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

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Abstract

A sustained export price boom may not benefit workers if the resulting rents lead employers to invest in coercive activities that reduce wages. We formalize this idea in a simple model of an agricultural economy with exogenous export price fluctuations and plantation owners who mobilize the power of the state to coerce peasants. Coercion is any action that reduces the value to peasants of working in the non-plantation economy e.g., working as independent smallholders. Using unique data for 14 British West Indies sugar colonies from 1838 to 1913, a period in which sugar prices collapsed, we examine the impact of waning planter elite power on wages, incarceration rates, and peasant-biased taxes. In those colonies where the plantation system declined most, incarceration rates and peasant-biased taxes fell and, remarkably, wages rose.

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1 Introduction

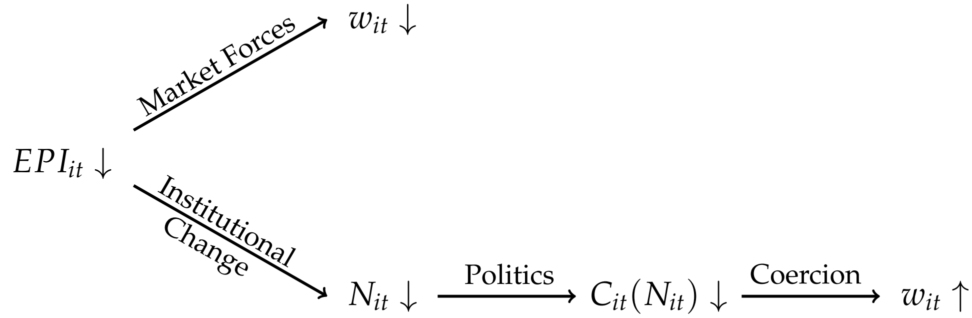
Changes in the terms of trade that increase labor demand should, in theory, increase wages e.g., Stolper and Samuelson (1941). Yet additional factors are at play in many high-profile instances of export-driven increases in labor demand: Flower pickers in Colombia, palm oil plantation workers in Indonesia, 'sea-slave' fishermen in the South China Sea, fruit pickers in Northern Mexico, assembly workers in China, and sugar-cane cutters in Central America have all been the topic of media reports focussed on wages, working conditions, and the coercive behaviour of powerful employers.[1] In addition, these reports document close ties between employers and the state i.e., police, judges, and politicians, which suggests that export-driven increases in labor demand can corrupt or otherwise weaken existing institutions. We argue that rising export prices can generate rents for employers who are members of the local elite, rents which are used to recruit state support for coercive labor policies. Restated, rising export prices can increase the rents from trade that accrue to elites, increasing both the resources available for investing in coercive institutions and the returns to those investments.

While this argument is supported by anecdotes of varying veracity, systematic analysis is hampered by lack of data and a convincing identification strategy. Data are needed on export prices and wages as well as on concrete measures of coercive policies, institutions, and elite power. For identification, we exploit a remarkably relevant historical setting involving 14 British West Indies sugar colonies from 1838 (the emancipation of slaves) to 1913. At the start of the period, all islands produced almost exclusively sugar, 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 away from the plantation. This depressed wages. Unfortunately for planters, world sugar prices collapsed during the 19th century so that by 1913 sugar was worth just one quarter of what it had been in 1838. Where this decline in sugar-prices eroded the plantation system, investments into coercive institutions were reduced, thus freeing up non-plantation opportunities for peasants.

Figure 1 describes this history and summarizes our main hypothesis. i indexes colonies, t indexes years, and EPI_{it} is an index of export prices in which sugar is the dominant component in

[1]See The Los Angeles Times (2014), The New York Times (2015), and The Guardian (2012, 2015).

Figure 1: The Impact of Trade on Wages via Market Forces and Institutions



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

the early years. The collapse in export prices had two offsetting effects on wages. The first operates through *market forces* in that lower output prices reduced the demand for labor, thereby reducing wages. The second operates through *institutional change* in that lower prices made plantation agriculture less profitable, thereby limiting the strength of the planter elite (N_{it}). This reduced the equilibrium level of government coercion (C_{it}), making it more remunerative for peasants to leave the plantation and set up as independent smallholders. By 'coercion' we specifically mean policies that devalue smallholder agriculture.[2]

Our theory gives rise to two panel regressions, which in stripped-down terms are

$$\ln w_{it} = \beta N_{it} + \gamma EPI_{it} \text{ and } C_{it} = \beta' N_{it} + \gamma' EPI_{it} \tag{1}$$

where N_{it} is the strength of the plantation system, measured as (1) the share of sugar in total exports, or (2) the share of all plantation crops in total exports, or (3) the share of whites in the population. EPI_{it} is the index of export prices. EPI_{it} is measured in two ways. The first is a Tornqvist index of the prices of 17 crops that account for 98% of all exports. The second comes directly out of the Fréchet-based structural model of crop choice developed by Costinot, Donaldson and Smith (2016). It is estimated using a unique database we assembled on agro-climactic

[2]Coercion is modelled as a policy that does not hurt plantation workers directly, but instead reduces the returns to being a smallhold farmer. More formally, coercion is a policy that reduces the reservation wage of plantation workers by reducing the value of plantation workers' outside options. This notion of coercion is borrowed from Acemoglu and Wolitzky (2011).

conditions by crop in the Caribbean. C_{it} is measured in two ways. The first is the incarceration rate per capita. The second is an index of four coercive taxes, by which we mean land taxes that were higher for smallholds than for plantations and tariffs that were low against foodstuffs that competed with smallhold crops.[3] All data were laboriously collected from the British Colonial Office's *Blue Books*, which contain meticulous records of wages, exports and export prices by crop, incarceration rates and tax rates, and the share of whites in the population.

Our first empirical finding is a 'missing correlation': When we regress w_{it} only on EPI_{it} and colony fixed effects, we get a tightly estimated zero correlation between agricultural output prices and agricultural wages. We then show this to mean that the market-forces channel and institutional-change channel in figure 1 were roughly offsetting. When we estimate the equations in (1), we find $\widehat{\beta} < 0$ and $\widehat{\beta}' > 0$ (the weakening of the planter elite raised wages and reduced coercion). This is the institutional-change channel. We also estimate $\widehat{\gamma}' = 0$ (no *direct* effect of export prices on coercion) and $\widehat{\gamma} > 0$ (the positive impact of export prices on wages). This is the market-forces channel. Our estimates of $\widehat{\beta}$ and $\widehat{\beta}'$ imply that a complete collapse of the plantation system would have doubled wages, halved incarceration rates, and reduced coercive taxation by two standard deviations. These are large effects. This core finding holds up under an extensive range of robustness checks.

Before Emancipation in 1838, the 14 colonies were exceedingly similar. Economically, all were slave societies and all were specialized in sugar cane production. Institutionally, all had effective political and legal systems inherited from Britain and were dominated by a small group of white planters. The subsequent differential evolution of N_{it}, which ranges from the complete collapse of the plantation economy in some islands to its continued and unbridled dominance in others, is our key variation. In terms of identification, it requires an explanation of what drives it. One important determinant was agro-climatic conditions. N_{it} was more likely to decline in colonies that were marginally productive for plantation crops and in colonies that were highly suitable for non-plantation crops. These two possibilities are important because they imply direct neoclassical wage responses and hence need to be addressed with a model of crop choice, which we do as discussed.

[3] Planters pushed for low tariffs on those food imports which competed directly with smallhold crops (Rogers 1970, 96; Green 1976, 186).

Nonetheless, the OLS results may be confounded by unobserved labor demand or labor supply shocks which could be driving the differential evolution of N_{it}. We address this concern with an IV strategy that explores differences in geographic conditions that mattered only after Emancipation and only through their effect on N_{it}. Specifically, some colonies had large sugar-unsuitable but fertile hinterlands, while others had next to none. During slavery, this difference did not matter: Plantation-unsuitable land lay uncultivated because slaves were not allowed to use it. After slavery, this difference became important because the availability of uncultivated land made it difficult to restrict the freed slaves from setting up as squatting smallholders. We interact this cross-sectional difference with a time-series of British naval expenditure in the Americas. Naval expenditure mattered because the Navy was the planters' main tool for suppressing violent revolts against the coercive state (Lewis 1986, 96; Rogers 1970, 263; Craig-James 2000, 251; Dookhan 1977, 202). Without the Navy's backing, local elites faced higher revolt probabilities and these were even larger in places with more uncultivated land because more coercion was needed to secure labor. A second instrument is the exogenous occurrence of hurricanes, which often wreaked severe damage on the capital stock of plantations.

Our figure 1 theory speaks to a literature on the impact of globalization on institutional change. Seminal contributions are Acemoglu, Johnson and Robinson's (2005) study of how the Atlantic trade affected European property rights institutions and Greif's (2005; 2006) study of how medieval long-distance trade gave birth to markets characterized by arm's length exchange. See also Engerman and Sokoloff (1997), Sokoloff and Engerman (2000), La Porta, Lopez-de-Silanes and Shleifer (2008), Levchenko (2007, 2013), Nunn (2008), and Puga and Trefler (2014).

We are particularly interested in 'legal coercion' i.e., the use of the legislative, judicial, and policing powers of the state to benefit a small elite at the expense of the majority of society. See Greif (2005) and Acemoglu and Robinson's (2012, ch. 9) study of Apartheid. It is distinct from the coercion that an individual planter may have exercised over their workers under slavery e.g., by punishing workers for low productivity (Acemoglu and Wolitzky, 2011). Instead, legal coercion typically aimed at reducing workers' reservation wage by reducing their outside options. In this, our study is related to Bobonis and Morrow (2014) who show that positive coffee price shocks in Puerto Rico between 1849 and 1874 distorted investments in human capital to reduce plantation workers's outside options. Our study differs in that we can directly measure wages and coercion, in that we observe 14 countries over 80 years, and in that we have an exogenously varying measure of a coercive institution. Our study is also closely related to Naidu and Yuchtman (2013), who examine the interaction between the British Master and Servant law and exogenous output price fluctuations in determining working conditions.[4] While Naidu and Yuchtman (2013) focus on how employers selectively applied a given coercive legislation within a relatively short time window, we focus on the long-run evolution of a coercive system i.e., the demise of British planter elites, and the resulting changes in wages as well as in the evolution of the law itself.

Any historical paper on the terms of trade and wages must also pay homage to the remarkable scholarship of Jeff Williamson and his coauthors (O'Rourke and Williamson, 2001; Clemens and Williamson, 2004; Williamson, 2006). 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 studies of long-run wage movements in labor markets that are coercive — there are few of these in Williamson's samples — must additionally consider the institutional-change channel. Finally, our paper relates to several regional literatures on international trade and coercive labor 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 labor through coercion e.g., McCreery (1986) and Paige (1998). Of particular relevance is the study by Carvalho and Dippel (2016), who focus on the gradual rise of colored elites in the post-Emancipation Caribbean. They present a theory in which colored elites were less able to support labor coercion because they were more accountable to the citizenry, and test this theory in roll-call voting data of the colonies' legislative assemblies.

In section 2 we review the history of legal coercion in the British West Indies. In section 3 we develop our theory. In section 4 we describe the data and how we measure our key variables. In sections 5 and 6 we present OLS and IV results, respectively. Section 7 concludes.

[4]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 labor contracts. After abolition (1876–1890), wages rose in counties where prosecutions had been most common and wages became more responsive to demand shocks.

2 History

The Emancipation of Slavery in 1838 impacted some British West Indies colonies more than others. In some colonies, such as 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 on the same terms as before Emancipation (Merivale 1861, 339–340; Engerman 1984, 134). In most other colonies, Emancipation initially led to sharply rising wages as freed slaves rejected plantation life in favour either of squatting on abandoned estates or of buying small plots in the hinterland (Merivale 1861, 340–341; Engerman 1984, 134 and table 2; Riviere 1972, 13). This period of rising wages and 'flight off the estates' did not last long (Hall 1978, 7; Green 1976, 174–175, 198; authors' calculations from the *Colonial Blue Books*). Within five years of Emancipation the white planter elite had developed a system of legal coercion over labor which ensured that the plantation system maintained its grip on the islands for the better part of the 19th century.

Legal coercion took three main forms. First, planters lobbied for a host of restrictions which limited worker access to affordable land and to land with clear legal title. Large tracts of Crown land were 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 was kept off the market for decades after Emancipation (Sewell, 1861, 103, 106, 133). Also, peasants were prohibited from pooling their resources to buy plantations and bankrupt planters were pressured not to sell to smallholders (Eisner 1961, 211, Craton 1997, 390).

Second, the tax system penalized smallholders. A smallholder with five acres could pay higher taxes than a planter with 500 acres. Not only did such high smallhold taxes reduce the returns to smallholding, they led to punitive loss of title. For example, 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. Many other discriminatory taxes have been documented, including export taxes that were higher on smallhold crops than on sugar e.g., Underhill (1895, xvii). One particularly contentious tax was the import tariff on crops that competed directly with smallhold crops. These tariffs reduced import competition and thus increased the returns to smallholding. Import tariffs were "opposed by the estate interests since they tended to deplete labor reserves by driving workers from plantations to the hinterland, where they grew ground provisions" (Rogers, 1970, 96). Green

(1976, 186) similarly states that there was political conflict "over import duties on food, [which] enticed freedmen to abandon estate labor in favor of the production and sale of provisions."

Third, the full force of the law was brought to bear on peasants who attempted to squat on abandoned estates or Crown land. 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). 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. Local magistrates, who were often former plantation overseers (McLewin, 1987, 85–87), over-zealously enforced the laws by jailing rather than fining those who set foot on abandoned estates. This abusive jailing 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 result in imprisonment. The salience of the squatting-incarceration issue is illustrated by Jamaica's Morant Bay Rebellion. By 1865, a number of villages had been established illegally on Crown lands in the hills above Morant Bay. Tensions ran high as the government sought to limit 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, 59). A crowd gathered at the courthouse, violence broke out, and then quickly ignited all of Jamaica. The Rebellion left 600 dead and many more imprisoned (Underhill, 1895; Craton, 1988).

After carefully itemizing these and other coercive practices, 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 labor 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 smallholders of the British West Indies (BWI). Its role was simple: Reduce the returns to smallholding so as to encourage peasants to work on the plantations for low wages. Restated in more theoretical language, legal coercion did not affect plantation workers directly; rather, it affected them indirectly by reducing their *outside options*.

Despite the effectiveness of legal coercion, between 1838 and 1913 planters faced two challenges over which they had no control. First and foremost, in 1838 the BWI colonies almost exclusively exported sugar, yet by 1913 the price of sugar was just one quarter of what it had been in 1838. This collapse of sugar prices was the primary reason for the decline of BWI plantations. Since the price of sugar will be a regressor in our empirics, we note that this price collapse was completely exogenous. It was the result of increased production from new sugar cane producers and from European beet sugar. World competition was so stiff that by 1913, the BWI produced just 1% of world sugar output.[5] Similarly, to the limited extent that planters shifted into other crops such as cocoa, BWI was a minor player in world markets and faced exogenous world prices.

The second challenge was military. Whites were a tiny minority in the colonies, less than 3% of the population by 1913 and, in many colonies, numbering only in the hundreds. They depended on the ability of the British navy to rapidly respond to the ever-present threat of rebellion. However, British naval spending in the Caribbean dropped from £600,000 in 1838 to £200,000 by 1870 as Britain shifted forces to China (the Opium Wars), the Crimea and elsewhere. Whites felt exposed and left in droves for England, thereby further weakening the white planter elite and the plantation system.

3 A Simple Model of Coercive Labor Market Institutions

Before turning to econometric work we present a model that accomplishes two things. First, it describes how the use of coercion to reduce outside options results in the predictions of figure 1. Second and more important, we will be examining the impact of prices on wages, but in a world with multiple crops, price impacts are surprisingly complex. As a simple example, suppose there are two crops (bananas and cocoa) and consider a smallholder who has only planted bananas. When the price of cocoa rises the smallholder's income rises if he substitutes towards cocoa and remains unchanged if he stays in bananas. Thus, the impact of export prices on wages depends on how crop choices respond to prices. We thus present a model of crop choice along the lines developed by Costinot et al. (2016). We note in passing that this is not a theoretical paper and encourage the reader to move quickly through the theory so as to save energy for the empirics.

[5] See online appendix figures 1 and 2.

3.1 Technology and Crop Choice

There is an exogenous measure L of workers (former slaves) and an endogenous measure N of planters (members of the planter elite). There is a continuum of heterogeneous plots indexed by ω, each of which can be planted in one of $g = 1, \ldots, G$ crops. We follow Costinot et al. (2016) in modelling crop choice by assuming that plot ω planted in crop g has a baseline yield of $z_g(\omega)$ where $z_g(\omega)$ is a random variable with a Fréchet distribution: $Pr\{z_g(\omega) < z\} = e^{-T_g z^{-\theta}}$. On a plantation, plot ω combined with one worker produces output $\tau_g^p z_g(\omega)$ where $\tau_g^p \geq 0$ describes the efficiency of plantation agriculture e.g., τ_g^p is large for sugar and small for livestock. On a smallhold, plot ω combined with one worker produces output $\tau_g^s z_g(\omega)$ where $\tau_g^s \geq 0$ describes the efficiency of smallhold agriculture. The crop-specific τ_g^p and τ_g^s explain why some crops are better-suited than others for plantation agriculture.

We consider a small open economy so that crop prices $\mathbf{p} = (p_1, \ldots, p_G)$ are exogenous. Crops are chosen to solve $\max_g p_g \tau_g^j z_g(\omega)$ where $j = p$ if it is a plantation plot and $j = s$ if it is a smallhold plot. The optimal choice varies across plots, but on average the expected revenue per plot will be

$$r(\mathbf{p}, \tau^j) = \mathbf{E} \max_g p_g \tau_g^j z_g(\omega) = \left(\Sigma_k T_k (\tau_k^j p_k)^\theta \right)^{\frac{1}{\theta}} \Gamma \ , \quad j = p, s \tag{2}$$

where $\tau^j = (\tau_1^j, \ldots, \tau_G^j)$ and $\Gamma = \Gamma(1/\theta - 1)$ is the gamma function. See Appendix A for the proof or Costinot et al. (2016, 215). $r(\mathbf{p}, \tau^j)$ captures how crop choices respond to prices.

Each smallholder is randomly allocated one plot and each planter is randomly allocated $l(N) \geq 1$ plots. Since each plot uses one worker, the maximum number of planters is $N = L$ and when $N = L$ each planter receives one plot i.e., $l(L) = 1$. We also assume that the more planters there are the more land they receive collectively ($\frac{\partial \ln l(N) N}{\partial \ln N} > 0$), but not individually ($\frac{\partial \ln l(N)}{\partial \ln N} < 0$). The latter creates a 'congestion cost' which ensures that not all agriculture is plantation agriculture.

