# Small Farms, Large Transaction Costs: Incomplete Property Rights and Structural Change in Haiti

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**Abstract**

Many developing countries are stuck in small, low-productivity farms. Such countries also have poor property rights institutions, which create transaction costs towards reallocating land to large farms. I look at how transaction costs from historical property rights institutions affected the agricultural structure of Haiti, the poorest country in the Western Hemisphere. Using new data on farms created in Haiti from 1928 to 1950, I find transaction costs prevented farmers from starting large farms. Furthermore, transaction costs stopped Haiti from developing plantations in response to a labor supply shock caused by the Trujillo Massacre in the Dominican Republic.

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In developing countries, agriculture accounts for a significant share of economic activity, but the cultivation is often performed on small farms. Such countries could improve agricultural and labor productivity by moving to larger farms (Adamopoulos and Restuccia 2014, Foster and Rosenzweig 2017). Yet moving from small to large farms requires reorganizing property rights, and developing countries already struggle in this area (De Soto 2000). In theory, property rights should adjust to changes in the economy (Demsetz 1967); that developing countries have not already moved to large farms suggests there are frictions to adjusting property rights.

One way to learn why markets in developing countries do not reallocate land to its most productive use is to examine Haiti's failure to transition to large farms at the beginning of the 20th century. In the 18th century, Haiti's colonial economy was the most productive in the world, and even in the 19th century its post-Independence small-farm economy outperformed the Dominican Republic and other Caribbean neighbors (Bulmer-Thomas 2012, p. 190). Yet, at the turn of the 20th century, Haiti fell behind. As its neighbors responded to booming export demand and shifted agriculture to larger farms, Haiti stood firm in its small-farm agriculture. Historians argue this failure to consolidate farms was caused by overpopulation and a practice of subdividing farms over generations (Lundahl 1979), but such theories are incomplete. In this paper, I argue Haiti failed to transition to more productive agriculture because historical property rights institutions created significant transaction costs to forming plantations.

While there are many examples in the developing world of colonial and even pre-colonial institutions causing incomplete property rights and other inequities (Engerman and Sokoloff 2002, Acemoglu et al. 2001, Dell 2010, Michalopoulos and Papaioannou 2016, 2013), the property rights institutions considered here are important because they were not established by colonists; instead, they were created by a newly independent nation in *reaction* to colonists. Haiti's high transaction costs came from a combination of three post-Independence property rights institutions: (1) a large redistribution of the former French plantations; (2) inheritance patterns on peasant land that gave every family member a veto right to selling it; and (3) a constitutional ban on foreigners owning land in Haiti. Because of Haiti's early independence in 1804, the institutions had time to ossify ahead of the 20th century, when new opportunities for the region arose because of changing agricultural technologies and growing export demand. Countries with similar endowments and histories to Haiti, like the Dominican Republic and Jamaica, took advantage of the developments and expanded plantation-style agriculture. But even though Haiti seemed to be in a similarly advantageous position, farmers could not create large plantations because of high transaction costs.

While others have attributed Haiti's agriculture structure to transaction costs (Moral 1961), this paper is the first to test the hypothesis using microdata collected from more than 5,700 agricultural plots. The plots were created between 1928 to 1950 under a land reform implemented during the 1915-1934 U.S. occupation of Haiti. In addition to the land data, I proxy for transaction costs using settlement patterns taken from historical maps. The transaction cost measurement comes from a thought experiment: if a farmer wants to start a plantation, how many people would he need to evict. The two datasets allow for the first rigorous test of the various theories for Haiti's

small farms. The data strengthen the case for transaction cost theory and weaken the support for alternative theories summarized in Lundahl (1979).

Haiti's agricultural development, or lack thereof, can be explained with a standard Ricardian model that incorporates transaction costs. To a two-good model, I add the assumption that one of the goods must be produced on large, contiguous farms and that acquiring such farms requires transaction costs. In equilibrium, the transaction costs prevent the adoption of large farms, causing land to sit idle, and workers migrate to the country with higher productivity or lower transaction costs. The predictions are consistent with the fact that at the same time countries like the Dominican Republic (Haiti's island neighbor) were moving toward large farms, most of Haiti's land sat idle, and more than 100,000 Haitians (approximately 20% of the prime-age male labor force) were migrating to work on foreign farms.

The Ricardian model predicts that in the absence of transaction costs, ending migration should increase the amount of land adopted under large-scale farms relative to small-scale farms. But transaction costs in the land market will distort adoption towards smaller farms. I test the prediction looking at farms created following the Trujillo Massacre of 1937. The massacre cut off the Dominican Republic as a source of labor demand and pushed refugees into Haiti's border districts. A difference-in-differences analysis reveals that after the massacre districts near refugee camps had a large and significant increase in farm creation. Yet practically no new plantations were created, and three-quarters of the land was in subsistence farm sizes. This result is consistent with transaction costs impeding the land market and disproves many alternative hypotheses.

The institutions considered here contribute to a growing literature on how transaction costs affect economic development. India's economy is dominated by small farm because Indian families, like Haitians, also divide properties among heirs; such practices have led to ineffecient, small farms (Foster and Rosenzweig 2011). In Cuba, transaction costs from negotiating with entrenched landowners forced investors to develop sugar mills on the eastern side of the island, far from Havana and the established sugar industry (Dye 1994). The problem is not isolated to the developing world: fragmented land ownership impeded shale oil production in North Dakota (Leonard and Parker 2018). To overcome such problems, economic development sometimes requires (involuntarily) reallocating property rights in response to changing economic conditions (Lamoreaux 2011). Indeed, violating or weakening property rights on the path to development occurred in France (Finley et al. 2017, Rosenthal 1990), England (Dimitruk 2017, Bogart and Richardson 2011), and America (Priest 2006). But such a solution requires a government with the capacity to reorganize and enforce property rights, a dilemma discussed in the conclusion.

