensitivity of results to omitting one decade at a time. The baseline specifications appear in table 1 and are repeated in the column labelled 'Include All Decades.' See the notes to table 1 for additional details.

Online Appendix Table 4: Sensitivity to Time Fixed Effects: Alternative Specifications of Time

Panel A. Dependent Variable: Log wages ln w_{it}

	Baseline:	Decade	Degree of Year Polynomial:		
Year	Year FEs	FEs	2	4	6
Static with Colony FEs (table 1, panel A, column 3)					
N_{it}: Sugar exports as a	-0.44***	-0.43***	-0.41***	-0.44***	-0.44***
share of total exports	(-3.25)	(-3.34)	(-3.02)	(-3.42)	(-3.50)
Observations	944	944	944	944	944
R^2	0.75	0.74	0.68	0.71	0.71
Dynamic with Colony FEs (table 1, panel A, column 7)					
N_{it}: Sugar exports as a	-0.42***	-0.46***	-0.43***	-0.44***	-0.42***
share of total exports	(-4.01)	(-4.17)	(-4.02)	(-3.98)	(-4.33)
p_t: Price of sugar		0.36***	0.59***	0.34**	0.34**
in London		(3.08)	(3.55)	(2.76)	(2.65)
Observations	893	893	893	893	893
R^2	0.90	0.88	0.88	0.88	0.88

Panel B. Dependent Variable: Incarceration Rates per Capita C_{it}

	Baseline:	Decade	Degree of Year Polynomial:		
Year	Year FEs	FEs	2	4	6
Static with Colony FEs (table 1, panel B, column 3)					
N_{it}: Sugar exports as a	0.59***	0.57***	0.62***	0.59***	0.58***
share of total exports	(3.61)	(3.48)	(3.63)	(3.62)	(3.63)
Observations	856	856	856	856	856
R^2	0.58	0.54	0.51	0.53	0.54
Dynamic with Colony FEs (table 1, panel B, column 7)					
N_{it}: Sugar exports as a	0.47***	0.44***	0.49***	0.48***	0.48***
share of total exports	(3.52)	(3.32)	(3.53)	(3.48)	(3.58)
p_t: Price of sugar		0.62***	0.63***	0.62***	0.61***
in London		(10.94)	(11.92)	(11.59)	(10.93)
Observations	783	783	783	783	783
R^2	0.75	0.72	0.72	0.72	0.72

Notes: This table reports on the sensitivity of results to the use of year fixed effects. The baseline specifications appear in table 1 and are repeated in the column labelled 'Baseline: Year FEs.' In the 'Decade FEs' column we include decade fixed effects. In the 'Degree of Year Polynomial' columns we include polynomials of the form $\sum_{k=1}^{n} \alpha_k (year - 1837)^k$ for n = 2, 4, 6. See the notes to table 1 for additional details.

Online Appendix Table 5: The Impact of Coercion on Wages: An Alternative IV Strategy

	First Stage		OLS		IV	
	C_{it}: Incarceration Rate		ln w_{it}: Log Wages		ln w_{it}: Log Wages	
	Static	Dynamic	Static	Dynamic	Static	Dynamic
	(1)	(2)	(3)	(4)	(5)	(6)
N_{it}: Sugar exports as a share of total exports	0.57***	0.57***				
	(4.09)	(3.71)				
C_{it}: Incarceration rate per capita			-0.03	-0.08	-0.77**	-0.86**
			(-0.83)	(-1.65)	(-2.55)	(-2.85)
ln$w_{i,t-1}$: Lagged wages		0.05		0.78***		0.76***
		(0.29)		(14.55)		(12.89)
Year fixed effects	y	y	y	y	y	y
Observations	803	768	803	768	803	768
R^2	0.60	0.61	0.65	0.87		
Endogeneity test					4.32	6.81
(p value)					0.04	0.01
Weak instruments test (F)					16.75	13.76

Notes: This table reports the results of the regression $\ln w_{it} = \beta C_{it} + \lambda_i + \lambda_t + \varepsilon_{it}$ where C_{it} is instrumented with N_{it}. The first stage regression $C_{it} = \beta^1 N_{it} + \lambda_i + \lambda_t + v_{it}$ appears in columns 1–2. The OLS and IV results appear in columns 3–6. Even-numbered columns include lagged wages (the dynamic model) and, in columns 4 and 6, long-run coefficients are reported. The model is just identified. Exogeneity of C_{it} is rejected at the 5% (static) and 1% (dynamic) levels. The difference between the OLS and IV estimates is as predicted by the model. Specifically, a positive unobserved productivity shocks will (1) drive up wages and (2) drive up N_{it} and hence C_{it}. It will thus lead to a spurious positive correlation between wages and coercion. *This explains why the OLS estimate is so biased towards zero.*