3.2 The Worker's Occupational Choice and Coercion

Each smallholder must choose between plantation work and smallholding. Utility from working on the plantation is w.[6] Utility from smallholding is $r(\mathbf{p}, \tau^s) - C$ where C is the negative impact

[6] By equating utility with income we are implicitly assuming that only the numeraire good is consumed and that all other goods are exported.

of planters' legal coercion on the returns to smallholding. C is endogenous. It follows that in any equilibrium with both plantation and smallhold agriculture,

$$w = r(\mathbf{p}, \tau^s) - C \ . \tag{3}$$

$r(\mathbf{p}, \tau^s)$ captures how wages respond to prices when crop choices are endogenous.

The costs of coercion (e.g., building jails) are given by C^γ where $\gamma > 1$. These costs are funded by a head tax on planters of C^γ/N. Consider planter profits. When there are N planters, each receives $l(N)$ plots, earns per plot revenues of $r(\mathbf{p}, \tau^p)$, pays per plot wages of $r(\mathbf{p}, \tau^s) - C$ and is left with profits of

$$\pi(C, N) \quad = l(N) \left[r(\mathbf{p}, \tau^p) - r(\mathbf{p}, \tau^s) + C \right] - C^\gamma/N \ . \tag{4}$$

We use Grossman and Helpman's (1994) 'Protection for Sale' framework to determine the level of coercion C. $C \geq 0$ is chosen to maximize a weighted sum of the profits of the N planters and the L workers:

$$W(C) = \alpha N \pi + L w \ . \tag{5}$$

α is the weight given to planters' profits. Our key assumption is that $\alpha > 1$ so that planters have greater sway over the choice of coercion. Substituting equations (3)–(4) into (5) and maximizing with respect to C subject to $C \geq 0$ yields the following characterization of optimal coercion. Let $\bar{N}$ be the value of N for which $\alpha l(N) N - L = 0$. Under our assumptions, $\bar{N}$ is unique and $0 < \bar{N} < L$. The optimal level of coercion is

$$C^*(N) = \left(\frac{\alpha l(N) N - L}{\alpha \gamma} \right)^{\frac{1}{\gamma - 1}} \qquad \text{for} \ \ N \geq \bar{N} \tag{6}$$

and $C^*(N) = 0$ for $N < \bar{N}$. Since the land controlled by planters is increasing in the number of planters [$l(N)N$ is increasing in N], equation (6) implies one of our key results, namely, $C^*_N > 0$ when N is sufficiently large. The insight is simple: The stronger is the planter elite, the greater is its political influence (as measured by αN) and hence the higher is the level of coercion. Equation (6) further implies a threshold effect: When the number of planters drops below $\bar{N}$, there is no coercion. See Appendix A for proofs.[7,8]

3.3 The Planter's Decision and Free Entry of Planters

Each potential planter must choose between staying in England and earning $\overline{W}$ versus moving to the colony. In the colony the planter earns the equation (4) profits $\pi(N) \equiv \pi(C^*(N), N)$ unless there is a Morant Bay-style rebellion in which case he earns 0. Expected profits are thus $m\pi(N)$ where m is the probability of no rebellion and is increasing in British military spending in the Caribbean (m for military). If $m\pi(N) < \overline{W}$ for all N then no planter moves to the colony and there is only smallholding. If $m\pi(N) > \overline{W}$ for all N then L planters move, each has one plot and one worker, and there are no smallholders. We focus on the intermediate case where planters and smallholders coexist. In that case there is an N^* such that

$$m\pi(N^*) = \overline{W} \ . \tag{7}$$

This equation pins down the equilibrium number of planters N^*. In Appendix A we provide sufficient conditions on the underlying parameters of the model for such an N^* to exist and to be stable in the usual sense that $\pi_N(N^*) < 0$.

N^* is increasing in m. This follows from equation (7) and $\pi_N(N^*) < 0$. We will argue below that m is exogenous and, since m has no direct impact on anything but N^*, m is an instrument for N^*.

How N^* responds to crop prices will depend on crop substitution patterns. To see exactly how this plays out, rank crops so that τ_g^p/τ_g^s is increasing in the crop index g i.e., the higher the index g, the more suitable is the crop for plantation agriculture relative to smallhold agriculture. It is straightforward to show that a rise in the price of a plantation-suitable crop attracts new planters from England while a rise in the price of a smallhold-suitable crop encourages existing planters to return to England. A precise statement appears in lemma 1 of Appendix A.

[7] We note in passing that if $\alpha = 1$ then $\bar{N} = L$ so that $C^* = 0$ for all N, which reflects the fact that coercion is an inefficient redistributive policy that would never be used if smallholders had equal say in choosing coercion.

[8] This 'Protection for Sale' setup abstracts away from part of the collective action problem in that the level of coercion grows with the number of planters. However, planters do not solve the bigger collective action problem, namely, that of collectively restricting entry into planting and thereby preventing profits from being driven to zero. Historically, in the median colony whites represented only 1.6% of the population so that, in the highly racialized colonial society, whites 'stuck together.' Thus empirically, there was no white collective action problem when it came to policies restricting black smallholders.

3.4 General Equilibrium and Comparative Statics

An equilibrium in our small open economy is a crop choice for each plot ω and mode $j = p, s$ that solves $\max_g p_g \tau_g^j z_g(\omega)$, a wage w that leaves each smallholder indifferent between plantation work and smallholding (equation 3), a level of coercion $C^*(N^*)$ that maximizes planter-biased societal welfare (equation 6), and a mass of planters N^* that leaves each planter indifferent between staying in England and moving to the colony (equation 7).

Our main comparative statics results are as follows. First, the wage is increasing in an index of prices $r(\mathbf{p}, \tau^s)$ and decreasing in coercion C. See equation (3). Second, coercion is increasing in the number of planters. See equation (6). Third, the number of planters is increasing in the price of plantation-suitable crops. See lemma 1 of Appendix A. These three properties are summarized visually in figure 1. Fourth, in the absence of coercion, wages are given by $w = r(\mathbf{p}, \tau^s)$ (equation 3). We thus have a benchmark for competitive wages that deals explicitly with the crop substitution problem identified at the start of this section.

4 Data

Starting in the mid-1830s, Britain began collecting statistics on colonial conditions. 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 thousands of the relevant *Blue Book* pages. As well, we made use of the *Statistical Tables Relating to the Colonial and Other Possessions of the United Kingdom*, annual Censuses, and various other House of Commons Parliamentary Papers. We manually entered the relevant data into spreadsheets and built a panel data set on exports and export prices by crop, race demographics, wages, incarceration rates, coercive taxes, and military expenditures. The panel consists of 14 colonies from 1838 to 1913.

4.1 Measuring Institutional Change N_{it}

Our main thesis is that the white planter elite used coercion to reduce wages and, therefore, that a weakening of the plantation system led to a decline in legal coercion and a rise in wages. In this section we describe and justify three measures of the strength of the planter elite N_{it}.

1. Sugar Exports

Sugar in the British West Indies was by far and away the dominant plantation crop, completely eclipsing all other crops such as cotton or coffee. Sugar is consistently identified with a plantation mode of production and has often been argued to be detrimental to economic and social development e.g., Sokoloff and Engerman (2000) and Easterly (2007). We therefore use the share of sugar in total exports as our first measure of the strength of the planter elite.[9]

The top panel of figure 2 displays the lowess-smoothed share of sugar in total exports by colony. 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. Five colonies remained heavily involved in sugar for the entire period (Antigua, Barbados, Guyana, St. Kitts, and Nevis). Four colonies saw sugar decline to less than half of total exports (St. Lucia, Trinidad, Tobago, and Jamaica). Five colonies exited sugar entirely by the end of period (Virgin Islands, Grenada, Dominca, St. Vincent, and Montserrat). In figure 2 and the econometric analysis below we use lowess-smoothed export shares because we are interested in capturing long-run changes in the strength of the plantation system rather than short-run agricultural fluctuations.[10]

2. Exports of All Plantation Crops

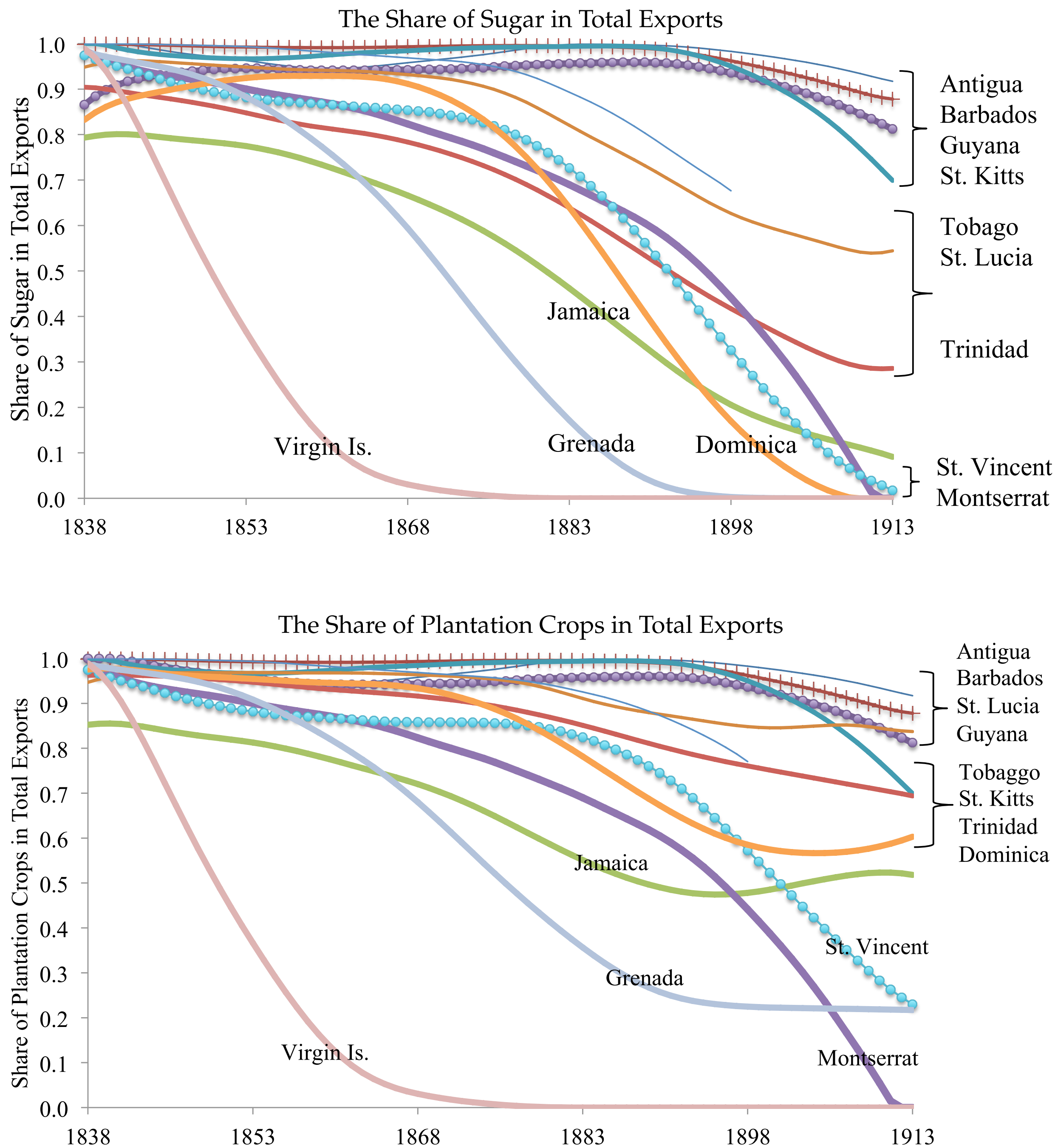
As sugar prices collapsed some planters shifted to other crops, which gives rise to our second measure of elite power, the share of plantation-produced goods in total exports. There are two difficulties in measuring this. First, except for sugar, no other crop was exclusively a plantation crop e.g., coffee was typically grown both on plantations and smallholds.[11] We must therefore use

[9]There is no consensus in the literature about the factors that make sugar a plantation crop and such a discussion is beyond the scope of the paper. However, since we are often asked about this we conjecture that three factors are important. (1) The sugar mill was a major capital asset that was beyond the financial reach of all but the richest members of Caribbean society (Marshall, 1996, 73; Lobdell, 1996, 322, 326). (2) Sugar must be processed within hours of harvesting so that there was always a sugar mill either on the plantation or nearby. See Higman's (2001, figure 2.5) map of Jamaican mills. (3) Labor demand during the sugar harvest was physically brutal (e.g., 90-hour work weeks) and conflicted with workers' needs to harvest their own provision grounds (Higman, 1984, 182–183). These factors favoured a system of production that vertically integrated harvesting with milling at a single location (the plantation) and which, in the racialized post-Emancipation period, used coercion rather than overtime pay as an incentive device i.e., these three factors favoured a plantation system.

[10]The lowess smoothing faithfully reproduces the annual data. See online appendix figure 3.

[11]See Nugent and Robinson (2010) for a discussion of the primacy of politics over nature for understanding why coffee is sometimes a plantation crop (El Salvador, Guatemala) and sometimes a smallhold crop (Colombia, Costa Rica).

Figure 2: The Differential Decline of the Plantation Economy



Notes: This figure reports the share of sugar in total exports (top panel) and the share of plantation crops in total exports (bottom panel). Nevis is not reported because it stayed above 0.99 in each panel. Also, Nevis merged with larger St. Kitts in 1883 and Tobago merged with larger Trinidad in 1899.

detailed histories of each colony to identify which crops were plantation crops. Second, we must use the *Blue Books* to construct a 76-year panel of exports by colony and crop. This is a huge undertaking: 76 years of consistent export data for developing economies is rare even for present-day data. The final database contains exports by colony and year for 17 products accounting for 98% of exports. The products are sugar, livestock, arrowroot, cocoa, lime juice, cotton, bananas, oranges, pimento, coffee, charcoal, lumber, coconuts, ginger, other spices (cloves, mace and nutmeg), balata (a natural tar), and asphalt. For the purposes of identifying plantation crops we focus on crops that were important in the sense of accounting for at least 15% of any one colony's exports in any one year. There are eight such crops and they account for 95% of exports.[12] For each of these crops in each colony in each year we then used historical accounts to code up the share of production accounted for by plantations, $Pl_{git} \in [0, 1]$, and used this to calculate the share of plantation-crop exports in total exports. Details appear in Appendix B.

The bottom panel of figure 2 plots the share of plantation crops in total exports by colony. The differences between the top and bottom panels are mainly due to cocoa. Cocoa was a major export crop for Trinidad and St. Lucia (where plantations produced three quarters of all cocoa exports) and Grenada and Dominica (where plantations produced one quarter of all cocoa exports). The main smallhold crops varied by colony but include livestock in the Virgin Islands, arrowroot in St. Vincent, lime in Montserrat, cocoa in Grenada and Dominica, and fruits and coffee in Jamaica. See online appendix figure 3 for details.[13]

3. White Population Share

One cannot understand the declining power of the British West Indies plantation system without understanding the demographics of race. In the U.S. Deep South on the eve of the Civil War, one in two people were white (Gibson and Jung, 2005). In contrast, for our 14 colonies in 1838,

[12]The crops are sugar, cocoa, coffee, cotton, arrowroot, livestock, lime, and fruit. Fruit is largely a Jamaican aggregate consisting of bananas, oranges and pimentos.

[13]All available evidence strongly suggests that the share of sugar and other plantation crops is strongly and negatively correlated with the number of smallholders and smallholder participation in exports. Eisner (1961, 215–235) discusses how Jamaican plantation exports were replaced with smallhold exports. For the 1838–1860 period, Riviere (1972, 15-17) documents the rapid rise in the number of smallholds in Antigua, Barbados, St. Kitts, Guyana, Trinidad, Tobaga, St. Lucia, St. Vincent, Grenada and Montserrat. 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 smallholders and, more important, a marked shift by the smallholders to export crop production." That is, rising smallholder power was reflected in the rise of non-plantation exports and the decline of sugar and other plantation production in total exports.

Table 1: Whites as a Share of the Population, 1838 and 1913

	Barbados	St. Vincent	St. Kitts	Guyana	Antigua	Jamaica	Nevis	St. Lucia	Dominica	Montserrat	Grenada	Virgin Islands	Tobago
1913	6.9%	5.2%	4.9%	4.1%	3.0%	1.8%	1.7%	1.6%	1.2%	1.1%	1.0%	0.7%	0.5%
1838	12.4%	4.7%	7.3%	5.5%	5.3%	4.5%	5.2%	6.0%	3.7%	3.9%	2.5%	8.4%	2.0%

Notes: Authors' calculations based on census data. Nevis and Tobago data listed as 1913 are for 1882 and 1898, respectively.

whites were a tiny minority (6%) and white power stemmed solely from sugar profits and military support from the British government. By 1913 only 3% of the population was white. Froude (1888, ch.XVII) lamented that "the English of those islands are melting away. Families who have been for generations on the soil are selling their estates everywhere and are going off. Lands once under high cultivation are lapsing into jungle . . . The white is relatively disappearing, the black is growing." To European observers at the time, the exodus of whites was synonymous with the weakening of the plantation system.

Unfortunately, standard sources of demographic data are scarce. Of necessity, we therefore collected all of the colonial decennial censuses and built what is by far the most comprehensive database on Caribbean race demographics ever assembled. We interpolate linearly between censuses, we note that there are no race data for Trinidad, and we refer the reader to online appendix table 1 for details.

Table 1 shows the share of whites by colony for the first and last years of our sample. Interestingly, almost all of the colonies where whites were more than 3% of the population in 1913 were colonies that stayed in sugar. Likewise, almost all of the colonies where whites were less than 1.5% of the population in 1913 were colonies with almost no sugar exports in 1913. Thus, the export and race data present similar portraits of the decline of the white elite-dominated plantation system.

4.2 Wage (W_{it}) and Coercion (C_{it}) Data

The *Blue Books* report daily wages for 'predial' workers i.e., for agricultural workers who might move from plantation to plantation without a contract. Where possible we have compared our wage data to wages reported in contemporary sources. See Appendix C for details.[14]

From the *Blue Books* we were able to consistently collect time series on two forms of legal coercion: One is coercive taxation, the other is incarceration rates. The latter is new incarcerations per capita (expressed as a percent). The mean for our sample is 1.1%, indicating that 1.1% of the population entered jail each year. We do not have data on the reason for incarceration; however, Brizan (1984, 134) reports that in Grenada, two-thirds of court cases from 1850 to as late as 1890 involved the types of legal coercion discussed in section 2.