## 1 Haiti's missing plantations

From 1870 to 1930, Latin America and the Caribbean experienced an export boom. Trade costs fell with the adoption of steam-powered ships (Pascali 2017), and in response the region exported more (Chasteen 2011). But the boom passed over Haiti. Thanks to its coffee production, Haiti

had never been the poorest economy in the region; however, thanks to Brazil's ambitious coffee production during the boom, Haiti's economy shrank (Bulmer-Thomas 2012 p. 157). Haiti did not have the high export profits that allowed other countries to construct roads and railways (Holt 1992, Dye 1994) nor the high tax revenues that financed their public education (Musacchio et al. 2014). Because Haitian agriculture slipped, Haiti began to diverge from its neighbors. To understand Haiti's departure, we must see that workers who wanted to respond to the boom had to emigrate because historical property rights institutions created large transaction costs in the Haitian land market.

The failure of Haiti's exports to respond to the export boom led Bulmer-Thomas to conclude, "The Haitian economy, it would seem, was not able to respond to these price signals from the market with the flexibility required" (Bulmer-Thomas 2012 p. 190). But focusing on export statistics distracts from the fact that Haiti's primary export during the boom was not commodities, it was people. In the early 20th century, large numbers of Haitian workers migrated to the Dominican Republic and Cuba to earn wages two to six times higher than what they could get in Haiti. Though the actual number of migrants was impossible to document, about 100,000 went to the Dominican Republic each year (State Department 1924), and between 10,000 and 25,000 migrants traveled to Cuba (HBRF, 1926, p 96).[1] The two countries employed about 20% of Haiti's prime-age (25-55) male workforce, sapping Haiti's domestic labor supply.[2] The Haitian labor market responded to price signals, and those signals told the workers to leave.

The land market, on the other hand, did not respond, and land sat idle throughout the country. For context, the population was four times larger than colonial times yet farmers cultivated only two-thirds of the land cultivated by colonists.[3] The government owned about half of the country's land, but most of its property (about 900,000 hectares) sat idle.[4] Private landholders too left land idle (HBRF, 1938, p 99. See also Millspaugh (1929)). Adding to the puzzle, the evidence presented in Section 5 shows that the idle land was quality agricultural property.

Observers at the beginning of the 20th century puzzled over why so many workers moved abroad when there was so much idle land available. Some policymakers wondered why workers would leave

[1]The average unskilled wage in Haiti was 1.00 to 1.50 Gdes per day but in Cuba it was 5.00 to 7.50 Gdes (Haiti Bureau du representant fiscal 1926 p. 97). Furthermore, the workers could purchase clothing from the company store at one third to one half the price of clothing in Haiti, which means the real wage was even higher (State Department 1924). Sugar companies paid the costs of travel, passport, and a bond for each laborer to insure the migrant's return upfront. These costs were not trivial–the United Fruit Company spent more than $100,000 annually on 5,000 men (State Department 1924). The record is conflicted on how much the incidence of migration costs fell on the worker. Some laborers could circumvent migration fees by taking unofficial boats, so the true flows were higher.

[2]For instance, in Aux Cayes, the fourth most populous district in the country, scarce male labor caused women and children to fill the vacant positions. Furthermore, recruiters selected the healthiest and most able workers to leave the country (State Department 1927). See also the editorial in Le Temps, Oct 1927

[3]Colonists cultivated one million hectares (McClellan 2010, p. 64), and Brisson (1968) calculated that four departments cultivated 496,000 hectares, which was 40% of the arable land in these departments. He estimated in the fifth department there was 354,000 hectares of arable land. Applying the same 40% figure to this department yields 141,000 hectares, making the total cultivated land 637,000. Hence, the farmers only cultivated 64% of the total land cultivated by colonists.

[4]Brisson (1968) estimates that large-landholders owned about 960,000 hectares in Haiti and that only 7% was under cultivation. Lundahl (1996) argues that large, private land owners would have held very little of this land. The government held most of it. See also Millspaugh (1929).

Figure 1: Example of checkerboard holdings on a 100 hectare piece of land


Notes: Every dot represents a building, mostly homes and huts. The map depicts the region around Ouanaminthe, Haiti and Dajabon, Dominican Republic. The thick black line in the middle is the border between the two countries. Red lines are roads and red polygons are urban areas.

when there was enough good land to employ their talents (State Department 1927), and others argued that employing the migrant labor on the idle domestic land would create higher returns than migrating (HBRF, 1930, p 141). But there was no consensus on why Haiti was losing workers or how it could gain ground.

Haiti failed to respond because no one had large, contiguous tracts of idle land that could be converted to plantations. Even though half of the agricultural land sat idle, this land did not exist on a frontier characterized by large spaces of unoccupied land. Haiti's absence of large landholdings made it unique in the region, a contrast most clearly demonstrated looking at the distribution of houses on the border of Haiti and the Dominican Republic. Figure 1 shows this border using an excerpt from a map created by the U.S. Army Inter-American Geodetic Survey in 1956. The difference in the distribution of houses is clear: in Haiti, houses are spread all over the land, but in the Dominican Republic they are clustered together, leaving plenty of property for plantation agriculture. Moral (1961) argues this difference is why American capital went to other Caribbean countries: Haiti did not have large tracts of land owned by a single propertyholder (see p. 64). Starting a plantation at the efficient scale would require buying land from too many smallholders. The historical institutions that destroyed large farms had created significant transaction costs to reassembling them.

## 1.1 The Historical Origins of Haiti's High Transaction Costs

Although the government owned plenty of idle land, farmers could not acquire large tracts without evicting or negotiating with tenants because private holders dotted the country. Unique for the Western hemisphere (Lundahl 1979 p. 37), the agricultural organization was a result of historical land redistribution, inheritance patterns, and a ban on foreigners owning property. Other countries during the boom, like the Dominican Republic and Jamaica, did not have this problem and shifted resources to sugar production.

Shortly after independence in 1804, the Haitian government divided and redistributed the colonial plantations. During the Haitian revolution (1792-1804), the authorities confiscated property from plantation owners, and after independence, under President Alexandre Petion, the Haitian government began redistributing it (Thoby 1888 pp. 11-12). Redistribution changed Haiti's agricultural structure and destroyed sugar production (Mackenzie 1830). Through official and unofficial channels, land fell into the hands of about 450,000 former slaves, and Haiti's economy became a country of small farmers.