We were also able to consistently code four features of the coercive tax system. The first is a measure of the regressiveness of property taxes. The second is whether all land (smallhold and plantation) was taxed together or whether plantations were additionally taxed. The third and fourth are the tariffs on the two main food imports, flour and rice.[15] Each colony had its own unique mix of taxes, some preferring one type and others preferring another. We therefore focus on the principal component of these four taxes in the main results. We also report results for each tax separately in online appendix table 2. That these taxes were an important part of legal coercion was explained in section 2 and is further illustrated by the 1853 Virgin Islands riots. Repairs to infrastructure damaged by a series of hurricanes in the 1840s and early 1850s resulted in a large public debt. The government responded by shifting the tax burden onto smallholders. Specifically, in 1853 the government doubled the head tax on livestock, the most important peasant activity in the Virgin Islands. This led to escalating tensions, a major riot and many incarcerations (Dookhan, 1975, ch. 7 and especially page 156).

[14]We work with nominal wages. The *Blue Books* report that the major components of the cost of living were largely imported from Britain (clothing and many staples such as flour and rice) so that all 14 colonies shared a common cost of living. It follows that the cost of living deflator is absorbed in the year fixed effects used in our regressions.

[15]The specific coding varied by the tax. First, property taxes were always progressive in that properties in higher-value property tax brackets were taxed at higher rates. Also, empirically, every increase in the number of tax brackets corresponded to an increase in the progressiveness of the tax system. Because all of our regressions will include colony fixed effects, and we therefore identify only within-colony over-time variation, we are not concerned about the different cutoffs of the tax brackets across islands, and use the number of property tax brackets as a simple proxy for the land and property tax code's overall progressivity. Second, while there were always taxes on land and property, some islands imposed additional taxes on plantations. We coded a simple indicator for whether there was such an additional plantation tax. Finally, import tariffs on flour and rice were specific tariffs and thus coded as tariff amounts per pound. In summary, for all four taxes a higher value is less coercive in the sense of placing a relatively higher incidence on the backs of planters.

4.3 Price Data and the Export Price Index $r_i(\mathbf{p}_t, \tau^s)$

Sugar prices are from Blattman, Hwang and Williamson (2007). These are virtually identical to data in Deerr (1950), the seminal work on the subject, and to export unit values (export revenues divided by export quantities) as reported in the *Blue Books*. For the remaining 16 products we built export unit values. Developing prices at such a detailed level required meticulous work and validation against the sporadic contemporary sources available. Details appear in Online Appendix A.

We develop two export price indexes, a standard Tornqvist index, which has many desirable and well-known properties, and $r_i(\mathbf{p_t}, \tau^s)$ of equation (2). We first describe the Tornqvist index. Bearing in mind that we will always have colony fixed effects, we express the Tornqvist index in changes:

$$Tornqvist_{it} \equiv \sum_{g=1}^{17} \frac{1}{2} \left(\frac{x_{git}}{\Sigma_k x_{kit}} + \frac{x_{gi,t-1}}{\Sigma_k x_{ki,t-1}} \right) \ln \frac{p_{gt}}{p_{g,t-1}} \tag{8}$$

where x_{git} is exports of crop g by colony i in year t and p_{gt} is the corresponding world price.

The remainder of this section deals with estimating $r_i(\mathbf{p_t}, \tau^s)$. This is a major undertaking and demands a detailed discussion; however, we keep it short in the main text and refer the reader to Appendix D. First, we need information on agro-climactic conditions. Standard sources for crop-suitability data are too coarse for our colonies.[16] We therefore hired an expert to gather agro-climatic data at an unusually fine level and to develop the agro-climatic suitability indexes for the 8 most important crops listed in section 4.1.2. This entails identifying the agro-climactic factors relevant for each crop and coding each factor into four bins ranging from very suitable (1) to very unsuitable (4). For example, lime has seven factors including average temperature (23–30°C is very suitable) and soil pH (6.1-6.5 is very suitable). The details of our crop suitability coding appear in Online Appendix B and online appendix tables 9 and 10. We show in section 6.1 that our crop suitability measure for sugar is accurate. Let A_{gi} be a vector of crop suitability characteristics pertaining to crop g.

We estimate the parameters of $r_i(\mathbf{p_t}, \tau^s)$ using an almost standard gravity equation method

[16]For example, each grid cell in the *Geographically Based Economic Data* (GBED) database (e.g., Michalopoulos, 2012) has a resolution of 0.5 degrees latitude by 0.5 degrees longitude, which, at the equator, is over 3,000 square kilometers. Likewise, the crop suitability data compiled by the FAO GAEZ project (e.g., Costinot et al., 2016) 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 GBED database.

common to Fréchet-based models. That is, we relate crop-level exports to the $T_{gi}(\tau_g^j)^\theta(p_{gt})^\theta$ terms in equation (2). In the standard gravity approach a plot's productivity is drawn from a single distribution, but here it is drawn from two distributions, depending on whether the plot is a plantation (τ_g^p) or a smallhold (τ_g^s). To keep the estimation within a standard framework we assume that a plot's productivity is drawn from a single distribution with a parameter τ_g which is the geometric average of τ_g^p and τ_g^s. Specifically, $\tau_g(Pl_{git}) \equiv (\tau_g^p)^{Pl_{git}}(\tau_g^s)^{1-Pl_{git}}$ where Pl_{git} is the share of crop g in colony i in year t produced on plantations. We also assume that $\ln T_{gi} = \alpha_g A_{gi}$ where α_g is a parameter vector. Gravity estimation very roughly boils down to regressing log exports on A_{gi}, Pl_{git}, a crop dummy, and $\ln p_{gt}$.[17] The gravity equation identifies the parameters $\{\alpha_g, \tau_g^p, \tau_g^s\}_{g=1}^G$ and θ. From the estimates of these parameters we recover estimates of the $r_i(\mathbf{p_t}, \tau^s)$. See Appendix D for details.

As to the empirical results, the most important parameter is the coefficient on prices θ, which guides how changes in export prices affect crop substitution patterns. As shown in table 7 of Appendix D, we estimate $\widehat{\theta} = 2.17$ (t =4.17), which is in line with Costinot et al. (2016) who estimate $\widehat{\theta} = 2.46$. In addition, the gravity equation R^2 is 0.86, which means that agro-climactic factors do a good job of explaining crop patterns.

5 OLS Evidence

Our theory, summarized in figure 1, motivates our core regressions:

$$\ln w_{it} = \beta N_{it} + \gamma EPI_{it} + \delta X_{it} + \lambda_i + \lambda_t + \varepsilon_{it} \quad (9)$$

$$C_{it} = \beta' N_{it} + \gamma' EPI_{it} + \delta' X_{it} + \lambda_i' + \lambda_t' + \varepsilon_{it}' \quad (10)$$

where i indexes colonies, t indexes years, C_{it} is one of our two measures of coercion (incarceration rates and coercive taxes), N_{it} is one of our three measure of the strength of the plantation economy, EPI_{it} is one of our two export price indexes ($r_i(\mathbf{p}_t, \tau^s)$ and $Tornqvist_{it}$), X_{it} is a vector of other observables, and the λs are fixed effects. The panel consists of 14 colonies over the years 1838–1913.[18]

[17]To see this note that $\ln \tau_g^j = Pl_{git} \ln \tau_g^p + (1 - Pl_{git}) \ln \tau_g^s = \ln(\tau_g^p/\tau_g^s)Pl_{git} + \ln \tau_g^s$. Hence, $\ln[T_{gi}(\tau_g^j)^\theta(p_{gt})^\theta] = \alpha_g A_{gi} + \theta \ln(\tau_g^p/\tau_g^s)Pl_{git} + \theta \ln \tau_g^s D_g + \theta \ln p_{gt}$ where D_g is a crop dummy. This explains the regressors A_{gi}, Pl_{git}, D_g, and $\ln p_{gt}$.

[18]Nevis and Tobago end in 1882 and 1898, respectively, for a total of 1,018 possible observations.

As in figure 1, our core prediction is that the institutional change associated with the demise of the plantation system and white flight led to higher wages and less coercion ($N_{it} \downarrow \Rightarrow\ w_{it} \uparrow, C_{it} \downarrow$). Further, market forces associated with the collapse in the price of the major export crop (sugar) led to lower wages and had no implications for coercion ($EPI_{it} \downarrow \Rightarrow\ w_{it} \downarrow, C_{it}$ unchanged).

We start with the simplest possible specification, but one which will be seen to produce robust estimates. Consider table 2, panel A, column 0. It is a regression of $\ln w_{it}$ on the export price index $r_i(\mathbf{p}_t, \tau^s)$ and colony fixed effects. Surprisingly, the coefficient is zero, which is the puzzle discussed in the introduction. In column 1, we add N_{it} as measured by the plantation export share. This unpacks the two wage channels in figure 1 and generates the expected sign pattern: A fall in export prices lowers wages, but a weakening of the plantation system raises wages.

In columns 0′ and 2 we repeat the exercise, but with the Tornqvist index of export prices replacing $r_i(\mathbf{p}_t, \tau^s)$. In column 3 we add year fixed effects to flexibly purge the coefficient on N_{it} of any omitted time trend. Little changes across columns 1–3.[19]

Columns 4–6 repeat columns 1–3, but with the plantation export share replaced by the sugar export share. The coefficients on N_{it} in columns 4–6 are consistently about one-quarter smaller than in columns 1–3, indicating that the broader measure of plantation crops in columns 1–3 indeed captures the presence of other crops relevant for coercion.

The remaining panels have the same structure as panel A except that the dependent variables are incarceration rates per capita (panel B) and coercive taxes (panel C). As predicted in figure 1, the stronger is the plantation system, the higher are incarceration rates and coercive taxes. Further, but less important for our theory, both export price indexes are statistically insignificant in these panels.[20]

The magnitudes of the coefficients on plantation export shares are large. Consider column 3, which is our preferred specification because it has the most controls (colony and year fixed effects). Between 1838 and 1913 the average plantation export share declined from 0.98 to 0.58, a decline of

[19]To avoid adding columns, in specifications with year fixed effects we omit $r_i(\mathbf{p}_t, \tau^s)$ and the Tornqvist index. These are never statistically significant even at the 10% level and their inclusion has no effect on the coefficient on N_{it}. For example, the column 3 coefficient of -0.64 becomes -0.65 when $r_i(\mathbf{p}_t, \tau^s)$ is added and -0.64 when the Tornqvist index is added.

[20]Recall that coercive taxes is the principal component of four different taxes. Online appendix table 2 separately reports panel C for each of these four taxes. All coefficients in that table have the expected sign, but are not always statistically significant because different colonies chose different subsets of the four taxes in developing their mix of coercive taxes. In practice, the principal component puts almost equal factor loadings on each of the four taxes so that the principal component has a correlation of 0.9 with a variable which is the simple average of the four different taxes.

Table 2: Baseline Regressions

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

			N_{it}: **Plantation** Export Share			N_{it}: **Sugar** Export Share		
	(0)	(0')	(1)	(2)	(3)	(4)	(5)	(6)
N_{it}			-0.69***	-0.52***	-0.64***	-0.47***	-0.31**	-0.44**
			(-3.94)	(-3.53)	(-3.59)	(-3.12)	(-2.56)	(-2.96)
(Export Price Index)$_{it}$	0.03	0.11*	0.21***	0.22***		0.21***	0.21***	
	(0.53)	(2.00)	(3.06)	(3.63)		(3.25)	(3.69)	
Index / Year FE:	$r_i(\mathbf{p}_t)$	Tornqvist	$r_i(\mathbf{p}_t)$	Tornqvist	year fe	$r_i(\mathbf{p}_t)$	Tornqvist	year fe
Observations	915	915	915	915	915	915	915	915
R^2	0.654	0.660	0.700	0.697	0.763	0.689	0.686	0.755

Panel B. Dependent Variable: Incarceration Rates per Capita

	N_{it}: **Plantation** Export Share			N_{it}: **Sugar** Export Share		
	(1)	(2)	(3)	(4)	(5)	(6)
N_{it}	0.67**	0.53**	0.90***	0.47**	0.34**	0.62***
	(2.84)	(2.66)	(3.53)	(2.42)	(2.28)	(3.31)
(Export Price Index)$_{it}$	-0.14	-0.13		-0.15	-0.12	
	(-1.42)	(-0.99)		(-1.35)	(-0.90)	
Index / Year FE:	$r_i(\mathbf{p}_t)$	Tornqvist	year fe	$r_i(\mathbf{p}_t)$	Tornqvist	year fe
Observations	801	801	801	801	801	801
R^2	0.494	0.493	0.585	0.491	0.489	0.578

Panel C. Dependent Variable: Coercive Taxation

	N_{it}: **Plantation** Export Share			N_{it}: **Sugar** Export Share		
	(1)	(2)	(3)	(4)	(5)	(6)
N_{it}	3.04***	3.34***	2.90***	2.23***	2.38***	2.01***
	(4.45)	(6.96)	(4.27)	(5.04)	(7.27)	(3.65)
(Export Price Index)$_{it}$	0.21	0.06		0.13	0.03	
	(0.66)	(0.20)		(0.40)	(0.12)	
Index / Year FE:	$r_i(\mathbf{p}_t)$	Tornqvist	year fe	$r_i(\mathbf{p}_t)$	Tornqvist	year fe
Observations	942	942	942	942	942	942
R^2	0.747	0.744	0.772	0.731	0.730	0.749

Notes: (*a*) Panel A presents estimates of the wage equation (9). Panel B presents estimates of the coercion equation (10) for incarceration rates. Panel C presents estimates of the coercion equation (10) for coercive taxation, the principal component of four coercive taxes. (*b*) In each panel, columns 1–3 report results for the plantation export share (i.e. the share of plantation-produced exports in total exports) whereas columns 4–6 report results for the sugar export share (i.e., the share of sugar in total exports). These variables appear in figure 2. (*c*) All specifications include colony fixed effects. In addition, columns 1 and 4 include $r_i(\mathbf{p}_t, \tau^s)$, columns 2 and 4 include the Tornqvist export price index, and columns 3 and 6 include year fixed effects. (*d*) Standard errors are clustered by colony. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. t-statistics are in parentheses.

0.40. This led to a 0.26 log point increase in wages (0.64×0.40). It also led to a 0.36 percentage point fall in incarceration rates per capita (0.90×0.40), which is large relative to the mean incarceration rate of 1.1%. Finally, it led to a one standard deviation fall in coercive taxes ($2.90 \times 0.40/1.19$ where 1.19 is the standard deviation of coercive taxes). In contrast, from 1838 to 1913, export prices fell by as much as 1.27 log points (depending on the colony and the choice of export price index), which translates into wage declines of at most 0.28 percentage points (0.22×1.27). This illustrates our central thesis that changes in export prices can induce institutional changes that are very important for understanding changes in wages and coercion.[21]

Our third indicator of the strength of the plantation system is the share of whites in the population. The estimated coefficients on white shares always have the expected signs, but the magnitudes fluctuate wildly due to the influence of outliers (Barbados, Virgin Islands, and St. Kitts). The non-parametric econometric solution is to convert the white share variable into a rank variable and this produces stable results, as we shall see. However, this misses the deeper economic issue. As the historical discussion surrounding table 1 indicated, it is not the simple within-colony change in the share of whites that matters (which is the sample variation that drives our fixed effect specifications), but whether a colony has crossed a threshold beyond which there are too few whites to maintain planter power. Indeed, our theory predicted the existence of such a threshold ($\bar{N}$ in equation 6). To let the data determine the threshold, we create quartile dummy variables: the fourth quartile dummy equals 1 for any observation with a white share below 1.9%, the third quartile dummy equals 1 for any observation with a white share between 1.9% and 3.6%, and the second quartile dummy equals 1 for any observation with a white share between 3.6% and 6.1%.

Table 3 reports the results when using these white-share variables to measure the strength of the white planter elite (N_{it}). Each column is two separate regressions. Consider column 1 of the upper panel. The dependent variable is log wages and the independent variables are the export price index $r_i(\mathbf{p}_t, \tau^s)$, colony fixed effects and quartile dummies (the first quartile is the omitted category). In the bottom panel we instead include the rank of the white share. In column 1 we include $r_i(\mathbf{p}_t, \tau^s)$, in column 2 we include the Tornqvist index, and in column 3 we include year fixed effects.

[21] From figure 2, only two colonies had a complete collapse in the plantation system (N_{it} going from 1 to 0). Our estimates imply that this led to a fall in wages of 0.64 log points, a fall in incarceration rates of 0.90 percentage points, and a fall in coercive taxation of 2.4 standard deviations ($2.4 = 2.90/1.19$). These are very large effects.

Table 3: The Exodus of British Whites and the Plantation System

	Wages			Incarceration Rates			Coercive Taxes		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
White Share Dum.									
4th quartile	0.44***	0.43***	0.35***	-0.50***	-0.51***	-0.86***	-1.07**	-1.54***	-0.87
(few whites)	(6.18)	(7.51)	(3.22)	(-3.12)	(-3.67)	(-3.86)	(-2.91)	(-6.02)	(-1.60)
3rd quartile	0.25**	0.27***	0.20**	-0.44***	-0.46***	-0.65***	-0.13	-0.32	-0.04
	(2.81)	(3.59)	(2.22)	(-3.38)	(-3.22)	(-3.83)	(-0.43)	(-1.30)	(-0.09)
2nd quartile	0.08	0.09	0.07	-0.27***	-0.28***	-0.26*	-0.17	-0.25	0.02
	(0.87)	(1.10)	(0.73)	(-5.11)	(-5.78)	(-2.00)	(-0.89)	(-1.56)	(0.08)
(Export Price Index)$_{it}$	0.14**	0.20***		-0.06	-0.12		0.72**	0.46	
	(2.51)	(4.50)		(-0.50)	(-0.80)		(2.25)	(1.51)	
Index / Year FE:	$r_i(\mathbf{p}_t)$	Tornqvist	year fe	$r_i(\mathbf{p}_t)$	Tornqvist	year fe	$r_i(\mathbf{p}_t)$	Tornqvist	year fe
Observations	844	844	844	737	737	737	866	866	866
R^2	0.687	0.695	0.744	0.418	0.420	0.533	0.692	0.664	0.730
Percentiles of	-0.66***	-0.62***	-0.46**	0.61*	0.58**	1.44**	2.06***	3.00***	1.83*
White Share	(-4.76)	(-4.40)	(-2.52)	(1.86)	(2.27)	(2.48)	(3.70)	(3.78)	(2.10)
Index / Year FE:	0.16**	0.23***		-0.10	-0.14		0.62	0.21	
	(3.02)	(5.36)		(-0.70)	(-0.86)		(1.63)	(0.52)	
Observations	844	844	844	737	737	737	866	866	866
R^2	0.675	0.686	0.734	0.414	0.415	0.532	0.679	0.655	0.719

Notes: (*a*) The dependent variable is wages in columns 1–3, incarceration rates in columns 4–6, and coercive taxes in columns 7–9. (*b*) Each column is two separate regressions. In the bottom panel the measure of the strength of the white planter elite is the ranked share of whites in the population (0 for the smallest white share and 1 for the largest white share). In the top panel the strength of the white planter elite is measured by quartile dummies of the distribution of white shares. The first quartile (white share > 6.1%) is omitted. (*c*) All specifications include colony fixed effects. Columns 1–3 also include $r_i(\mathbf{p}_t, \tau^s)$, the Tornqvist index, and year fixed effects, respectively. Likewise for columns 4–6 and 7–9. (*d*) Trinidad is omitted for lack of data, which reduces the sample size relative to table 2. (*e*) Standard errors are clustered by colony. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. *t*-statistics are in parentheses.