After the redistribution, inheritance patterns put the properties under the control of entire lineages. Property owners divided their land equally among heirs (Bastien 1985), a practice officially encoded in the law (Lundahl 1979 p. 278; Force 2016, p. 41) and culturally reinforced by a desire to prevent large-scale agriculture from returning and destroying the legacy of emancipation (Dubois 2012 pp. 109-110). Each heir received usufructuary rights over the inherited land, but the entire family held the alienation rights; thus, a farmer could cultivate his plot as he wished, but if he wanted to sell it he needed approval from his siblings, cousins, and beyond. Any family member could veto the sale. The initial redistribution by itself would make aggregating land difficult; however, aggregating plots became even harder because most of the private land had multiple legitimate claimants.

As a final blow, the Haitian government banned foreigners from owning property. In the 1805 constitution, fearing foreign powers would reassert control over their newly independent nation, the Haitian founding fathers put all former French properties into the State's hands and prohibited foreigners of any nation from acquiring property in Haiti (Janvier 1886). The government enforced the ban through the 19th century, stopping outsiders who attempted to circumvent it. This introduced a crippling hysteresis by cutting off a key source of capital that could have aggregated land before it became too costly. In 1918, the U.S. occupation eliminated the ban, but because the Haitian government enforced it for 100 years, removing it did not change the country's agricultural organization. Investors could purchase land, but they could not cultivate it without dispossessing many farmers.

Because of these three influences, anyone wanting to establish a large plantation during the export boom would have needed to evict or contract with many private farmers. Yet no one had eviction powers; not farmers, not investors, not even the government.[5] At the beginning of the

[5]There are many reports of the government expropriating wealth from peasants, but there are few confirmed instances prior to the 1915 U.S. occupation of it confiscating peasant land (Murray 1977, pp. 341-42). In some cases,

occupation, eviction powers were so limited that many American companies who received land from the Haitian government could not cultivate it because of the difficulty removing the small farmers (Casey 2012 pp. 84-85). During the occupation, some Americans advocated reforming eminent domain law to make eviction easier (HBRF, 1938, p 99), but others opposed it because they wanted to maintain support from the masses (Schmidt 1971, p. 179). Instead of evicting farmers, companies could contract with them, but achieving the minimum efficient scale required contracting with too many parties. "One sisal company, desiring to acquire about twenty hectares [50 acres] in the east of Cul-de-Sac, *has negotiated for three years with 180 propertyholders*" (Moral 1961 p. 185, emphasis mine). There was no low cost solution to the prevalence of smallholders on agricultural land.

Contrasting Haiti with the Dominican Republic spotlights the importance of historical property rights institutions. Since colonial times, Haiti and the Dominican Republic have had significantly different property rights institutions.[6] In the 18th century when Haiti generated large profits for French investors, the Dominican Republic played a peripheral role in Spain's empire. Because most of the Dominican Republic's economic activity came from raising cattle—which requires large, open pastures for grazing—its colonial economy produced more concentrated land holdings and a lower population density. Then to defend against a possible Haitian incursion, the Dominican government fortuitously promoted foreign investment just as the export boom began (Pinkett 1941, Sagas 1994). By the end of the 19th century, investors in the Dominican Republic demanded clear property rights, received preferential treatment from the government, and bought large tracts of frontier land (Martinez 1999, Moya Pons 1985).

In contrast to the Dominican experience, during the same period Haiti suppressed foreign investment. Foreigners gained ground in Haiti when an 1860 Haitian law allowed households headed by a foreigner to own land as long as the Haitian wife held the title (Janvier 1886 p. 275). Exploiting the provision, foreign merchants acquired wives and property, but the strategy soon became popular enough to worry the government (Dubois 2012 p. 174). A new constitution in 1879 stripped citizenship from women married to foreigners, required them to sell any property within three months of the marriage, and forbade them from acquiring property in the future. The law allowed the woman to regain her citizenship and property rights only if the husband died and the couple had no children (Janvier 1886 pp. 422-23). Just as export demand increased, the Haitian government closed a loophole available to foreign investors.

Consider the case of Jamaica as a counterfactual for Haiti's institutions. Jamaica had similar factor endowments as Haiti, and both had colonial sugar economies that relied on slave labor. Jamaica even experienced a similar post-emancipation land redistribution that destroyed sugar production.[7] But unlike Haiti, Jamaica could not ban foreigners from owning property, because

the government claimed peasant land, but the owner successfully challenged it in court and won (Haiti Bureau du representant fiscal 1928 p. 74).

[6]During colonial times, French-owned Haiti was called Saint Domingue, and Spanish-owned Dominican Republic was Santo Domingo.

[7]But instead of the Jamaican government redistributing the plantation land, parties of former slaves pooled resources, purchased entire plantations, then divided the land. The freeholders chose similar plot sizes to their

emancipation did not remove Jamaica from the British Empire. When the export boom increased banana prices, foreign investors monopolized shipping and then bid up land prices, bringing plantations back to Jamaica (Holt 1992). In contrast, when the Standard Fruit Company tried to establish banana plantations in Haiti in the 1930s, the institutions had already created large transaction costs. Standard Fruit had to convince hundreds of little owners to accept contracts, and those who did not accept created costly property rights disputes (Lundahl 1979, p. 286).

In summary, historical institutions divided the land among the population and created forces that prevented the government or investors from consolidating it. By the beginning of the 20th century, smallholders dotted the country, a unique position relative to similar countries.

### 1.2 Popular Alternative Theories for Haiti's Small Farms

Because Haiti's small farms are such a contrast to the agricultural structure in the rest of the region, the cause for such small farms has been a focus of the limited scholarship on Haiti's economic history, which are summarized in Lundahl (1992, Chapter 6). Two popular theories are subdivision and overpopulation; the first is an element of the transaction cost theory mentioned above, while the second is related but, as discussed below, makes different predictions. Lundahl considers the transaction cost theory and dismisses it as a primary cause. But because data on Haitian land is scarce, the empirical support for any of the theories is limited, and the dismissal of transaction costs is hasty.

The subdivision theory contends that farms are small in Haiti because farmers inherited them that way. The theory is an important element to the transaction cost story because it argues that the cost of making farms smaller is low but the cost of making them bigger is high. But there is an important distinction between subdivision theory and the transaction cost theory. Under subdivision theory, if farmers could choose their farms instead of inheriting a farm split every generation, then farmers would choose bigger farms. On the other hand, the transaction cost theory says that even when farmers can create new farms, transaction costs limit the size. The two predictions can be tested with the data collected for this paper.

The overpopulation theory claims that Haiti's high population density has forced the population onto small farms. High population density creates expensive land and cheap labor, leading to small farms cultivating labor-intensive crops. But if high population density was the only problem, then increasing returns to scale is the only condition necessary to transition to plantation agriculture. Because economies of scale characterize the plantations in the region, it seems that the theoretical basis for overpopulation theory is weak. Furthermore, predictions from overpopulation theory is directly opposed to transaction cost theory. Overpopulation predicts that districts with the highest population densities should have the largest demand for land, whereas the transaction cost theory predicts that such districts also have higher transaction costs (since there are more people to negotiate with) and therefore demand for land will be lower. The data will allow for testing these predictions too.

Haitian counterparts: the modal plot was between one and two hectares (Holt 1992).

## 2 Haitian Land Adoption and Settlement Patterns

Although other researchers have proposed that transaction costs impeded plantation development in Haiti, none had the data to test the hypothesis.[8] Data on Haitian land are difficult to find (Lundahl 1996), but here I present two new sources I collected and show they reveal patterns in the land market consistent with the transaction cost hypothesis.

### 2.1 Land Rental Data

The first data come from a 1927 land reform initiated by the U.S. occupation. In 1914, the U.S. Marine Corp began occupying Haiti as an extension of its Caribbean strategy.[9] The marines initially intended to leave quickly, but the occupation lasted until 1934 because officials feared a hasty withdrawal would create instability.[10] In extending the occupation, American officials gained greater control over policymaking,[11] and one of the top priorities became strengthening the Haitian government through increased internal revenues. The Haitian government relied almost exclusively on volatile customs receipts. From 1911 to 1915, customs supplied over 97% of government revenue. This dependency decreased after the U.S. entered, but even in 1926 customs still comprised 86% of revenues.[12]

Seeking a stable source of internal revenue, the American officials controlling Haiti's finances believed the government could increase revenues from land (HBRF, 1927, p 65). Haiti had neither a land tax nor even a cadaster to indicate who owned land, each possibilities for reform. But instead of instituting a divisive land tax program, the American officials decided to reform a flagging land rental program from 1877.[13] The American reforms clarified the program's organization, corrected price distortions, and created incentives to invest in the land. For example, the reformers chose the rental rate to compete with market rates (Millspaugh 1929). Also, the reform guaranteed the tenant could farm the land for 20 years and made him the residual claimant on any investments he made on the plot. The American officials hoped that fixing such issues would increase the demand

[8] For example, Moral (1961) argues the transaction cost hypothesis using convincing anecdotal evidence. Lundahl (1979) mentions the argument and provides his own anecdotal evidence but focuses on other hypotheses using macrodata.

[9] The Caribbean was a key commercial and military location because of the Panama Canal and the islands' strategic positions. To protect US interests, the military secured nearly every major territory in the region. In the early 20th century, the U.S. was present in Cuba, Puerto Rico, Nicaragua, the Dominican Republic, and Haiti (Schmidt 1971). Haiti was an especially important location because of its strong German presence and its chronic political instability (Heinl 1996).

[10] The grassroots Haitian resistance forces were rising again and causing problems for the American soldiers. Officials believed that withdrawing without establishing stronger institutions would leave the island in chaos (Schmidt 1971)

[11] Schmidt (1971) argues that the U.S. leaders extended the Progressive movement and implemented technocratic reforms to eliminate corruption and improve efficiency. Many reforms were effective and greatly reduced corruption; even U.S. firms had trouble gaining special privileges (Millspaugh 1929, Schmidt 1971). In their reports we can see that officials were constantly looking for inefficiencies to resolve.

[12] A study published at the time, cited by the Financial Adviser's report, claimed Haiti was the country most dependent on customs receipts; its reliance far exceeded the next two highest: Salvador (66%) and the Dominican Republic (50%).

[13] As one official said, "It would be hard to devise a system more susceptible to fraud or more difficult to administer properly" (Haiti Bureau du representant fiscal (1925) p. 119).

for rental land and quickly supply the government with revenue.

I have collected data on the universe of agricultural plots adopted under the program from 1928 to 1950. The program's legislation required the government to publish a notification in its official gazette, *Le Moniteur,* any time a farmer adopted idle land. The notifications show that over this 22 year period farmers adopted 5,792 agricultural plots.[14] Each notification contains descriptive information about the requested land, listing the plot's location in one of Haiti's 105 administrative districts (*communes*) and describing the plot's size and neighbors—i.e. what was located on the north, south, east, and west side of the plot. It also listed the renter's name and the date he or she requested the land.

### 2.2 Settlement Pattern Data

The 1956 U.S. Army Inter-American Geodetic Survey,[15] excerpted in Figure 1, gives the most detailed record of the population's spatial distribution. Moral (1961) cites it in his argument that transaction costs impeded plantation development, but he only points to the diffusion the map displays. Using an image processing algorithm I developed, I convert the maps into a data set on settlement patterns.

The settlement pattern data represent a thought experiment: if a farmer wants to start a 100 hectare plantation,[16] how many households would he need to remove? Using the maps, one could answer this question by finding a location then counting how many houses are on the map. Instead of a specific plantation, I divide the entire map into "simulated plantations" of about 100 hectares (256 x 256 pixel squares). Simulated plantations are assigned to the district containing the majority of its pixels,[17] and plantations are discarded when the majority of pixels falls in the ocean or in the Dominican Republic. The map produces 32,412 simulated plantations in 70 districts, with the average district containing 506 plantations.

To complete the thought experiment, I developed an algorithm, described in the appendix, to process the simulated plantation images. For plantation $i$ in district $d$, the algorithm outputs $x_{id}$, the number of houses in the image. I randomly selected 5% of the plantations in each district to process through the algorithm. For each district, I calculate $\mu_d$ and $\sigma_d$, which are the mean and standard deviation of $x$ for all plantations in district $d$.