All the white share dummies and white share ranks have the expected signs. In terms of magnitudes for our preferred wage specification (column 3, top panel), if a colony moves from the first quartile (many whites) to the second, third or fourth quartiles (few whites), its log wage rises by 0.07, 0.20, and 0.35 log points, respectively. Thus, the white share dummies not only have the expected sign, but also have the expected increasing pattern. Turning to incarceration rates and coercive taxes in our preferred year-fixed-effect specification, if a colony moves from the first to fourth quartiles, incarceration rates fall by 0.86 percentage points (which is large compared to the mean incarceration rate of 1.1%) and coercive taxes fall by a statistically marginally insignificant three-quarters of a standard deviation ($0.87/1.19$).[22]

To conclude, our three measures of the strength of the plantation system and two measures of price indexes produce similar conclusions in support of our central thesis. We next turn to examining the robustness of the previous results.

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, coercion and the plantation system it is wise to model this persistence in a more structured way. To this end we include a lagged dependent variable.[23] Table 4 reports the results with one-year lagged dependent variables. Using the example of the wage equation, we estimate $\ln w_{it} = \rho \ln w_{i,t-1} + \beta N_{it} + \gamma \ln EPI_{it} + \lambda_i + \lambda_t + \varepsilon_{it}$. For comparability, we report the long-run coefficients $\beta/(1-\rho)$ and $\gamma/(1-\rho)$. A comparison of the results in tables 2 and 4 shows that the static and dynamic models generate similar estimates. For wages and incarceration rates, the long run coefficients of the dynamic model are somewhat smaller on average (e.g. -0.51 vs. -0.64 in table 2, and 0.72 vs. 0.90 in table 2), while for coercive taxes, they are somewhat larger (e.g. 3.29 vs. 2.90). Identical conclusions hold using the sugar export share. See online appendix table 3.

2. Other Drivers of Wage Dynamics: As pointed out in section 2, historians of the British West Indies have emphasized two and only two differences between the 14 colonies. The first is

[22]Interpreting the bottom panel (column 3), if a colony moves from the highest share of whites (rank of 1) to the lowest share (rank of 0) its log wage rises by 0.46 log points.

[23]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.

Table 4: Dynamic (Lagged Dependent Variable) Model

	Wages			Incarceration			Coercive Taxes		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
N_{it}: **Plantation** Exports as	-0.78***	-0.56***	-0.51***	0.52*	0.40**	0.72***	3.39***	3.72***	3.29***
Share of Total Exports	(4.98)	(4.42)	(3.97)	(1.85)	(2.11)	(2.90)	(4.36)	(6.79)	(3.80)
(Export Price Index)$_{it}$	0.27***	0.29***		-0.11	-0.09		0.38	0.38	
	(3.13)	(3.18)		(0.90)	(0.71)		(1.13)	(1.19)	
Lagged Dependent	0.75***	0.75***	0.75***	0.65***	0.65***	0.63***	0.87***	0.87***	0.87***
	(15.27)	(15.05)	(15.48)	(9.57)	(9.68)	(9.86)	(25.15)	(23.88)	(26.20)
Index / Year FE:	$r_i(\mathbf{p}_t)$	Tornqvist	year-fe	$r_i(\mathbf{p}_t)$	Tornqvist	year-fe	$r_i(\mathbf{p}_t)$	Tornqvist	year-fe
Observations	866	866	866	725	725	725	929	929	929
R^2	0.878	0.879	0.898	0.711	0.711	0.750	0.957	0.957	0.960

Notes: This table re-estimates table 2 after adding the lagged dependent variable. Columns 1–3 re-estimate columns 1–3 of panel A of table 2. Columns 4–6 re-estimate columns 1–3 of panel B of table 2. Columns 7–9 re-estimate columns 1–3 of panel C of table 2. As in table 2, each set of 3 columns first adds $r_i(\mathbf{p}_t, \tau^s)$, then the Tornqvist index, and then, in our preferred specification, year fixed effects. All specifications have colony fixed effects. Long-run coefficients are reported. Significance levels for long-run coefficients use score-based F tests. The square root of these F-tests appear in parentheses. Standard errors are clustered by colony. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. See the notes to table 2 for additional details.

the suitability of the colonies for growing sugar, a difference that we have already controlled for with $r_i(\mathbf{p}_t, \tau^s)$ as well as colony fixed effects. The second is the timing of when the colonies came into British hands. The early colonies, notably Barbados and Antigua, had many years to develop and import slaves before the slave trade ended in 1807. They thus had high labor/land ratios and relatively low slave prices in 1836. In contrast those that came late, notably Trinidad (1797) and Guyana (1803), tended to have high land/labor ratios and high slave prices.[24] Online appendix table 4 lists each colony's founding year, area, 1838 land/labor ratio and 1836 slave price.[25] One might conjecture that our measures of white planter power are simply picking up market-driven long-run impacts of these initial cross-sectional differences. To investigate, we interact our export price indexes with both the 1836 land/labor ratio and the 1836 slave price. As we will see, these interactions are generally unimportant. Note that our colony fixed effects will control for all level effects of initial conditions.

While the late colonies could not import slaves, they could import indentured East Indian labor. Between 1838 and 1913, cumulative net immigration of indentured labor was 230,000 for

[24]In 1807, Britain ended the Atlantic slave trade. Until 1836, slaves could be legally bought and sold locally in each island but not across islands.

[25]The slave price is from the slave compensation schedules of 1836 as reported in Martin (1839). We use compensation for the 'head slaves' class, but cross-colony differences in compensation are similar for all slave classes.

Table 5: Labor Supply Shocks and Interaction between Initial Conditions and Terms of Trade

	Log Wages		Incarceration Rates		Coercive Taxation	
	(1)	(2)	(3)	(4)	(5)	(6)
Plantation Export Share (N_{it})	-0.64***	-0.68***	0.90***	0.81***	2.90***	2.64***
	(-3.59)	(-3.53)	(3.53)	(3.64)	(4.27)	(3.68)
Log Indian Immigration$_{it}$		-0.03**		0.00		-0.10**
		(-2.95)		(0.07)		(-2.38)
$r_i(\mathbf{p}_t, \tau^s)$ x (Slave Price)$_{1836}$		-0.00		-0.01*		-0.03
		(-0.26)		(-2.04)		(-0.85)
$r_i(\mathbf{p}_t, \tau^s)$ x (Land/Labor)$_{1836}$		-0.14		5.51*		8.18
		(-0.09)		(2.11)		(0.78)
Observations	915	915	801	801	942	942
R^2	0.763	0.774	0.585	0.589	0.772	0.788

Notes: All columns include colony and year fixed effects. Odd-numbered columns repeat results from column 3 of table 2. Even-numbered columns add in three variables: The log of the cumulative net Indian migration and $r_i(\mathbf{p}_t, \tau^s)$ interacted with 1836 slave prices and 1836 land/labor ratios. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. t-statistics are in parentheses.

Guyana, 124,000 for Trinidad, 37,000 for Jamaica and much smaller amounts for Grenada, St. Lucia, Antigua and Dominica (Roberts and Byrne, 1966). A more informative way of presenting these numbers is to note that in 1913, the ratio of cumulative net immigration to population exceeded 0.15 for only two colonies, Guyana where it was 0.77 and Trinidad where it was 0.37. Thus, while immigration likely reduced wages, this impact was important in only two colonies.[26]

Table 5 reports our findings. Columns 1, 3, and 5 repeat our preferred baseline specification (the year fixed effect specification in column 3 of table 2). In columns 2, 4 and 6 we add three variables: The log of cumulative indentured immigration from 1838 to year t and the export price index $r_i(\mathbf{p}_t, \tau^s)$ interacted with both the 1836 slave price and the 1836 land/labor ratio. The interaction terms are insignificant both individually and jointly, the coefficient on indentured immigration is statistically significant and, most importantly, the inclusion of these variables has little impact on the coefficient on plantation export shares. Online appendix table 5 shows that this conclusion extends to a number of other specifications including those with sugar export shares and with the Tornqvist index.

[26]The post-1880 Guyanese gold rush and Panama canal building also potentially impacted wages in neighbouring colonies, but we have examined these empirically and found no evidence of any impacts.

3. 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 6 we drop one colony at a time, re-estimate our preferred specification (column 3 of table 2) and report the results. None of our conclusions change. In online appendix table 7 we drop one decade at a time, re-estimate our preferred specification (column 3 of table 2) and again find no change in our conclusions. In online appendix table 8 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 conclusions change.

4. Clustering: In the tables above we reported results clustered by colony. This addresses concerns about serial correlation within a cross-sectional unit i.e., a colony. (See Bertrand, Duflo and Mullainathan, 2004.) Another concern is correlation across colonies within a given year due to common shocks. To address these concerns we also ran all our main specifications with two-way clustering that allows for separate arbitrary correlations within colony and within year (Cameron, Gelbach and Miller, 2011). 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). 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, which 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. We implement these alternative clustering methods for our preferred specification (column 3 in table 2) and report p-values for our key N_{it} coefficients. With our baseline clustering, the p-values in column 3 of table 2 are 0.00330, 0.00370, and 0.00091 respectively for wages, incarceration rates and coercive taxation. With two-way clustering (colony- and year-level clustering), the p-values are 0.00331, 0.00541, and 0.00116 respectively. With the wild bootstrap, the p-values are 0.00801, 0.02603, and 0.0800 respectively. In short, our results survive more conservative approaches to standard errors.[27]

To conclude this section, our OLS results in table 2 are robust.

[27]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 90%, 79% and 92% of all potential wage, incarceration rate and coercive taxation 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 ($\Delta x_{it} = x_{it} - \widehat{\rho} x_{i,t-1}$ for each variable x), and re-estimated the model with generalized differences and clustered standard errors. The resulting coefficients changed very little.

6 Endogeneity of N_{it} and Instrumental Variables

Part of the post-Emancipation differential evolution of the plantation system is explained by differences in agro-climactic suitability for plantation and non-plantations crops. In section 5 we carefully controlled for these differences with our two measures of the export price index. However, this leaves unanswered the question of what is driving the residual variation in N_{it}. Our main concern here is the possibility that part of the negative correlation between w_{it} and N_{it} may have been spuriously induced by unobserved labor demand and supply shocks. Consider first the resulting endogeneity bias this would create in the wage equation. A positive labor-supply shock drives down w_{it} and makes plantation agriculture more profitable (raises N_{it}). If this contributed to our negative correlation between w_{it} and N_{it}, then the estimated OLS effects would be too large in absolute terms.[28]

A positive labor-demand shock, meaning an increase in agricultural productivity on plantations (τ^p) and smallholds (τ^s), has effects that depend on whether τ^p/τ^s rises or falls. The historical literature suggests that τ^p/τ^s rose over time e.g., Curtin (1954, 158) and Galloway (1989, 95–119). In this case, improved sugar cane technology raises plantation productivity and labor demand, which increases w_{it} and makes plantations more profitable (raises N_{it}). This induces a *positive* correlation between w_{it} and N_{it} i.e., this works against finding our negative correlation. It also implies that IV estimates will be larger in absolute value than OLS estimates. This is what we will find. To deal with unobserved labor demand and supply shocks we turn to an IV approach.

6.1 Instrument 1: $(\textbf{British Naval Expenditure}_t) \times (\textbf{Outside Option}_i)$

A key determinant of the plantation system's strength was the ease with which planters could restrict the peasant smallhold outside option. In a colony like Barbados, all of the land was sugar-suitable and in 1838 only 4% of land was not under cultivation (1838 Barbados *Blue Book*); hence, the planter elite easily restricted peasant outside options. In a colony like Jamaica with its sugar-suitable coastal plane and higher-elevation interior (which was fertile but not sugar-suitable), the planter elite could not easily prevent smallhold agriculture. *During* slavery this difference be-

[28]We note, however, that we have already examined the most important labor supply shock (the arrival of East Indian indentured labor) and found that it made no difference to our estimates. Thus, labor supply shocks are unlikely to explain our results.

tween Barbados and Jamaica did not matter because sugar-suitable land was similarly suitable everywhere and the hinterland was largely inaccessible to slaves. *After* Emancipation, differences in the availability of a fertile but sugar-unsuitable hinterland led to differences in the ease with which the planter elite could restrict the peasant smallhold outside options.

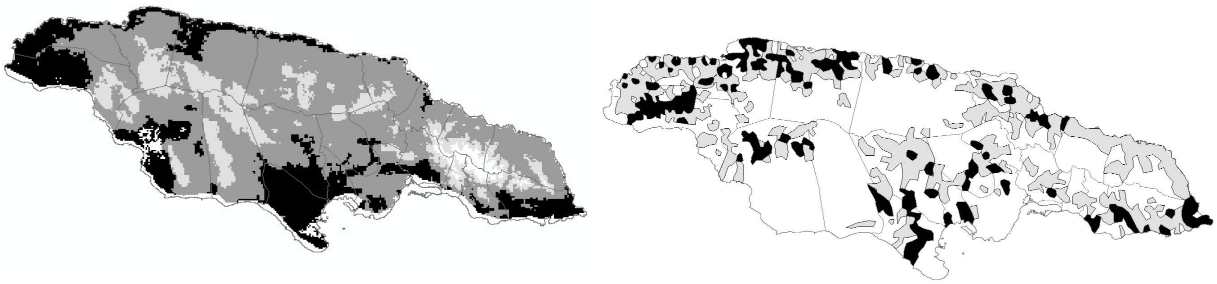
In terms of our model, we can add a coercion cost shifter O_i which is higher in colonies with a larger hinterland. (O_i for *O*utside option.) Let $O_i + C_{it}^{\gamma}$ be the cost of achieving coercion level C_{it}. Then it is trivial to show that an increase in O_i has no effect on wages w_{it} or optimal coercion C_{it}^{*}, but reduces planter profits and hence the equilibrium number of planters N_{it}^{*}. That is, O_i is an instrument for N_{it}^{*}.

To measure O_i we carefully calculated the share of each colony's land that is highly suitable for sugar cane. This was a major undertaking, but we relegate the details to a footnote.[29] The relationship between O_i and the historical outside options that peasants actually had is visually displayed in figure 3 for Jamaica, the only colony with historical maps on evolving land-use patterns. In the right panel, the shaded areas (both black and grey) are plantations in 1790. In the left panel, the black areas are lands that we have coded as highly suitable for sugar cane. The two are spatially correlated and, averaging across Jamaica, the share of land under plantation in 1790 is very close to the share of highly sugar-suitable land.[30] We also note that O_i is an extremely good predictor of cross-colony differences in the 1913 plantation and sugar export shares: The higher is O_i, the smaller is the 1913 sugar export share. See figure 4. There are two outliers in figure 4: In both Grenada and the Virgin Islands the the plantation system had collapsed by 1913 despite low values of O_i. Grenada's exceptionalism is simple: Grenada is good for sugar, but perfect for cocoa

[29] We hired an expert to develop a suitability index at the fine spatial resolution described in section 4.3 (8,144 equally sized cells). The index uses the six factors important for sugar cane (temperature, rainfall, elevation, soil pH, slope, and soil texture). At the cell level, each factor is categorized into one of four bins. For example, rainfall in the range of 1100–1500 millimetres per year is highly suitable for sugar cane, rainfall in the ranges of 950–1100 or 1500–1990 is moderately suitable for sugar cane, rainfall in the ranges of 800-950 or 1990–2500 is moderately unsuitable for sugar cane, and rainfall in the ranges below 800 or above 2500 is highly unsuitable for sugar cane. Weights for the six factors are from Jayasinghe and Yoshida's(2010) artificial neural network model. For each cell, the weights are used to aggregate the six factors into one of four characterizations of sugar cane suitability: highly suitable, moderately suitable, moderately unsuitable and highly unsuitable. The vast majority of the cells in our colonies are either highly or moderately suitable so that in what follows we define our 'suitability index' as the share of cells that are highly suitable. Since cells are equally sized, the index is also the share of land that is highly suitable. Finally, the weights make no use of Caribbean land use patterns (weights are based on Sri Lankan data) so that the weights and therefore the suitability index are entirely exogenous.

[30] The right panel of figure 3 illustrates another point. The grey-shaded areas are plantations that shut down between 1790 and 1890. These were the lands that were most difficult to keep out of peasant hands and were thus a major focus of coercive interventions.

Figure 3: Sugar Suitable Land in Jamaica (Left), and Plantations in 1790 and 1890



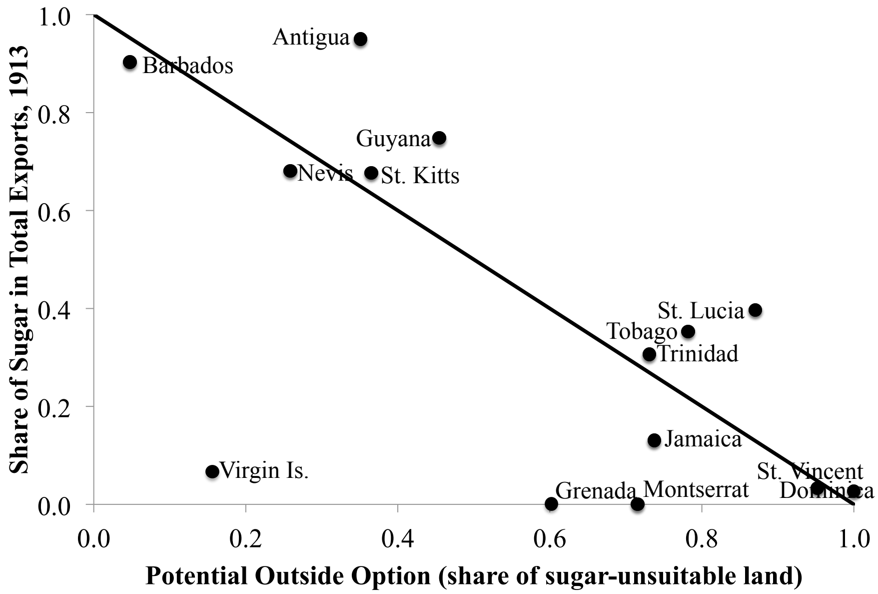
Notes: The left panel shows the spatial distribution of land that is highly sugar-suitable (black), moderately sugar-suitable (dark grey), moderately sugar-unsuitable (light grey) and highly sugar-unsuitable (white). See Online Appendix B for details. The right panel shows the extent of sugar plantations in 1790 (black plus grey areas) and 1890 (black areas). There is a good match between our estimate of sugar-suitable land in the left panel, and the historical sugar plantation land in Jamaica. The left panel is based on authors' calculations. The right panel is a digitized version of Higman's (2001) remarkable figure 2.9.