Note that the maps were created a few years after the end of the sample of land rental data. Naturally, when considering the effect of settlement patterns on land use, the timing raises questions of reverse causality. I discuss the reverse causality concerns below, but the key point is that any

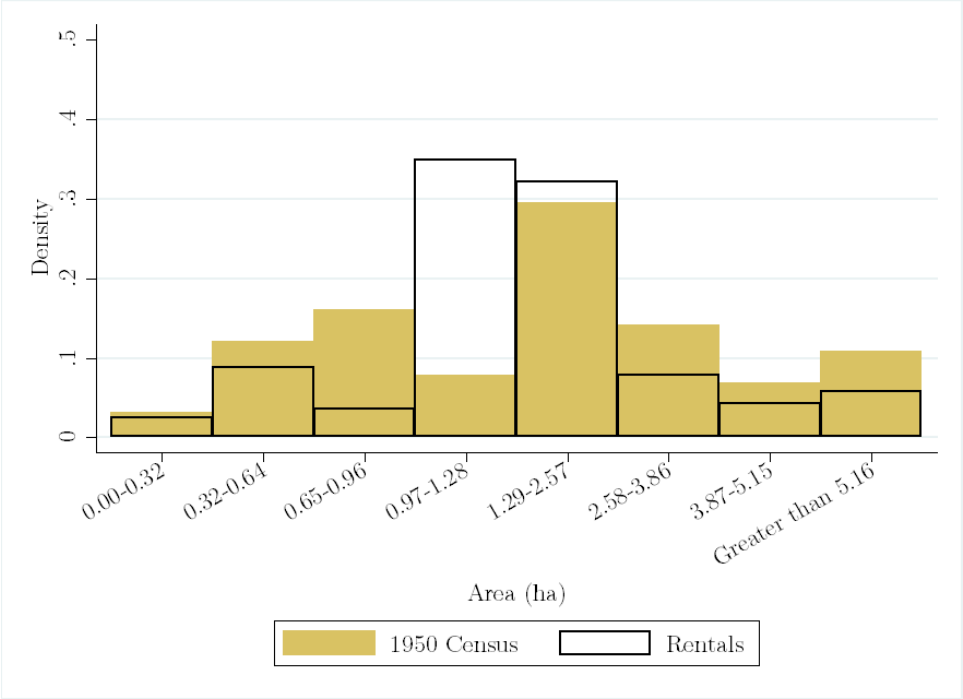
[14]Every notification lists the first date it was published, which allows me to explore gaps to confirm there are no missing notifications. Because the law requires all notifications to stay in *Le Moniteur* for at least three months, I can use multiple issues to double check notifications and avoid missing data that might result from damaged or missing issues. Table A1 lists the issues of *Le Moniteur* used for data.

[15]The 1:25,000 scale map is available at the Digital Library of the Caribbean www.dloc.com.

[16]The 100 hectare size was chosen to balance the minimum size needed to cultivate cash crops with the typical size of large plantations. For instance, in the Dominican Republic in 1970, 57% of land was cultivated on farms 50 hectares or more, and more than 20% of farmland was on plots 1,000 hectares or more.

[17]In the event taht the plantation's pixels fell evenly in more than one district, the district was randomly assigned.

Figure 2: Distribution of adopted plot size, 1928-1950




Notes: Kernel density estimate of the distribution of plots adopted under the Haitian land rental program. The smallest plot is 0.10 hectares and the largest is 1,000 hectares.

issues with reverse causality work against the transaction cost theory.

## 3 Testing popular theories using the new data

Before exploring the transaction cost theory, it is important to use the data to address the popular theories for Haiti's small farms which were mentioned in Section 1.3. First, I test subdivision theory, which claims that farms are small because farmers obtain their land through divided inheritances. Then I test overpopulation theory, which argues high population density has forced farmers onto smaller farms.

Subdivision theory predicts that if farmers could choose their farms instead of inheriting a farm split every generation, then farmers would choose bigger farms. Farmers get this freedom to choose is under the land rental program, making it the perfect test for subdivision theory. To test the prediction, I compare the rental farms to privately held farms in the 1950 census, the majority of which were acquired through inheritance. The theory predicts that government rentals should be larger than census farms. On the other hand, transaction cost theory predicts that transaction costs constrain farm size.

The land rental data provide some evidence in favor of subdivision theory, but with reservations. Figure 2 superimposes the farm-size distribution for the rental plots on the distribution of all farms reported in the 1950 census according to the bins defined in the census. The distribution of rental

Table 1: Comparing Land Available in 1934 to All Land Rented from 1934 to 1950

| District | Departement | Available (1934) | Rented (1934-1950) |
|---|---|---|---|
| Croix-des-Bouquets | Ouest | 470 | 94 |
| Fort Liberte | Nord | 1,593 | 1,077 |
| Thomazeau | Ouest | 223 | 610 |
| Petionville | Ouest | 301 | 37 |
| Ganthier | Ouest | 168 | 532 |

Notes: All figures are in hectares. Available land comes from a 1934 advertisement published in *Le Moniteur*, 1934 No. 24 (22 March 1934).

land has greater density around 1.29 ha. On the one hand, the density shows that farmers avoided the smallest plots, consistent with subdivision. On the other hand, they did not choose the largest farm sizes. Thus, while subdivision can explain why many Haitians farm 0.5 ha instead of 1.0 ha, it cannot explain why farmers are not moving to large, plantation-style farms. The missing explanation is transaction costs.

Moving to overpopulation theory, the land rental data provide little supporting evidence. If competition for land was a major hurdle, then we would expect farmers to eagerly accept the opportunity to cultivate unoccupied land. Yet the nearly 5,800 plots together constituted about 30,000 ha, an unremarkable figure compared to the nearly 900,000 ha available (Brisson 1968). One could object that the Brisson calculation overestimates the amount of land available. But for some districts we have lower-bound estimates of available land. In 1934, the government listed properties available for rent in five districts,[18] and Table 1 shows that in most districts farmers did not even adopt as much land in 16 years as was available in the one year. Despite the government's efforts to induce farmers with its rent guarantees, investment incentives, and clear title, few farmers rented land.