(Richardson, 1997, 193) so its sugar decline is explained by exogenous cocoa suitability, which we capture in our crop choice model. The Virgin Islands' early exit from sugar is due to hurricanes in 1848, 1852, 1867 and 1871 which destroyed the colony's sugar infrastructure and left planters too indebted to rebuild given the low price of sugar. Hurricanes form the basis of our second instrument as we will discuss in a moment.

Where O_i was high, the planter elite had to make extensive use of coercion to reduce wages. The result was a higher threat of revolt. Historical examples such as the Morant Bay Rebellion make it clear that the planter elite relied on the British navy for suppressing peasant revolts (Lewis 1986, 96; Rogers 1970, 263; Craig-James 2000, 251; Dookhan 1977, 202). We therefore introduced British naval expenditures into the model (m in equation 7). The preceding discussion implies an interaction: Where O_i was higher, the negative effect of a reduction in m on the plantation system was more pronounced. Letting m_t be the log of British naval expenditures, our instrument is then $Z_{it} \equiv m_t \times O_i$.

It is possible that Caribbean naval expenditures are endogenous: Waning planter representation in the British parliament likely led to waning political support for Caribbean naval expenditures. We therefore use naval expenditures in North America. Both Caribbean and North American naval expenditures were subject to the same exogenous shocks, meaning expenditure reductions that occurred as Britain shifted its naval resources out of the Caribbean and North

Figure 4: Initial Conditions and Sugar's End-of-Period (1913) Export Share



Notes: Each point is a colony's N_{it} in 1913 plotted against its share of land that is unsuitable for sugar cane cultivation, which is a proxy for the share of all land that was unused in 1838. The $-45°$ line provides a benchmark. Plantation shares for Nevis (Tobago) are extrapolated out to 1913 using 1882 (1898) data and growth rates from St. Kitts (Trinidad).

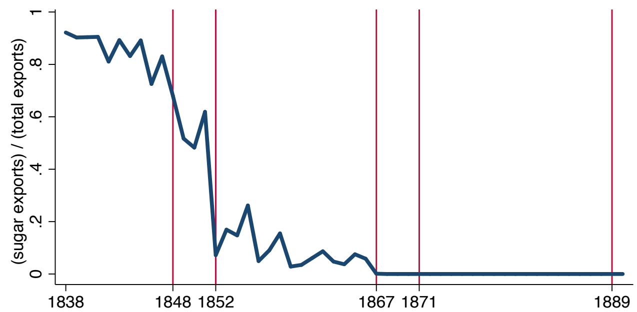
America and into the Crimea and other theatres of war.[31]

6.2 Instrument 2: Hurricane Damage HDI_{it}

Hurricanes provide a second exogenous driver of plantation decline. 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 sugar mills was increasingly difficult as falling sugar prices eroded planters' profitability and hence their ability to borrow in London (Marshall 1996, 73; 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, hurricane landfalls that destroyed

[31]The data on British military expenditure in the Americas and Caribbean comes from three House of Commons sources: *General Abstract of the Colonial Expenditure* for 1832–1853, *Returns of the Strength and Cost of Troops in the British Colonies* for 1853–1866, and *Army Estimates for Military Purposes in the Colonies* for 1866–1913.

Figure 5: Hurricanes and the Decline of Virgin Islands Sugar



Notes: Vertical lines are hurricane dates. Sugar did not recover after 1889.

mills 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 few remaining mills, including every single mill on the main island of Tortola (Dookhan, 1975, 126). Figure 5 shows the evolution of sugar as a share of total exports in the Virgin Islands. Vertical lines are major hurricane dates. The figure vividly displays the long-term consequences of hurricanes via their destructive effects on sugar mills.

Against this historical backdrop we assign each hurricane a 'damage' index, which is the two-year log change in sugar exports. Let x_{sit} be colony i's sugar exports in year t and let t_0 be the date of a hurricane so that $\Delta_i(t_0) \equiv \ln x_{si,t_0-1} - \ln x_{si,t_0+1}$ is the two-year log change in sugar exports. If sugar exports increased after the hurricane ($\Delta_i(t_0) < 0$) then we set $\Delta_i(t_0)$ 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 depressed exports that speaks to the infrastructure damage. The list of all hurricanes and the corresponding $\Delta_i(t_0)$ appear in Online Appendix C.1.

Our hurricane damage index instrument is thus $HDI_{it} \equiv \Delta_i(t_0)$ 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 $\Delta_i(t_0)$. Hurricane landfall data are from the annual hurricane track maps published by the United States National Hurricane Center (2014) and, for the pre-1851 period, by 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). We use all five hurricane categories in the main text. In Online Appendix C.2 (table 11) we confirm the robustness of our results to using only major hurricanes, as well as to conditioning our instruments on sugar's pre-hurricane share of total exports.

6.3 IV Estimates

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

$$N_{it} = \theta HDI_{it} + \phi(m_t O_i) + \phi'(m_t^2 O_i) + \lambda_i + \lambda_t + \varepsilon_{it} \tag{11}$$

where the instruments are the hurricane damage index and the interaction of the log of British military spending in North America m_t with potential outside options O_i. We also include a squared term as this improves the first stage. The λs are colony and year fixed effects.

The bottom panel in table 6 reports estimates of equation (11). We expect θ to be negative because hurricane damage reduces N_{it} and this is the case. We expect $\partial N_{it}/\partial O_i = \phi m_t + \phi' m_t^2 < 0$ because better potential outside options for peasants weakens the plantation system and this is the case for all m_t in the data.

The top panel reports the IV second stage. All specifications have colony and year fixed effects. Odd-numbered columns repeat the OLS benchmarks from column 3 of table 2. Even-numbered columns are IV estimates and are statistically significant in every case. Further, the over-identification tests and weak-instruments tests all pass.

We argued above that if there is endogeneity bias then we expect $\beta^{IV} < \beta^{OLS} < 0$ in the wage equation and $\beta^{IV} = \beta^{OLS}$ in the incarceration rate and coercive taxation equations. To investigate, the row labelled 'Endogeneity test' shows the p-value of a Hausman test, which is a test of the difference between the OLS and IV estimates. In the wage equation the difference is statistically significant at the 5% level ($p = 0.042 < 0.05$). In the incarceration rate equation ($p = 0.694$) and the coercive taxation equation ($p = 0.246$), the OLS-IV difference is statistically insignificant. As noted above, this is indicative of unobserved labour demand shocks and of the absence of unobserved labour supply shocks.

Table 6: IV Estimates

	Wages		Incarceration		Coercive Taxation		Wages		Incarceration		Coercive Taxation	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Second Stage Regression (IV):												
	N_{it}: **Plantation** Export Share						N_{it}: **Sugar** Export Share					
N_{it}:	-0.64***	-0.96***	0.90***	1.37***	2.90***	2.93***	-0.44**	-0.97***	0.62***	1.45**	2.01***	2.90***
	(-3.59)	(-6.20)	(3.53)	(3.27)	(4.27)	(6.96)	(-2.96)	(-3.68)	(3.31)	(2.23)	(3.65)	(4.43)
Hansen J overid (p value)		0.646		0.138		0.159		0.327		0.189		0.134
Endogeneity test (p value)		0.042		0.694		0.246		0.203		0.411		0.130
Weak instruments test (F)		14.157		14.611		21.785		15.714		12.527		20.419
Observations	915	915	801	801	942	942	915	915	801	801	942	942
First Stage Regression (Dependent Variable: N_{it})												
$m_t O_i$		-15.88**		-21.60**		-17.50**		-31.38***		-39.79***		-33.41***
		(-2.78)		(-2.48)		(-2.47)		(-4.13)		(-3.59)		(-3.82)
$m_t^2 O_i$		0.64**		0.87**		0.70**		1.26***		1.60***		1.35***
		(2.78)		(2.48)		(2.48)		(4.13)		(3.58)		(3.83)
HDI_{it}: Hurricane Damage Index		-0.04***		-0.04***		-0.05***		-0.04**		-0.03**		-0.04**
		(-4.19)		(-4.23)		(-5.19)		(-2.42)		(-2.39)		(-3.00)
R^2		0.871		0.875		0.864		0.847		0.856		0.844

Notes: (*a*) The top panel reports the IV estimates of equations (9)–(10). The endogenous regressor is N_{it}, which is the plantation export share in columns 1–6 and the sugar export share in columns 7–12. The bottom panel reports the first-stage estimates (equation 11 with dependent variable N_{it}). (*b*) In the bottom panel, there are three instruments built up from the hurricane damage index (HDI_{it}), British military spending in North America (m_t), and potential peasant outside options as measured by the share of sugar-unsuitable land (O_i). (*c*) A small p-value for the Hansen J-test (over-identification test) indicates that the instruments are not be valid. A small p-value for the Hausman endogeneity test indicates that the OLS and IV estimates are statistically different. An $F < 10$ indicates that the instruments are weak. (*d*) Odd-numbered columns repeat our preferred specifications from column 3 of table 2. (*e*) All specifications include colony and year fixed effects. Standard errors are clustered by colony. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. t-statistics are in parentheses.

7 Conclusion

According to standard international trade theories, changes in the terms of trade that lower labor demand should lower wages. Yet this is not evident in our 14 post-Emancipation British West Indies sugar colonies. We showed that two offsetting effects were at play. Lower export prices lowered wages through a standard *market forces* channel. However, this was offset by an *institutional change* channel that is novel to the literature: Lower export prices made plantation agriculture less profitable, thereby reducing the strength of the planter elite and its ability to reduce wages through coercive institutions. Thus, lower export prices led to higher wages, lower incarceration rates and a lower coercive tax burden on smallholders.

Interestingly, British West Indies coercion was *legal* coercion. That is, it operated through the planter-dominated legislature, judiciary, and police. This points to the importance of inclusive or broadly representative institutions.

Our analysis highlights the fact that in coercive labor market settings – of which there are many today – 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 Mathematical Proofs

Proof of Equation (2)**:** Drop j superscripts, i and t subscripts, and $\mathbf{p}_t$ arguments. Define $\widehat{T}_g \equiv T_g(\tau_g p_g)^\theta$. Let $r_g(\omega) = \widehat{T}_g z_g(\omega)^\theta$ be revenue per plot generated by crop g. Then $r_g(\omega)$ has cumulative distribution $e^{-\widehat{T}_g r_g^{-\theta}}$, density $\theta \widehat{T}_g e^{-\widehat{T}_g r^{-\theta}}$ and mean $\widehat{T}_g^{1/\theta}\Gamma(1-1/\theta)$. As is well known from Eaton and Kortum (2002), $Pr\{r_k(\omega) < r \ \forall k \neq g\} = e^{-(\widehat{T}-\widehat{T}_g)r^{-\theta}}$ where $\widehat{T} = \Sigma_{k=1}^{G}\widehat{T}_k$ and $Pr\{\text{choose } g\} = \widehat{T}_g/\widehat{T}$. Hence, the joint probability of g being the optimal crop choice and $r_g(\omega) = r$ is

$$Pr\{\ \{\text{choose } g\} \text{ and } \{r_g(\omega)=r\}\ \} = Pr\{r_k(\omega) < r \ \forall k \neq g\} Pr\{r_g(\omega) = r\} = (\theta \widehat{T} e^{-\widehat{T}r^{-\theta}})(\widehat{T}_g/\widehat{T}) \ .$$

The first term in parentheses is a Fréchet density with scale parameter $\widehat{T}$ and hence with mean $\widehat{T}^{1/\theta}\Gamma$. Hence the expected revenues generated by crop g are

$$r_g(\widehat{T}_g) \equiv \mathbf{E}[r_g(\omega)] = \widehat{T}^{1/\theta}\Gamma(\widehat{T}_g/\widehat{T}) = \widehat{T}_g \widehat{T}^{\frac{1}{\theta}-1}\Gamma \ . \tag{12}$$

Further, the expected revenues generated by all crops are

$$r(\widehat{T}_g) \equiv \Sigma_g r_g(\widehat{T}_g) = \widehat{T}^{\frac{1}{\theta}}\Gamma \tag{13}$$

where $\widehat{T} \equiv \Sigma_{g=1}\widehat{T}_g$. Substituting $\widehat{T}_g \equiv T_g(\tau_g p_g)^\theta$ into this mean yields equation (2). Q.E.D.

Characterization of $C^*(N)$: Substituting equations (3)-(4) into (5) yields $W(C) = (\alpha l(N)N - L)C - \alpha C^\gamma + \alpha l(N)N[r(\mathbf{p},\tau^p) - r(\mathbf{p},\tau^s)] + Lr(\mathbf{p},\tau^s)$, which is concave in C for $\gamma > 1$. Hence C^* is unique. $\partial W/\partial C = 0$ implies $(C^*)^{\gamma-1} = [\alpha l(N)N - L]/[\alpha\gamma]$. From the definition of $\bar{N}$ before equation (6), $\alpha l(N)N - L > 0 \Leftrightarrow N > \bar{N}$. Hence the constrained ($C \geq 0$) optimal solution is $C^* = 0$ for $N < \bar{N}$ and equation (6) for $N \geq \bar{N}$.

Existence, Interior Solutions, and Stability of N^*: The equilibrium number of planters N^* is given by equation (7). We first derive a sufficient condition which ensures an interior solution $N^* \in (0, L)$. Start by defining $\Delta r \equiv r(\mathbf{p},\tau^p) - r(\mathbf{p},\tau^s)$. A sufficient condition for an interior N^* is $\pi(0) > \overline{W}/m > \pi(L)$. From equation (4), $\pi(0) = l(0)\Delta r$ and it is tedious but straightforward to show that $\pi(L) < \Delta r L^{1/(\gamma-1)}$. Hence a sufficient condition on parameters is $l(0)\Delta r > \overline{W}/m > \Delta r L^{1/(\gamma-1)}$. To see stability, consider a plot of $\pi(N)$ and $\overline{W}/m$ against N. As we move from $N=0$ to $N=L$, $\pi(N)$ must cut the horizontal $\overline{W}/m$ line from above, which is the requirement for stability. Finally, at such an intersection N^*, $\pi_N(N^*) < 0$.

Lemma 1 (Response of N^* to Prices) *Assume that $G > 2$, $\theta > 1$ and $\tau_1^p = \tau_1^s$. Then there exists a crop g^* with $1 < g^* < G$ such that*

$$\frac{dN^*}{dp_g} > 0 \ \text{for} \ \ g > g^* \ \text{and} \ \frac{dN^*}{dp_g} < 0 \ \text{for} \ \ g < g^* \ . \tag{14}$$

with strict inequality for $g < g^*$.

The assumptions $G > 2$, $\theta > 1$ and $\tau_1^p = \tau_1^s$ rule out corner solutions where dN^*/dp_g is either positive for all g or negative for all g. The proof appears in the online appendix.

Appendix B The Share of Exports Attributed to Plantations

Let $Pl_{git} \in [0, 1]$ be the share of a given crop g grown in colony i in year t that was produced on plantations. It is coded as follows.

Sugar is always and everywhere a plantation crop. Hence $Pl_{sugar,it} = 1$ for all i and t.

Livestock in the Virgin Islands (1842–1913)[32] was exclusively a smallhold crop (Harrigan and Varlack 1975, 64–65; Dookhan 1975, 138) so that $Pl_{git} = 0$. Livestock in Tobago (1886–1892) was primarily a plantation crop (Craig-James, 2000, 266-267) so that $Pl_{git} = 3/4$.

Arrowroot in St. Vincent (1858–1913) started as a smallhold crop, but was adopted by planters after 1875. By 1885, planters accounted for about half of production (Richardson, 1997, 156–157; Handler, 1971). Hence $Pl_{git} = 0$ for $t \leq 1875$, $Pl_{git} = 1/2$ for $t \geq 1885$ and we linearly interpolate 1875–1885.

Lime in Montserrat (1867–1913): Sugar collapsed very early on and was not replaced by another export crop until much later when lime came on the scene. 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). Hence $Pl_{git} = 0$ for Montserrat lime and cotton.

Lime in Dominica (1887–1913) was sharecropped (Trouillot, 1988), which we conservatively code as $Pl_{git} = 3/4$.

Oranges, pimentos and bananas ('fruit') in Jamaica (1853–1913): Oranges and pimentos were smallhold crops. Hence $Pl_{git} = 0$ for oranges and pimentos. Bananas in Jamaica were initially a smallholder 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. Hence for bananas $Pl_{git} = 0$ for $t \leq 1885$, $Pl_{git} = 3/4$ for $t \geq 1895$ and we linearly interpolate 1885–1895.

Cocoa in Grenada (1861–1913), Dominica (1878–1913), Trinidad (1850–1913) and St. Lucia (1886–1913): Cocoa was primarily a plantation crop in Trinidad, St. Lucia and Tobago (Richardson, 1997, 194; Sewell, 1861, 102; Bekele, 2004; Harmsen, Ellis and Devaux, 2012, 240–241). Hence $Pl_{git} = 3/4$ for Trinidad, St. Lucia and Tobago. In Grenada, cocoa was "the ideal crop for smallholders" (Richardson, 1997, 194). While exact numbers on smallholder production are hard to

[32]Years in parentheses indicate the years in which the crop accounted for at least 15% of total exports. This information is not used in coding Pl_{git}.

come by, the 1853 Blue Book and the 1897 Royal Commission report that smallholder production was substantial. What is clearer is that the same highland geography that allowed cocoa to thrive also fostered the rapid growth of smallholder 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 rather than a pure plantation form. In Dominica, cocoa was primarily a smallhold crop. Trouillot (1988, 95) cites testimony given to an 1884 Royal Commission that seven-eighths of the cocoa crop was produced on smallholds. Though this strikes us as an exaggeration, it does indicate a substantial smallholder presence. Hence $Pl_{git} = 1/4$ in Grenada and Dominica.

Coffee in Jamaica (1838–1896): Two thirds of production was by smallholds (Eisner 1961, 217; American and Foreign Anti-Slavery Society 1849, 97; Lewis 1986, 72). Hence $Pl_{git} = 1/3$. A small amount of coffee was grown in Guyana and Dominica prior to 1860 and this was grown on plantations. Hence $Pl_{git} = 1$ for $t < 1860$ and $Pl_{git} = 0$ for $t \geq 1860$ in these two colonies.

Cotton in Monserrat (1905–1913), St. Kitts (1907–1913), St. Vincent (1905–1913) and Virgin Islands (1908–1913): This high-quality sea cotton was a smallhold crop that was promoted by English cotton manufacturers and government subsidies (*Blue Books*; Dookhan, 1975, 227-228). $Pl_{git} = 0$.

Finally, $Pl_{git} = 0$ in all cases not listed above.

Appendix C Wage Data

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. Wages are sticky so we also considered moving averages of 1 to 3 years. This strengthens our results. In Montserrat, wages appear to have been commonly accompanied by access to a cottage or use of provision lands, for which we do not know the monetary value (Fergus, 1994). All of our readings suggested that this norm in Montserrat was in place throughout our period so that it does not confound our results. Online appendix table 6 shows that none of our wage results depend on Montserrat.

Appendix D Gravity Equation

Substituting $\widehat{T}_g \equiv T_g(\tau_g p_g)^\theta$ into equation (12) of Appendix A and adding subscripts, the average earnings per plot from crop g are

$$r_{gi}(\mathbf{p}_t, \tau) = \left[T_{gi}(\tau_g p_{gt})^\theta\right] \left[\Sigma_k T_{ki}(\tau_k p_{kt})^\theta\right]^{\frac{1}{\theta}-1} \Gamma \, . \tag{15}$$

To estimate the parameters of this equation, recall that we assumed $\ln T_{gi} = \alpha_g A_{gi}$ and $\tau_g = \tau_g(Pl_{git}) \equiv (\tau_g^p)^{Pl_{git}}(\tau_g^s)^{1-Pl_{git}}$ where Pl_{git} is the share of exports produced on plantations. Then differencing equation (15) between crop g and any other crop g' yields

$$\begin{aligned}
&\ln r_{gi}(\mathbf{p}_t, \tau) - \ln r_{g'i}(\mathbf{p}_t, \tau) \\
&= \ln\left[T_{gi}(\tau_g(Pl_{git})p_{gt})^{\theta}\right] - \ln\left[T_{g'i}(\tau_{g'}(Pl_{g'it})p_{g't})^{\theta}\right] \\
&= \alpha_g A_{gi} - \alpha_{g'} A_{g'i} + \theta \ln(\tau_g^p/\tau_g^s)Pl_{git} - \theta \ln(\tau_{g'}^p/\tau_{g'}^s)Pl_{g'it} + \theta \ln(\tau_g^s/\tau_{g'}^s) + \theta \ln p_{gt}/p_{g't}\ .
\end{aligned}$$

We assume that exports per plot are a noisy measure of output per plot: $\ln x_{git}/n_i = \ln r_{gi} + \varepsilon_{git}$ where n_i is the number of plots. Then we obtain the estimating equation

$$\ln(x_{git}/x_{g'it}) = \beta_g A_{gi} + \beta_s A_{g'i} + \beta_g' Pl_{git} + \beta_{g'}' Pl_{g'it} + \beta_g'' D_g + \beta''' \ln p_{gt}/p_{g't} + \nu_{git} \quad \forall\ i, t \text{ and } g \neq g' \quad (16)$$

where βs are regression coefficients, g' is fixed (it will be sugar), D_g is a crop dummy and $\nu_{git} \equiv \varepsilon_{git} - \varepsilon_{g'it}$. It is easy to verify that the estimates of equation (16) identify all the parameters of (15) except $\tau_{g'}^s$, e.g., $\beta''' = \theta$. Thus, $r_{gi}(\mathbf{p}_t, \tau)$ and $r_i(\mathbf{p}_t, \tau) = \Sigma_g r_{gi}(\mathbf{p}_t, \tau)$ (see appendix equation 13) are known up to the multiplicative constant $\tau_{g'}^s$. Recall that if $Pl_{git} = 0$ for all g then $\tau = \tau^s$ i.e., if there is no plantation production then τ takes on its smallhold value τ^s. Hence, setting $Pl_{git} = 0$ for all g, $r_i(\mathbf{p}_t, \tau^s)$ is also known up to the multiplicative constant $\tau_{g'}^s$. In regressions we use $\ln r_i(\mathbf{p}_t, \tau^s)$ so that the additive constant $\ln \tau_{g'}^s$ is subsumed into intercepts.

Equation (16) is our gravity equation, where g' is sugar. Data on the share of exports produced on plantations (Pl_{git}) are described in section 4.1.2 and Appendix B. Data on export prices (p_{gt}) are described in section 4.1.2 and Online Appendix A. Data on agro-climactic conditions (A_{gi}) are described in section 4.3, footnote 29 and Online Appendix B. The bin-level agro-climactic variables are averaged up to the colony level to create the A_{gi}. Table 7 displays the estimates of the key parameters. There are $7126 = 1018 \times 7$ observations where 1018 is the number of colony-year pairs and 7 is the number of (non-sugar) crops. We estimate θ to be 2.17 (t =4.17). This is in line with Costinot et al. (2016) who estimate it to be 2.46.

The remaining estimates reported in table 7 are the coefficients on Pl_{git}. Except for livestock they are all positive as expected. There are several things to note. The negative livestock coefficient is largely driven by a comparison of Virgin Island smallholds with Tobago plantation and it is thus not surprising to find that the Virgin Islands did better. Cotton is always a smallhold crop, which means that its coefficient ($\beta_g' = \theta \ln(\tau_g^p/\tau_g^s)$) and hence τ_g^p are not identified; however, we do not need to know τ_g^p in order to recover $r_i(\mathbf{p}_t, \tau^s)$. The sugar coefficient is more complicated. $Pl_{g'it} = 1$ for sugar for all colonies and years, which means that the sugar coefficient $\beta_{g'}'$ and hence $\tau_{g'}^p$ are not identified. To deal with this, for the purposes of this regression only we treat sharecropped sugar as smallhold sugar. This is sensible because the alternative to plantation sugar is sharecropped sugar rather than smallhold/independent sugar. Marshall (1996) documents that sharecropping was very successfully used in Grenada, St. Lucia and Tobago during the 1840s and 1850s. We assume that half of sugar production in these three colonies was sharecropped and set

Table 7: Estimates of the Gravity Equation (16) — Recovering $r_i(\mathbf{p}_t, \tau^s)$

		$\theta \ln(p_{gt}/p_{st})$	2.17***		
			(4.17)		
		$\theta \ln(\tau^p_g/\tau^s_g)\, Pl_{git}$			
g = sugar	2.40	g = arrowroot	16.13***	g = livestock	-5.70
	(1.07)		(4.48)		(-1.45)
g = coffee	3.29***	g = lime	4.00	g = cotton	0
	(5.34)		(1.54)		
g = fruit	9.39	g = cocoa	20.75***		
	(1.74)		(3.32)		
Observations	7,126	R-squared	0.864		

Notes: This table reports the parameters of interest from equation (16). The dependent variable is $\ln(x_{git}) - \ln(x_{sit})$ where the s subscript stands for sugar. The first row is the coefficient θ on $\ln p_{gt}/p_{st}$. The remaining rows are the coefficients $\theta \ln(\tau^p_g/\tau^s_g)$ on Pl_{git}. The number of observations is non-sugar crops (7) times colony-year pairs (1018).

$Pl_{git} = 1/2$ for $t \leq 1860$, $Pl_{git} = 1$ for $t \geq 1865$, and linearly interpolate between 1860 and 1865. Thus, the thought experiment to recover $r_i(\mathbf{p}_t, \tau^s)$ is that sugar went from plantation agriculture to sharecropping, which is historically the right experiment.

Online Appendix

to

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

Online Appendix A Export Price Data

For a given crop, prices (export unit values) are based on the export data of the largest exporter of the crop. This ensures that the prices are based on large volumes. *Livestock*: There are many types of livestock. We use the most important of these, namely cattle and horses. Using Virgin Islands exports we build price series separately for cattle and horses and then aggregate them using a Tornqvist index (see equation 8). *Arrowroot* prices are based primarily on export data from Jamaica (1838-1854) and St. Vincent (1855-1913). The St. Vincent *Blue Book* data are augmented by St. Vincent data reported in the *Journal of the Royal Society of Arts* (1873). *Cocoa* prices are based on export data from Granada and Trinidad. *Cotton* prices are based on export data from Guyana (1838–1844) and Granada (1856–1913).[33] *Bananas, oranges, pimento, coffee, lumber, and ginger* prices are based on export data from Jamaica. For *other spices* (predominantly cloves, mace and nutmeg), prices are based on export data from Granada. *Charcoal* prices are based on export data from the Virgin Islands. *Asphalt* and *balata* (a natural tar) are based on export data from Trinidad and Guyana, respectively. *Lime juice* prices are based on export data from Jamaica (1838–61), Monserrat (1862–78), Dominica (1872–87), Monserrat (1872–78), and Jamaica (1891–1912). Because lime was exported in many different forms, we made extensive use of contemporary surveys of prices in order to develop a meaningful price series. *Coconut* prices are based on export data from Jamaica (1844–58), Tobago (1862–63), Tobago and Trinidad (1868–81), and Tobago, Trinidad and Jamaica (1882–1912).

Online Appendix B Soil Suitability

We understand well which agro-climatic conditions determine suitability for all of our crops.. Both the agro-climatic conditions and their mapping into suitability are crop-specific. This information is off-the-shelf available. Online appendix tables 9 and 10 show the suitability-ranges for each input for our four most important crops, as well as the sources for this coding. The variables given the climactic and soil conditions for each plot of land are, for cocoa, minimum temperature, maximum temperature, precipitation, number of months with precipitation less than 100mm, soil depth, soil pH, forest cover (cocoa trees prefer to be shaded), and elevation. For lime these variables are temperature, rainfall, soil pH, soil depth, soil texture (degree of sand and clay), slope, and elevation. For arrowroot, temperature, rainfall, soil pH, soil texture, and elevation. For livestock, meaning for the grasses used by livestock, temperature, rainfall, soil pH, elevation, slope, and humidity. For cotton, temperature, rainfall, soil pH, elevation, slope, and humidity. For fruit, temperature, rainfall, soil pH, soil depth, soil texture, slope, and elevation.

The challenge for the West Indies was obtaining all necessary agro-climatic data at a fine enough spatial resolution. With the help of an agronomist we were able to do so. 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/`. As a point of comparison, we ended up with 61,421 cells of 604 square-meters for the British West Indies.

In online appendix table 9, we describe how each island i's suitability for crop g is estimated

[33] This is the only crop that appears in Jacks (2005). Our price series is is highly correlated with the Jacks (2005) series except during the Civil War years.

from i's agro-climatic conditions as they affect g, with the sources for these codings listed in online appendix table 10. Key is the large variation across islands in some geographic characteristics like elevation and soil. The importance of elevation for sugar suitability is illustrated by comparison of top and bottom panel of the online appendix's figure 5, which shows that sugar suitable land in Jamaica was largely on the low-elevation coastal plains. The Caribbean is divided into three island chains: Most British Caribbean colonies–Dominica, the British Virgin Islands, Grenada, Montserrat, Nevis, St. Kitts, St. Lucia, and St. Vincent–belonged to the inner chain of the Lesser Antilles, which is volcanic and mountainous. Jamaica was the only British colony in the Greater Antilles (the others are Cuba, Haiti and the Dominican Republic), which are large islands also with mountainous interiors. The outer chain of Lesser Antilles–Anguilla, Bahamas, Barbados, Turks and Caicos–consists of flat limestone. Limestone had the great advantage that it was *flat*, but most of the outer chain – with the exception of Barbados–was of such low elevation that it was very vulnerable to salination from storm surges.

In the IV section 6, we proxy plantation land in 1838 with each island's share of highly sugar suitable land. For this, we coded sugar suitability directly based on agricultural science literature. Specifically, we follow the artificial neural network method described in Jayasinghe and Yoshida (2010). We do this because this estimation method makes no use of Caribbean land use patterns at all (it is based on Sri Lankan data) so that the weights and therefore the index are entirely exogenous to our data. The method boils down to ranking the six inputs and assigning them exponential weights: The most important characteristic is assigned weight $0.408 = \frac{1+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+\frac{1}{6}}{6}$; the second-most important is assigned weight $0.242 = \frac{\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+\frac{1}{6}}{6}$, and so on. These weights sum to one so that the aggregate index lies between 1 and 4. Following convention, we then 're-bin' the data by rounding 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). The cross-sectional part of our first instrument Outside Option$_i$ $\times$ Caribbean Naval Expenditure$_t$ is an island's land share that is not sugar suitable. See figure 3 for Jamaica. [34]

Online Appendix C Details of Hurricane Damage Construction

Online Appendix C.1 Hurricanes

The hurricane damage index is $\max[\ 0\ ,\ (\ln x_{si,t_0-1} - \ln x_{si,t_0+1})\ ]$ where t_0 is the year of the hurricane and x_{si,t_0-1} and x_{si,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 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 $t_0 = 1897$.

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 (*). We group colonies into three groups:

[34] 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 4.

1. Complete collapse of sugar: Virgin Islands 1848 (1.18*), 1852 (1.51*), 1867* (6.18*), 1871* (0.00), 1889 (0.00); Montserrat 1851 (0.64), 1889 (0.25), 1899* (0.00), 1909 (0.00); Grenada 1856 (0.00); Dominica 1883* (0.23*), 1903 (0.68); St. Vincent 1886 (0.48), 1898 (0.75).
2. Moderate decline of sugar: Tobago none; St. Lucia 1875 (0.00), 1894 (0.09); Trinidad 1878 (0.08); Jamaica 1874 (0.00), 1880 (0.00), 1886 (0.00), 1896 (0.10), 1903* (0.38*), 1910 (0.05).
3. No decline of sugar: Antigua 1910 (0.18); Barbados none; Guyana none; St. Kitts 1859 (0.0049), 1889 (0.08), 1908 (0.00), 1910 (0.15).

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.

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 C.2 Sensitivity to Hurricane Damage Coding

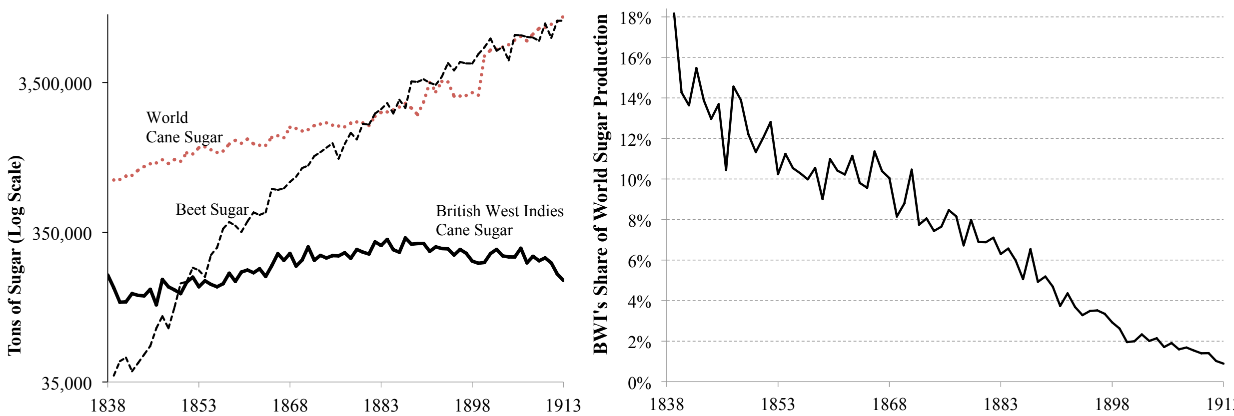
We made a number of specification choices in constructing the hurricane damage index. First, a concern about hurricanes is measurement error in the historical hurricane data. To deal with this we consider a subset of hurricanes that were *a priori* likely to be the most damaging. We use two criteria for identifying these. The first is that the hurricane was a 'major hurricane.'[35] 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 6 shows the distribution of elevations for each colony in our sample. (This is based on authors' calculations using GIS data.) We therefore

[35] Major hurricanes are indicated by a * in Online Appendix C.1.

code all Antiguan and Virgin Island hurricanes as storm surges. The results of defining HDI_{it} using major hurricanes and storm surges appear in columns 1–3 of online appendix table 11. This has virtually no affect on our conclusions.

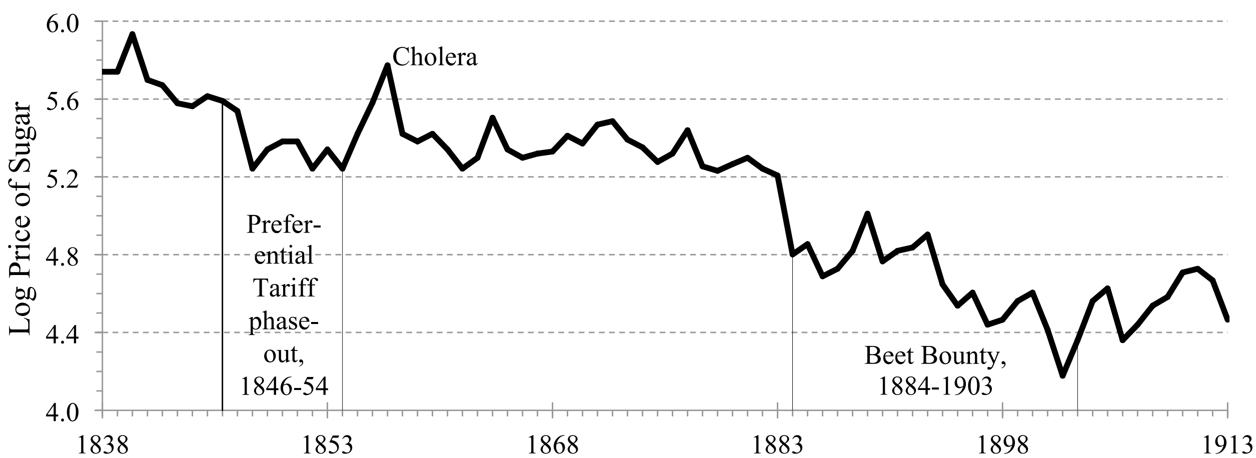
Second, $\Delta_i(t_0)$ can be large even when the importance of sugar is small. For example, the 1867 Virgin Islands hurricane caused a large log change decrease in sugar exports, but at a time when sugar was already all but gone. To deal with this we modify our instrument by using $\Delta_i(t_0)\frac{x_{si,t_0-1}}{x_{i,t_0-1}}$ 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 column 4–6 of online appendix table 11.