Details from the plot descriptions provide mixed support for overpopulation theory. Many of the plots were adjacent to private land. If we assume the notification always said when the government owned the neighboring plot, then 67% of plots had at least one neighbor owned by a private party. But the notification's writer might have assumed that the reader knew the government owned the surrounding land, meaning this figure might overestimate the prevalence of private land. A more conservative estimate looks just at how many plots had at least one state-owned neighbor and at least one privately-owned neighbor. In this case, 48% of plots were bordered by both private and

[18] *Le Moniteur*, 1934 No. 24 (22 March 1934)

state land. But many farmers chose small plots even when they could have rented larger ones: 15% of plots had at least one neighbor listed in the notification as "unoccupied state land," and 31% of plots had at least one neighbor listed as "rest of the land" or simply "the State." Together this means that 46% of renters gave up the opportunity to rent larger plots.

The evidence is problematic for overpopulation theory but supportive of transaction cost theory. Overpopulation theory has no problem with the 48% of plots that were adjacent to privately-owned land, but it has trouble reconciling the abundance of idle land, both next to the farms themselves and in the country generally. The evidence, however, is consistent with transaction cost theory. Idle land adjacent to farms is consistent with farms sizes dictated by diseconomies of scale on subsistence crops (Foster and Rosenzweig 2017). The high proportions of state and private neighbors found in the rental data suggest state- and privately-owned land coexisted in a patchwork that made it difficult to find large tracts of contiguous, unoccupied land. Thus, the only way to get plantation-sized farms was negotiating with many farmers, incurring large transaction costs.

The settlement pattern data allow for a direct test between overpopulation and transaction cost theory. According to overpopulation theory, high population density should increase the demand for land. But according to transaction cost theory, the relationship between settlement patterns and land rentals is different. Higher density means more transaction costs, and therefore fewer rentals, so we should see a negative relationship between land adoption and average density. Furthermore, for two districts with the same average transaction costs, the one with the greater variance has more land available at low transaction costs, so we should see more land adopted as the variance increases.[19] Thus, overpopulation and transaction costs provide opposing predictions.

The settlement pattern data allow me to calculate both the mean and standard deviation of settlements within a district. I assume that transaction costs to aggregating land are proportional to the number of settlements on that land. This is probably an underestimate of transaction costs because holdout problems can significantly increase costs as more people inhabit the land.

Table 2 shows the regression of total land adopted in each district from 1928 to 1950 on the settlement patterns. Consistent with transaction cost theory, higher average density leads to *lower* adoption, and higher variance leads to more adoption. Because the regression uses the log transformation of both the dependent variable and independent variables, the coefficients can be read as elasticities. The magnitude of both elasticities is greater than but not statistically different than one. The large magnitudes suggest that each additional household on a plot increases the transaction costs by more than one person, which matches the story of ancestral lines holding claim to a property. An additional house is not just one extra negotiation; it is an entire ancestral line.

As mentioned when describing the data, the settlement pattern data come from 1956, a few years after the end of the land rental sample, so there is a concern about reverse causality. Land rentals

[19]Suppose there are two districts, $D$ and $E$, and let $X_i$ be a random variable measuring transaction costs in district $i$ with mean $\mu$ and variance $\sigma_i^2$. Note that the mean is the same for both districts, and assume without loss of generality that $\sigma_D^2 > \sigma_E^2$. Let $F(Z)$ be the cumulative distribution function for the standard normal distribution. To start a plantation, an investor must find a plot of land where the transaction costs are less than $x < \mu$. Then the probability that the investor finds land in district $i$ with transaction costs less than $x$ is $F(\frac{x-\mu}{\sigma_i})$. Because $x < \mu$ and $\sigma_D > \sigma_E$, $F(\frac{x-\mu}{\sigma_D}) > F(\frac{x-\mu}{\sigma_E})$; thus the probability of finding suitable land in district $D$ is higher than in district $E$.

Table 2: The effect of settlement patterns on the total land adopted in a district, 1928-1950

| | ln(*Total Land*) | ln(*Total Land*) | ln(*Total Land*) |
|---|---|---|---|
| ln($\mu$) | -1.96*** | -1.68*** | -1.45** |
| | [0.46] | [0.58] | [0.56] |
| ln($\sigma$) | 1.87*** | 1.72*** | 1.23** |
| | [0.53] | [0.58] | [0.61] |
| Controls | | | |
| Near refugee camp | | X | X |
| Slope | | X | X |
| Latitude | | X | X |
| Market Access | | X | X |
| District Area (km2) | | | X |
| Population | | | X |

Notes: All regressions have 64 observations. Bootstrapped standard errors are in brackets. The variables $\mu$ and $\sigma$ are calculated from the maps as described in the appendix. Border indicates that the commune was in a border district. Slope is the mean slope in the district. *** p<0.01, ** p<0.05, * p<0.1

affect settlement patterns, so a critic would argue we are not observing the effect of settlement patterns on land adoption but rather the effect of adoption on settlement. But the reverse causality moves in the opposite direction of the transaction cost theory because land rentals should increase $\mu$, which would create a positive coefficient in Table 2. The reverse causality issues suggest that the effect of transaction costs is even larger than estimated.

Because settlement patterns are not random, the other columns in Table 2 use additional controls. Controlling for the district's average slope accounts for how terrain may alter settlement patterns, and controlling for the district's latitude captures the climatic suitability to cash crops. A market access control measures how many hours it takes to get to the closest large Haitian market, taken from a 1932 Marine report.[20] These controls reduce the coefficients' magnitude, but they remain above one, significant, and most importantly they retain the predicted signs.

To show that the transaction cost variables measure something more than population density, Table 2 also displays a column that controls for the district's land area and population. One might argue that the transaction costs variables are just measures of population density, but including these additional controls holds population density constant and compares differences in settlement patterns. Of course the relationship between transaction costs and population density is real, which is why including the controls reduces the magnitudes further, but the signs remain.