Online Appendix Figure 1: World Sugar Production by Region and the British West Indies' Share



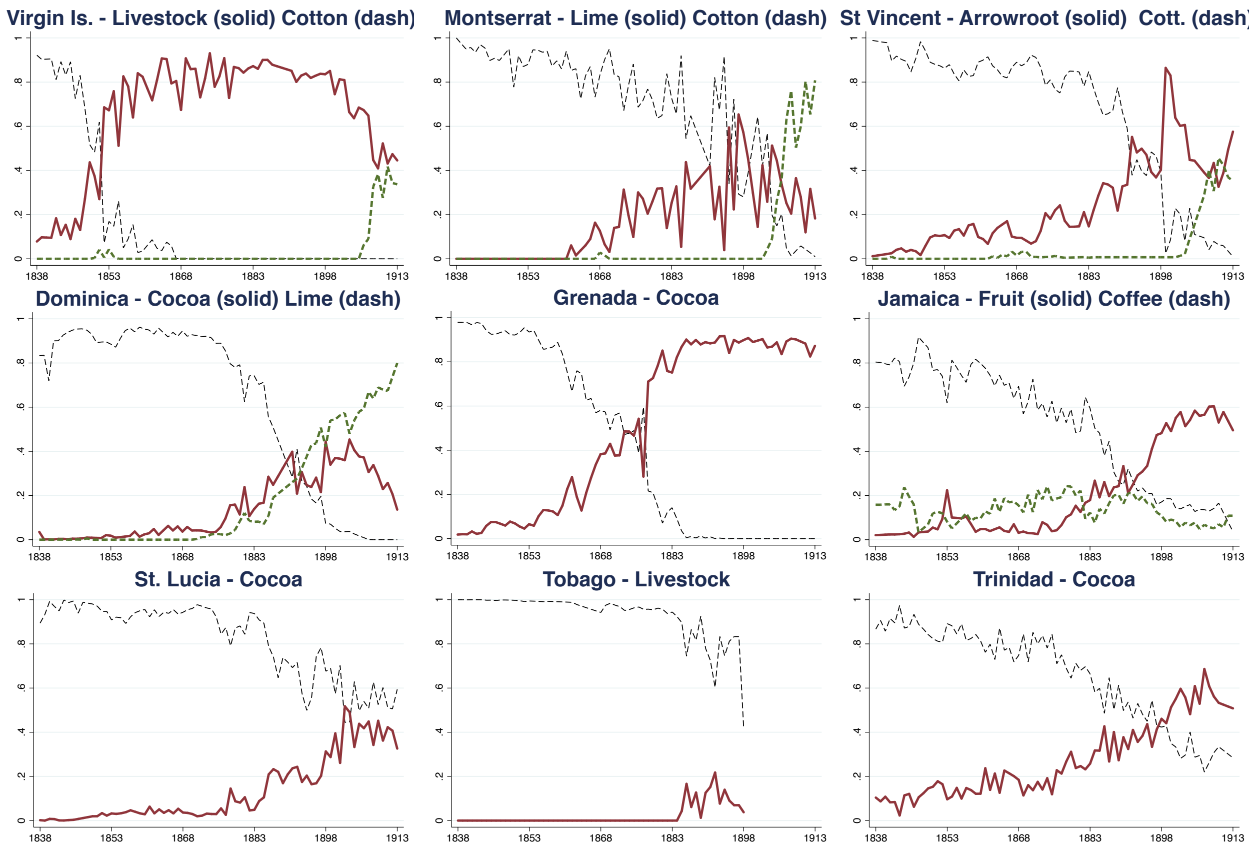
Notes: The left-hand panel is the log output of sugar (measured in tons) by source: (1) cane sugar grown in our sample of 14 British West Indies sugar colonies, (2) cane sugar grown worldwide, and (3) beet sugar. The right-hand panel is the British West Indies' share of world sugar output i.e., (1) divided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

Online Appendix Figure 2: The Secular Decline in Sugar Prices



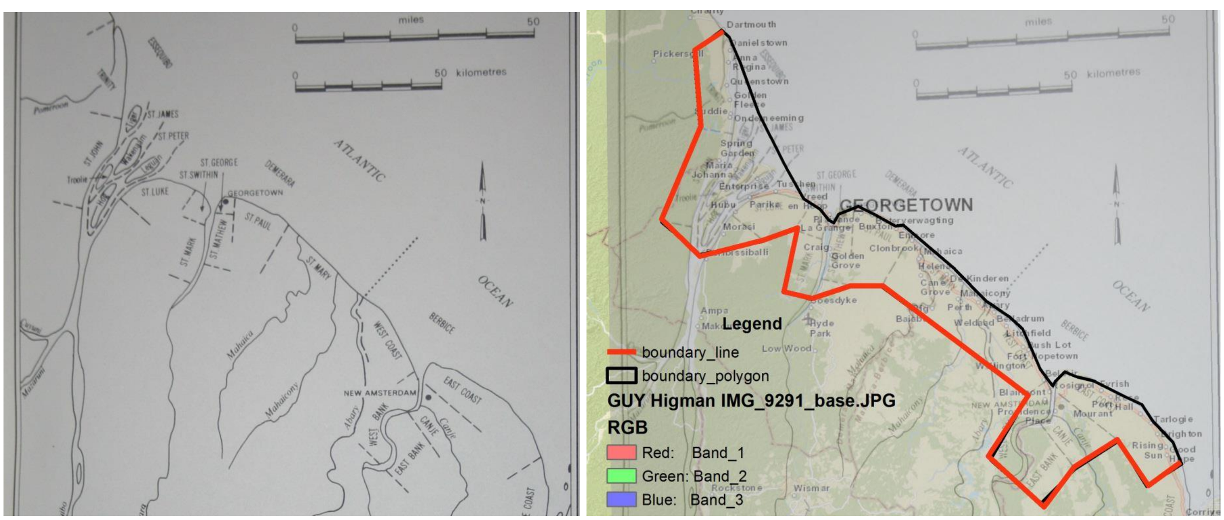
Notes: This figure plots the log of the London price of sugar. Two events stand out. As part of the repeal of the Corn Laws and the move to Free Trade, Britain's preferential tariff on West Indies sugar was phased out over the period 1846–54 (Curtin, 1954). Second, France and Germany subsidized domestic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

Online Appendix Figure 3: Major Export Crops of Colonies Where Sugar Declined



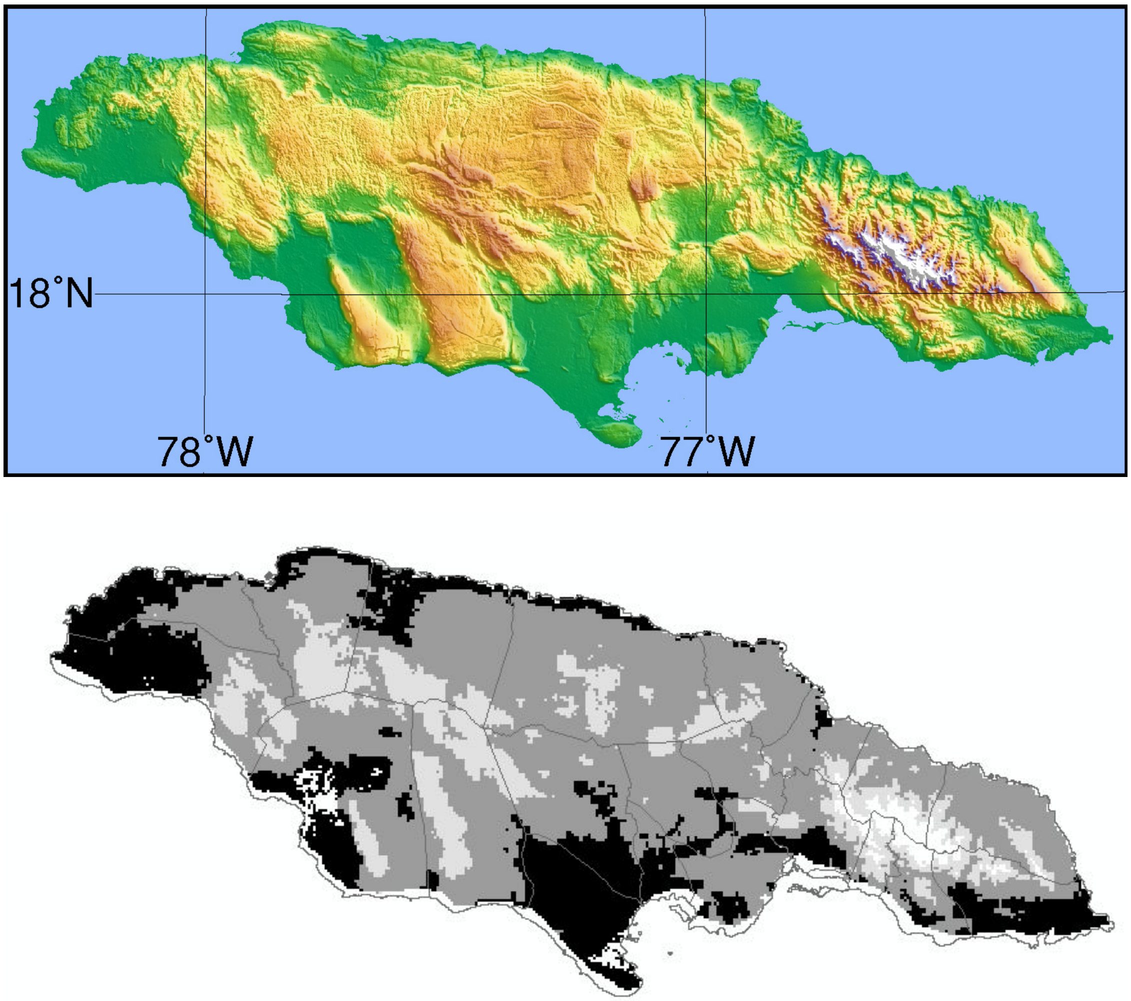
Notes: The figure displays the major export crops for colonies where sugar declined. The vertical axis is a crop's share in total exports. The horizontal axis is time (1838–1913). The thin dashed black line is the export share of sugar. The thick solid red line is the export share of the most important non-sugar crops. 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*.

Online Appendix Figure 4: Guyana



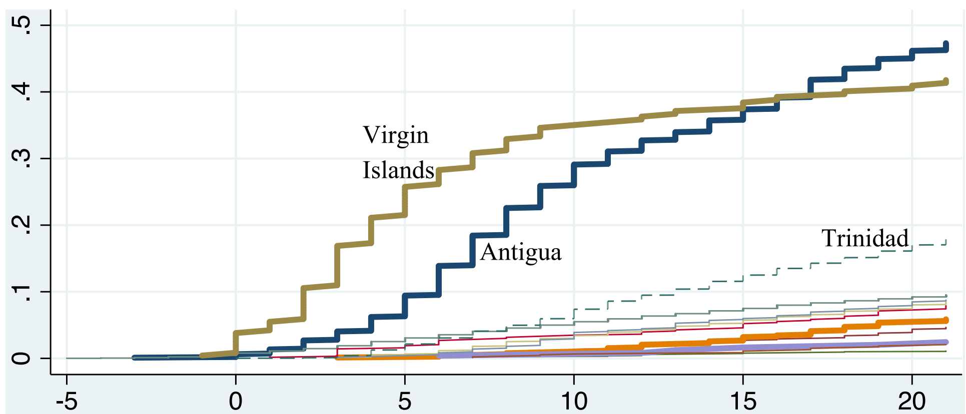
Notes: The left panel shows the historical boundaries of Guyana as dashed lines. The panel is from Higman (2000, figure 1.8). The right panel shows the results of geo-coding the map.

Online Appendix Figure 5: Sugar Suitability, and Topography in Jamaica



Notes: At the grid-cell level, suitability is scaled from 1 to 4. The top-panel of online appendix figure 5 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 3, 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 6: 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 Table 1: Share of Whites in the Population by Colony

	White Share (%)										Year		
	Pre-1838	Early 1840s	1851	1861	1871	1881	1891	1901	1911	post-1913	Pre-1838	Early 1840s	post-1913
ATG	5.3					5.2	5.1		3.2		1821		
BRB	12.8		11.6	10.9	10.2	9.3	8.6		7.0		1832		
DOM	4.0					1.3	1.2		1.2		1833		
GRD	2.6					1.3				0.9	1834		1921
GUY	3.5	3.6	2.8	2.4	1.8	1.5	1.3			2.3	1829	1841	1946
JAM		4.2		3.1	2.6	2.5	2.3		1.9			1844	
MON	4.3				2.8	2.4	1.7		1.1		1828		
NEV	5.4			2.6		1.8	1.4		0.8		1836		
SLU	6.5	5.0	4.1	3.5	2.6		2.3			0.2	1836	1843	1946
STK	7.3					7.5	7.6		5.1		1837		
STV	4.7	4.7		7.4	6.6	6.6	6.0			4.5	1825	1844	1931
TOB	2.3	1.6		0.8		0.6	-				1833	1844	
VIR	8.4	8.0		5.6	1.8	1.0	0.7			0.7	1838	1841	1921
TRI	9.2										1837		

Notes:

1. Grey shaded areas are colonies that disappear (Nevis merges with St. Kitts in 1883 and Tobago merges with Trinidad in 1899).
2. Censuses before 1838 and in the 1840s did not occur at regular times. The years of these censuses appear in the 'Year' columns.
3. We linearly interpolate all missing data. For data at the end points (e.g., 1838 and 1913) we must extrapolate and do so as follows. For Jamaica in 1838 we extrapolate back using the 1844–1861 change. For colonies missing 1913 but having 1911 data, we extrapolate using 1891–1911 growth rates. For colonies missing 1913 and 1911, we interpolate using post-1913 data, the year for which is indicated in the 'Years' column. For Tobago, we extrapolate to 1899 (when it merged with much-larger Trinidad) using 1861–1881 data.
4. Dominica, Grenada, Montserrat and St. Kitts each share a long gap in the data and it is possible that the decline of whites was not linear over these gaps. However, in the case of Grenada the censuses additionally report 'birth by country' data and these data change linearly.
5. There are no data for Trinidad between 1837 and 1946. In 1946 the white share was 2.7%.

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Online Appendix Table 2: Results for panel C of table 2, for each coercive tax separately.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	#Property-Tax Bins			**D(Plantation Tax)**			**Specific Import Tariff, Rice**			**Specific Import Tariff, Flour**		
N_{it}: **Plantation** Exports as	-3.65*	-4.58**	-3.17	-1.09**	-0.95**	-1.28**	-0.43	-0.74**	-0.19	-1.16*	-0.94	-1.08
Share of Total Exports	(-1.91)	(-2.66)	(-1.62)	(-2.31)	(-2.65)	(-2.34)	(-1.27)	(-2.60)	(-0.45)	(-2.07)	(-1.67)	(-1.33)
Export Price / year-fe :	$r_i(\mathbf{p}_t)$	Tornqvist	year fe	$r_i(\mathbf{p}_t)$	Tornqvist	year fe	$r_i(\mathbf{p}_t)$	Tornqvist	year fe	$r_i(\mathbf{p}_t)$	Tornqvist	year fe
R^2	0.566	0.553	0.604	0.559	0.581	0.596	0.766	0.758	0.785	0.315	0.314	0.354
N_{it}: **Sugar** Exports as	-2.92**	-3.50***	-2.46*	-0.78**	-0.63**	-0.94**	-0.32	-0.58**	-0.09	-0.71	-0.54	-0.47
Share of Total Exports	(-2.57)	(-3.76)	(-2.12)	(-2.29)	(-2.38)	(-2.27)	(-1.15)	(-2.62)	(-0.24)	(-1.55)	(-1.25)	(-0.69)
Export Price / year-fe :	$r_i(\mathbf{p}_t)$	Tornqvist	year fe	$r_i(\mathbf{p}_t)$	Tornqvist	year fe	$r_i(\mathbf{p}_t)$	Tornqvist	year fe	$r_i(\mathbf{p}_t)$	Tornqvist	year fe
R^2	0.566	0.562	0.599	0.524	0.540	0.557	0.766	0.761	0.784	0.312	0.311	0.349

Notes: This table reports the results in panel C of the baseline table 2, for each of the four measures of coercive taxation separately. Each of four sets of three columns in the top panel replicates columns 1–3 in the baseline table 2, for plantation crops' export share. Each of four sets of three columns in the bottom panel replicates columns 4–6 in the baseline table 2, for sugar's export share. The number of observations is 942 everywhere. Property taxes in columns 1–3 were always progressive but became consistently more so if property values were put in finer bins. They varied between one and ten bins by value. A negative coefficient indicates the plantation system caused more regressive property taxes. The plantation tax in columns 4–6 was binary with 1 meaning it existed. It only ever existed in four colonies, appearing in two and disappearing in two. Both import tariffs were specific tariffs and thus coded as tariff amounts per lbs.

Online Appendix Table 3: Lagged Dependent Variable Model, Sugar Share in Exports

	Wages			Incarceration			Coercive Taxes		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
N_{it}: **Sugar** Exports as	-0.58***	-0.36***	-0.36***	0.35*	0.24**	0.46***	2.35***	2.58***	2.23***
Share of Total Exports	(3.60)	(2.87)	(2.78)	(1.81)	(2.10)	(2.68)	(5.05)	(7.02)	(3.59)
(Export Price Index)$_{it}$	0.29***	0.29***		-0.12	-0.08		0.37	0.41	
	(3.05)	(3.15)		(0.91)	(0.65)		(1.11)	(1.34)	
Lagged Dependent	0.76***	0.76***	0.75***	0.65***	0.66***	0.64***	0.88***	0.88***	0.88***
	(15.56)	(15.12)	(16.15)	(9.84)	(9.90)	(10.10)	(27.29)	(26.90)	(28.46)
Index / Year FE:	$r_i(\mathbf{p}_t)$	Tornqvist	year-fe	$r_i(\mathbf{p}_t)$	Tornqvist	year-fe	$r_i(\mathbf{p}_t)$	Tornqvist	year-fe
Observations	866	866	866	725	725	725	929	929	929
R^2	0.878	0.878	0.897	0.711	0.711	0.749	0.956	0.956	0.959

Notes: This table repeats table 4, but with plantation export shares replaced by sugar export sales. See the table 4 notes for details.