Transaction costs do not just affect the number of farms created; the transaction costs should create smaller farms. Table 3 reports regressions with the same independent variables but changes

[20] *Monograph of Haiti*, 1932. Available at https://archive.org/details/MonographOfHaiti1932

Table 3: The effect of transaction costs on whether a largescale plantation was adopted in the district, 1928-1950

| | Any Large Farms | | | Log(Ave Farmsize) | | |
|---|---|---|---|---|---|---|
| $\ln(\mu)$ | -0.44*** | -0.40** | -0.33** | -0.83** | -0.54 | -0.44 |
| | [0.16] | [0.19] | [0.16] | [0.35] | [0.35] | [0.45] |
| $\ln(\sigma)$ | 0.53*** | 0.52** | 0.40* | 1.06** | 0.77* | 0.66 |
| | [0.19] | [0.23] | [0.21] | [0.42] | [0.41] | [0.45] |
| Controls | | | | | | |
| Near refugee camp | | X | X | | X | X |
| Slope | | X | X | | X | X |
| Latitude | | X | X | | X | X |
| Market Access | | X | X | | X | X |
| District Area (km2) | | | X | | | X |
| Population | | | X | | | X |

Notes: All regressions have 64 observations. Bootstrapped standard errors are in brackets. The dependent variable "Any Large Farms" is a binary variable equal to one if at least one property adopted in the district was 50 hectares or greater. The variables $\mu$ and $\sigma$ are calculated from the maps as described in the appendix. Border indicates that the commune was in a border district. Slope is the mean slope in the district. The IV columns take another sample of squares from the district as an instrument to correct for measurement error. *** p<0.01, ** p<0.05, * p<0.1

the dependent variable to a dummy variable for whether anyone adopted at least one plot greater than or equal to 50 hectares. Only 40% of districts in the sample had a plot this big. Table 3 shows that the relationship holds: greater density decreases the probability of having a large plot, and greater variance increases the probability. Table 3 also looks at the average plot size and finds similar results.

One concern with the regressions is that they do not control for the total government land supplied in each district, but evidence from government advertisements prove supply was not a binding constraint. Land supply is captured to some extent by controlling for the district's total land area, but omitting direct measures might misattribute the effect of supply differences to the settlement patterns. Differences in the supply of land across districts could create the same observed relationship between settlement patterns and land adoption: supply might be lower in districts with more households per plantation and higher in districts with greater variance. But Table 1 shows the adopted land is too small a fraction of the total idle land that land supply could not have been a binding constraint.

It is also important to note that the results in Tables 2 and 3 oppose overpopulation theory. Overpopulation theory predicts that population pressure pushes districts with denser settlements to adopt more land and larger farms. The results clearly refute such predictions, weakening the case for overpopulation theory.

# 4 A Model of Agricultural Structure and Transaction Costs

Historical property rights institutions caused Haiti to have high transaction costs to developing agricultural properties, but I have yet to show that these high transaction costs caused Haiti to miss the export boom. In fact, the discussion has omitted an obvious culprit: differences in productivity. I present a model that accounts for exogenous differences in transaction costs and in productivity (e.g. soil quality) and show that productivity differences cannot explain all of the facts presented. Furthermore, I derive testable hypotheses for how transaction costs affect agricultural structure that I can take to the land adoption data.

Since the primary point of comparison is going to be Haiti and the Dominican Republic, suppose that there are two small countries which we will label $H$ and $D$. The countries both produce two goods ($X$ and $C$) for trade on the international market using two factors, land ($T$) and labor ($L$). Because the small countries sell on the international market, the price for each good ($p_j$) is exogenous to the country's production. For ease of exposition, assume $p_C = 1$.

Country $i$ produces good $j$ using the production function $A_{ij}F(T_{ij}, L_{ij})$, which exhibits decreasing returns to scale and is continuous and twice differentiable, with $f_L > 0$, $f_T > 0$, $f_{LT} > 0$, $f_{LL} < 0$, and $f_{TT} < 0$. In some implications the exposition is clearer if we assume a Cobb-Douglas production function, $F(T, L) = T^{\alpha}L^{\beta}$ where $\alpha + \beta < 1$. Note that the function $F(T, L)$ does not differ across countries or goods. Productivity $A_{ij}$ can differ across countries, accounting for differences in soil quality or weather, and across goods, representing that one crop is more productive

than the other. Assume that the two countries use the same technology when producing $C$ and normalize it to equal 1 ($A_{HC} = A_{DC} = 1$). To produce $X$, the farmer needs large, contiguous land, which allows him to get the technology $A_{iX} > A_{iC}$.

Each country has an endowment of land and labor ($E_i^T$ and $E_i^L$). Assume that endowments are the same across countries ($E_H^T = E_D^T$, and $E_H^L = E_D^L$). Labor can migrate without cost.

Both countries have incomplete property rights, which introduce two types of transaction costs into the land market. First, for land producing either good, there is the cost of protecting that land, $\phi_{i1}$. Second, there is the cost of assembling land for producing $X$, $\phi_{i2}$. We can think of $\phi_{i1}$ as building fences (Hornbeck 2010) or devoting "guard labor" to the plot (Field 2007, Goldstein et al. 2015, Goldstein and Udry 2008). The cost of protecting property, even in contexts with well-functioning legal institutions, depends on how the original property rights were defined (Libecap and Lueck 2011). To reduce the costs of protecting property, governments might try to coordinate settlements (Allen 1991), but settlers might strike out on their own if the private costs of protecting property are lower than relying on the government (Dye and La Croix 2013). For simplicity, assume the cost of protecting land is the same for both countries ($\phi_{H1} = \phi_{D1} = \phi_1$). The cost $\phi_{i2}$ represents the institutions discussed in Section 2. Assembling large, contiguous land involves transacting with many smallholders, which I assume is constant per unit of land. While assembling land is costly, it is compensated by cultivating $X$ with the more productive technology $A_{iX}$, which is possible only on large, contiguous land. The transaction costs for land under each good $j$ can be summarized as $\phi_{ij}$, where $\phi_{iC} = \phi_1$ and $\phi_{iX} = \phi_1 + \phi_2$.