Online Appendix Table 4: Initial Conditions at the Time of Emancipation

Colony	Year Founded	Population 1836	Area sq-km	Area / Pop in Thds.	Slave-price 1836, in £
Antigua	1632	35,188	282	8.0	35.0
Barbados	1629	105,812	430	4.1	38.8
Dominica	1763	16,207	772	47.6	28.7
Grenada	1763	17,751	341	19.2	41.2
Guyana	1803	66,561	11,094	166.7	87.4
Jamaica	1655	381,951	11,234	29.4	31.0
Montserrat	1634	6,647	102	15.4	25.3
Nevis	1623	7,434	93	12.5	21.4
St. Lucia	1803	17,005	630	37.0	50.3
St. Kitts	1628	21,578	191	8.8	29.7
St. Vincent	1763	26,659	386	14.5	39.5
Tobago	1763	11,456	301	26.3	41.7
Trinidad	1797	34,650	4,950	142.9	83.6
Virgin Islands	1672	7,471	152	20.4	23.1

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 Emancipation. 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 1836 slave price is the price from the compensation tables in Martin (1839).

Online Appendix Table 5: Labor Supply Shocks and Interaction between Initial Conditions and Terms of Trade

	N_{it}: **Plantation** Export Share				N_{it}: **Sugar** Export Share			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Log Wages				Log Wages			
N_{it}:	-0.64***	-0.65***	-0.68***	-0.68**	-0.44**	-0.44***	-0.44**	-0.47**
	(-3.59)	(-3.79)	(-3.53)	(-2.68)	(-2.96)	(-3.10)	(-2.98)	(-2.18)
Log Indian Immigration$_{it}$		-0.03***	-0.03**	-0.03***		-0.02**	-0.02**	-0.03**
		(-3.10)	(-2.95)	(-3.03)		(-2.88)	(-2.89)	(-2.89)
Export Price x SlavePrice$_{1836}$			-0.00	0.00			0.00	0.00
			(-0.26)	(0.21)			(0.01)	(0.11)
Export Price x (Area/Pop)$_{1836}$			-0.14	-1.40			-0.17	-1.22
			(-0.09)	(-1.26)			(-0.10)	(-0.82)
Export Price :			$r_i(\mathbf{p}_t)$	Tornqvist			$r_i(\mathbf{p}_t)$	Tornqvist
R^2	0.763	0.773	0.774	0.775	0.755	0.764	0.764	0.765
	Incarceration Rates (per Thousand)				Incarceration Rates (per Thousand)			
N_{it}:	0.90***	0.90***	0.81***	0.87***	0.62***	0.62***	0.51***	0.55***
	(3.53)	(3.47)	(3.64)	(3.62)	(3.31)	(3.20)	(3.27)	(3.25)
Log Indian Immigration$_{it}$		0.01	0.00	0.01		0.00	-0.00	0.01
		(0.34)	(0.07)	(0.47)		(0.18)	(-0.15)	(0.25)
Export Price x SlavePrice$_{1836}$			-0.01*	-0.00			-0.02**	-0.00
			(-2.04)	(-0.57)			(-2.23)	(-0.56)
Export Price x (Area/Pop)$_{1836}$			5.51*	2.88			5.21*	2.19
			(2.11)	(0.99)			(1.95)	(0.68)
Export Price :			$r_i(\mathbf{p}_t)$	Tornqvist			$r_i(\mathbf{p}_t)$	Tornqvist
R^2	0.585	0.585	0.589	0.586	0.578	0.578	0.582	0.579
	Coercive Taxation (Principal Component)				Coercive Taxation (Principal Component)			
N_{it}:	2.90***	2.87***	2.64***	2.25**	2.01***	1.99***	1.86***	1.31**
	(4.27)	(5.34)	(3.68)	(2.98)	(3.65)	(5.09)	(3.80)	(2.52)
Log Indian Immigration$_{it}$		-0.08**	-0.10**	-0.09**		-0.08***	-0.11**	-0.10***
		(-2.21)	(-2.38)	(-2.82)		(-3.14)	(-2.99)	(-3.67)
Export Price x SlavePrice$_{1836}$			-0.03	-0.03			-0.03	-0.03
			(-0.85)	(-1.43)			(-0.90)	(-1.60)
Export Price x (Area/Pop)$_{1836}$			8.18	3.91			6.39	-0.14
			(0.78)	(1.03)			(0.52)	(-0.03)
Export Price :			$r_i(\mathbf{p}_t)$	Tornqvist			$r_i(\mathbf{p}_t)$	Tornqvist
R^2	0.772	0.783	0.788	0.791	0.749	0.761	0.771	0.773

Notes: All columns include colony and year fixed effects. Columns 1–4 show results for the plantation export share and columns 5–8 for the sugar export share. Columns 1 and 5 show the baseline results from columns 3 and 6 of table 2. Columns 2 and 6 add the log of the stock of net immigration into a colony from 1838 to year t. Columns 3–4 and 7–8 additionally include the export price index interacted with two initial conditions that have been argued to proxy for long-run differences in the marginal product of labor in the colonies. These are slave prices in 1836 and the area per capita (land/labor ratio) in 1836. Slave prices had diverged considerably by 1836 because the slave trade had been banned in 1807 i.e., 30 years prior.

Online Appendix Table 6: Sensitivity to Outliers: Omitting One Colony at a Time

	Omitted Colony													
	Antigua	Barbados	Dominica	Grenada	Guyana	Jamaica	St Kitts	Montserrat	Nevis	St. Lucia	St. Vincent	Tobago	Trinidad	Virgin Isl.
Outcome: Log Wage														
N_{it}: **Plantation** exports	-0.66***	-0.58***	-0.63***	-0.70***	-0.65***	-0.64***	-0.67***	-0.67**	-0.66***	-0.69***	-0.69***	-0.62***	-0.62***	-0.46***
share of total exports	(-3.48)	(-3.08)	(-3.47)	(-3.73)	(-3.35)	(-3.40)	(-3.82)	(-3.00)	(-3.62)	(-4.16)	(-3.79)	(-3.50)	(-3.33)	(-3.50)
Observations	842	841	841	841	847	860	871	842	872	842	848	858	844	846
R^2	0.768	0.773	0.767	0.776	0.638	0.767	0.778	0.775	0.766	0.767	0.771	0.767	0.757	0.772
Outcome: Incarceration Rates (per Thousand)														
N_{it}: **Plantation** exports	0.81***	0.79***	0.90***	1.03***	0.91***	0.78***	0.86***	0.98**	0.89***	0.95***	1.02***	0.95***	0.90***	0.83**
share of total exports	(3.15)	(3.19)	(3.32)	(3.20)	(3.55)	(3.63)	(3.28)	(2.89)	(3.36)	(3.67)	(3.64)	(3.80)	(3.58)	(2.74)
Observations	734	733	736	735	776	733	759	733	767	731	756	749	737	734
R^2	0.610	0.587	0.597	0.564	0.572	0.598	0.603	0.607	0.590	0.624	0.582	0.593	0.522	0.560
Outcome: Coercive Taxation (Principal Component)														
N_{it}: **Plantation** exports	2.50***	2.82***	2.93***	2.71***	2.90***	2.82***	2.87***	2.76***	2.97***	3.00***	2.93***	2.92***	2.93***	3.64***
share of total exports	(4.27)	(3.70)	(4.35)	(3.63)	(4.27)	(3.77)	(3.76)	(3.78)	(4.41)	(4.20)	(4.27)	(4.25)	(4.35)	(8.47)
Observations	866	866	866	866	942	866	866	866	897	866	866	881	866	866
R^2	0.780	0.752	0.768	0.754	0.772	0.819	0.767	0.754	0.774	0.772	0.774	0.774	0.780	0.788

Notes: This table reports on the sensitivity of our preferred specification (column 3 of table 2) to omitting one colony at a time.

Online Appendix Table 7: Sensitivity to Outliers: Omitting One Decade at a Time

	Omitted Decade							
	1838-1847	1848-1857	1858-1867	1868-1877	1878-1887	1888-1897	1898-1907	1908-1913
	Outcome: Log Wage							
N_{it} : **Plantation** exports as share of total exports	-0.64***	-0.44**	-0.66***	-0.61***	-0.68***	-0.64***	-0.69***	-0.66***
	(-3.59)	(-2.95)	(-3.34)	(-3.29)	(-4.16)	(-3.55)	(-3.45)	(-3.28)
Observations	915	804	789	789	776	788	796	809
R^2	0.763	0.779	0.771	0.770	0.783	0.758	0.748	0.759
	Outcome: Incarceration Rates (per Thousand)							
N_{it} : **Plantation** exports as share of total exports	0.90***	0.75**	0.91***	0.89***	0.80**	0.84***	0.89***	0.88**
	(3.53)	(2.83)	(3.22)	(3.63)	(2.75)	(3.51)	(4.18)	(2.86)
Observations	801	704	687	698	685	686	702	703
R^2	0.585	0.652	0.589	0.596	0.606	0.573	0.549	0.561
	Outcome: Coercive Taxation (Principal Component)							
N_{it} : **Plantation** exports as share of total exports	2.90***	3.20***	2.89***	2.98***	3.03***	3.04***	2.94***	2.52***
	(4.27)	(4.92)	(3.81)	(4.79)	(4.77)	(4.50)	(3.98)	(3.94)
Observations	942	812	812	812	812	817	822	831
R^2	0.772	0.853	0.767	0.769	0.771	0.767	0.769	0.754

Notes: This table reports on the sensitivity of our preferred specification (column 3 of table 2) to omitting one decade at a time.

Online Appendix Table 8: Sensitivity to Time Fixed Effects: Alternative Specifications of Time

	Decade	Degree of Year Polynomial:			Decade	Degree of Year Polynomial:			Decade	Degree of Year Polynomial:		
Year	FEs	2	4	6	FEs	2	4	6	FEs	2	4	6
Outcome:	Log wage				Incarceration Rates (per Thousand)				Coercive Taxation (Princ. Component)			
N_{it}: **Plantation** exports as	-0.63***	-0.61***	-0.62***	-0.63***	0.88***	0.97***	0.92***	0.90***	2.89***	2.87***	2.89***	2.89***
share of total exports	(-3.72)	(-3.35)	(-3.80)	(-3.87)	(3.66)	(3.91)	(3.66)	(3.61)	(4.44)	(4.35)	(4.47)	(4.43)
Observations	915	915	915	915	801	801	801	801	942	942	942	942
R^2	0.748	0.693	0.721	0.724	0.544	0.526	0.535	0.544	0.762	0.760	0.762	0.767

Notes: This table reports on the sensitivity of our preferred specification (column 3 of table 2) to the use of year fixed effects. 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 2 for additional details.

Online Appendix Table 9: Suitability Conditions by Crop

Sugar - Suitability Bins:	**(4)**	**(3)**	**(2)**	**(1)**	**(2)**	**(3)**	**(4)**
Temp (°C)	<19	20-22	23-25	26-30	31-35	36-38	>38
Rainfall (mm)	<750	750-1000	1000-1200	1200-1500	1500-2000	2000-2500	>2500
Soil ph	<5	5.0-5.5	5.6-6.0	6.1-6.9	7.0-7.5	7.6-8.4	8.5
Elevation (m)			<0	0-500	500-1000		>1000
Slope (%)				<15	15-30	30-60	>60
Humidity		60-70	70-80	80-90			

Lime - Suitability Bins:	**(4)**	**(3)**	**(2)**	**(1)**	**(2)**	**(3)**	**(4)**
temp (°C)	<13	13-18	18.1-23	23.1-30	30.1-34	34.1-38	>38
rainfall (mm)	<700	701-800	801-900	901-1200	1201-1900	1901-2500	>2500
soil ph	<4	4-5.5	5.6-6	6.1-6.5	6.6-7.5	7.6-9	>9
soil depth (%)	<50	50-69	70-89	90-100			
soil texture	sand		loamy sand	loam; sandy loam	silt loam; silt	loam (clay-; sandy clay-; silt clay-)	sandy clay; silt clay; clay
slope (degrees)				0-7	8-15	16-20	>20
elevation (m)				<500	501-1000	1001-1800	>1800

Cocoa - Suitability Bins:	**(4)**	**(3)**	**(2)**	**(1)**	**(2)**	**(3)**	**(4)**
Min Temp (°C)	<9 - restricted	9-13	13.0-17.99	18.0-20.99	21.0-23.99	24.0-24.03333	
Max temp (°C)	<24	24-26.99	27-29.99	30-32		32<	
Rainfall (mm)	<800	800-999	1000-1199	1200-2499	2500-2999	3000-3999	4000<
Rainfall: months with < 100mm	<4	3-4	1-2	0			
soil depth (%)	<50	50-69	70-89	90-100			
soil ph			4.5-5.99	6-6.5	6.51-7.00	7.0-8.0	8.0<
land cover (classes)	0, 1, 3, 4, 7, 11, 13, 16 - restricted	5, 6, 9, 10, 12,	14, 8	2			
elevation (m)	<0 - restricted			0-300	301-500	501-1000	>1000 - restricted

Arrowroot - Suitability Bins:	**(4)**	**(3)**	**(2)**	**(1)**	**(2)**	**(3)**	**(4)**
Temp (°C)	<17	17-20	20-23	23-29	30-32	32-34	>34
Rainfall (mm)	<700	700-1000	1000-1500	1500-2000	2000-3000	3000-4000	>4000
soil ph	<4	4-5	5-5.5	5.5-6.5	6.5-8		>8
soil type	Sand		Loamy sand	Loam, Sandy loam	Silty loam	Silt, Clay loam, Sandy clay loam, Silty clay loam	Sandy clay, Silty clay, Clay
elevation (m)				0-90	90-500	500-900	>900

Notes: This table shows the agro-climatic inputs that determine suitability for our four most important crops (in four panels): sugar, lime, cocoa, and arrowroot. Each agro-climatic condition is inputs into bins determining what range is ideal (=1), relatively suitable (=2), less suitable (=3), or completely unsuitable (=4). For most inputs, the ideal range is in the middle and suitability is dropping off away from it in both directions, hence the arrangement of columns.

Online Appendix Table 10: Sources for Table 9

Sugar:

Jayasinghe, P.K.S.C. and Masao Yoshida, "Development of Two GIS-based Modeling Frameworks to Identify Suitable Lands for Sugarcane Cultivation," Tropical Agriculture and Development, 2010, 54 (2), 51–61.

Cocoa:

1. https://www.daf.qld.gov.au/plants/fruit-and-vegetables/fruit-and-nuts/other-fruit-crops/growing-cocoa
2. http://www.academia.edu/9129782/A_Multi-Criteria_GIS_Site_Selection_for_Sustainable_Cocoa_Development_in_West_Africa_A_case_study_of_Nigeria
3. http://link.springer.com/article/10.1007/s10531-007-9183-5
4. http://www.icco.org/about-cocoa/growing-cocoa.html
5. http://www.xocoatl.org/tree.htm

Lime:

1. http://www.fao.org/nr/water/cropinfo_citrus.html
2. https://www.daf.qld.gov.au/plants/fruit-and-vegetables/fruit-and-nuts/citrus/citrus-land-andclimate-requirements
3. http://afghanag.ucdavis.edu/a_horticulture/fruits-trees/citrus/factsheets/FS_Fruit_Citrus_site_selection.doc
4. http://www.crec.ifas.ufl.edu/academics/classes/hos6545/pdf/mendel_1969.pdf
5. http://www.nda.agric.za/docs/Infopaks/CultivatingCitrus.pdf

Arrowroot:

1. http://jeromehandler.org/wp-content/uploads/2009/07/Arrowroot-History-71.pdf
2. http://www.prota4u.org/protav8.asp?h=M4&t=Maranta,arundinacea&p=Maranta+arundinacea
3. http://rfcarchives.org.au/Next/Fruits/Vegetables/Arrowroot9-96.htm
4. http://tropical.theferns.info/viewtropical.php?id=Maranta+arundinacea

Notes: This table lists the main sources that determined the coding of suitability bins in online appendix table 9.

Online Appendix Table 11: Alternative IV Specifications

	Wages	Incarce-ration	Coercive Taxes	Wages	Incarce-ration	Coercive Taxes
	HDI $_{it}$ **Defined Using Major Hurricanes and Storm Surges**			$HDI_{it} = D_{it}(t_0)(x_{is,t_0-1} / x_{i,t_0-1})$		
	(1)	(2)	(3)	(4)	(5)	(6)
N_{it}: **Plantation** Exports as Share of Total Exports	-1.20***	1.15***	2.17***	-1.21***	1.55***	2.45***
	(-5.39)	(3.52)	(3.40)	(-4.71)	(4.76)	(3.27)
Hansen J overid (p value)	0.590	0.048	0.119	0.852	0.022	0.126
Endogeneity test (p value)	0.054	0.895	0.631	0.072	0.112	0.586
Weak instruments test (F)	22.51	19.65	29.96	26.05	25.59	29.81
Observations	915	801	828	915	801	828
N_{it}: **Sugar** Exports as Share of Total Exports	-1.20***	1.32***	2.36***	-0.99**	1.69***	2.42***
	(-3.61)	(3.56)	(3.87)	(-2.97)	(5.56)	(4.36)
Hansen J overid (p value)	0.683	0.091	0.460	0.148	0.170	0.738
Endogeneity test (p value)	0.075	0.312	0.294	0.126	0.014	0.324
Weak instruments test (F)	15.11	11.18	20.57	20.83	17.71	20.93
Observations	915	801	828	915	801	828

Notes: Each set of 3 columns replicates the main IV results in table 6. The only difference is in the definition of the hurricane damage index HDI_{it}. The top panel replicates columns 2, 4, 6 of table 6 (for plantation crops' export share). The bottom panel replicates column 8, 10, 12 of table 6 (for sugar's export share). See the text for a discussion of the alternative codings of hurricane damage.

Jacks, David S., "Intra- and International Commodity Market Integration in the Atlantic Economy, 1800–1913," *Explorations in Economic History*, 3 2005, *42*, 381–413.

Jayasinghe, P.K.S.C. and Masao Yoshida, "Development of Two GIS-based Modeling Frameworks to Identify Suitable Lands for Sugarcane Cultivation," *Tropical Agriculture and Development*, 2010, *54* (2), 51–61.

Longshore, David, *Encyclopedia of Hurricanes, Typhoons, and Cyclones, New Edition*, New York: Facts On File, Inc., 2009.

Martin, Robert M., *Statistics of the Colonies of the British Empire*, London: WH Allen and Company, 1839.

Tannehill, Ivan Ray, *Hurricanes: Their Nature and History: Particularly those of the West Indies and the Southern Coasts of the United States*, Princeton: Princeton University Press, 1938.