The equilibrium is characterized by each country maximizing profits for each good they produce, satisfying the first-order conditions

$$p_i A_{ij} f_T(T_{ij}, L_{ij}) = r_i + \phi_{ij} \tag{1}$$

$$p_i A_{ij} f_L(T_{ij}, L_{ij}) = w_i, \tag{2}$$

the total labor used in both countries is equal to the countries' endowments

$$\sum_{i \in \{H,D\}} \sum_{j \in \{C,X\}} L_{ij} = \sum E_i^L, \tag{3}$$

and the land used in both countries equal to or less than the individual country's endowment

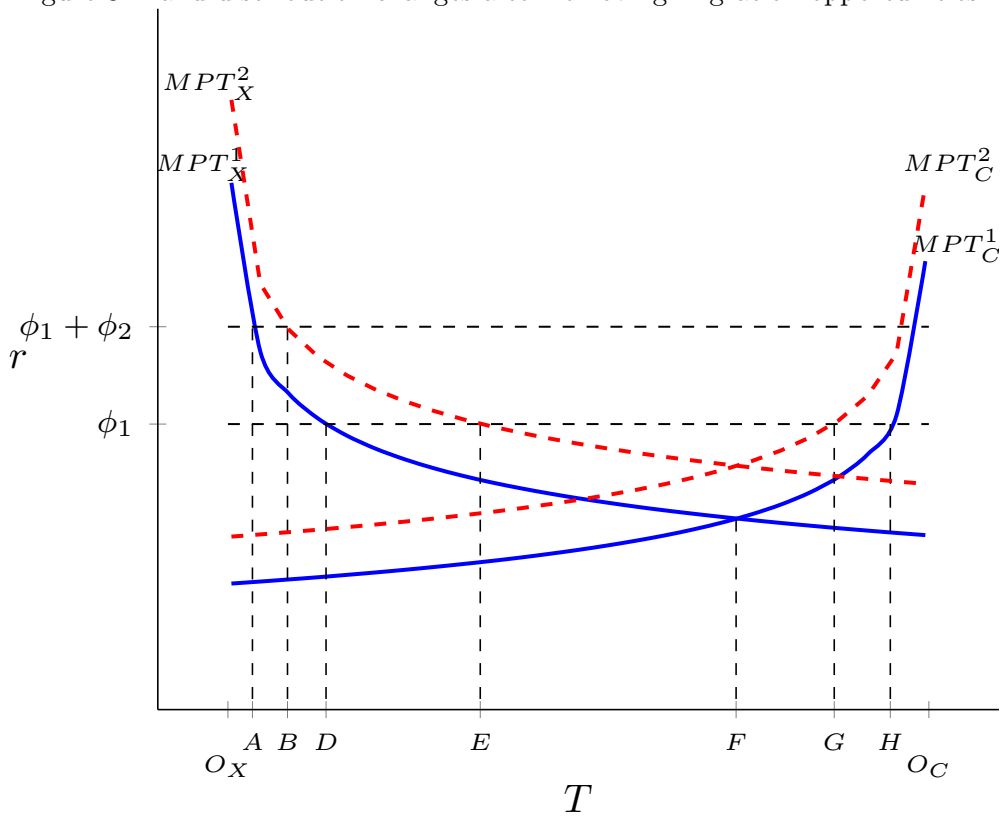
$$\sum_{j \in \{C,X\}} T_{ij} \leq E_i^T. \tag{4}$$

Note that if the land market does not clear, then $r_i = 0$.

The model shows how transaction costs affect the economy versus productivity differences. Thus, the countries only differ in the technology they use for producing $X$ ($A_{iX}$) or in the costs of assembling land for producing $X$ ($\phi_{i2}$).

*Implication 1: There exists a $\bar{\phi_1}$ for which $T_{iX} + T_{iC} < E_i^T$ (i.e. there is some idle land) for all*

Figure 3: Land distribution changes after removing migration opportunities




Notes: The x-axis shows the country's land endowment ($O_X O_C = E^T$), measuring from the left shows the marginal product of land in producing $X$, and measuring from the right shows the marginal product of land in producing $C$. Without transaction costs, the market clears at $r^*$. $MPT_J^1$ represents the marginal product of land in $J \in \{X, C\}$ when labor is free to move between countries. The shift to the dashed curves, $MPT_J^2$ represents the change in the marginal product of land when migration opportunities vanish and wages drop.

$\phi_1 > \bar{\phi_1}$.

This is a straightforward but important implication that can be seen in Figure 4. This figure plots the marginal product of land in $X$ and $C$, assuming the country allocates labor efficiently. The x-axis shows the country's land endowment ($O_X O_C = E^T$), measuring from the left shows the marginal product of land in producing $X$, and measuring from the right shows the marginal product of land in producing $C$. Without transaction costs, the market clears at rental rate $r^*$ , the amount of land in $X$ is $O_X F$, the amount of land in $C$ is $FO_C$, and there is no idle land. However, if $\phi_1$ is higher than $r^*$, even assuming $\phi_2 = 0$, then the land market will not clear: $T_X = O_X D$, $T_C = HO_C$, and $DG$ would sit idle. This result explains frontier land in economies in general, addresses the puzzle the American occupiers observed when they saw Haiti's idle land, and rationalizes why farmers did not rush to the idle land after the land rental reform.

*Implication 2: If $p_X < A_{iX}^{-1}$ , then there will be more land devoted to producing $C$ than to producing $X$. However, as $p_X$ increases, land quickly goes into producing $X$.*

This implication states that if the price of $X$ is too low, the country will devote more land to producing $C$. This result explains most of 19th century Haiti and the Dominican Republic. Returns to producing sugar were low (Dippel et al. 2016), so neither country produced much. Furthermore, at various points throughout the long century, Haiti was on the wrong end of unfavorable international relations, which further suppressed export prices. As cash crop prices increased, countries in the region adopted more plantation land. But Haiti did not. Which brings us to the next implication.

*Implication 3: If the cost of assembling land for $X$ is too high ($\phi_2 > \bar{\phi_2} = (p_X A_{iX} - 1)\phi_1$), then there will be more land devoted to producing $C$ than to producing $X$.*

Implication 3's proof is in the appendix, but Figure 4 demonstrates it graphically. With $\phi_2$ high enough, $T_X = O_X A$. Since land in $C$ does not have to incur the additional transaction cost, $T_C$ would still be $HO_C$. At the level of $\phi_2$ drawn, $T_X = O_X A < HO_C = T_C$. Furthermore, the $AB$ section would be idle in this circumstance.

This implication provides a possible explanation for why Haiti did not develop planation properties while the Dominican Republic did. If transaction costs to assembling plantation land are too high, then most of the land will be in subsistence farming, just as we observe in Haiti.

*Implication 4: All else equal, labor will migrate to the country with (a) the lower $\phi_{i2}$ or (b) the country with the higher $A_{ix}$. This migration pattern is strengthens as $p_x$ increases.*

The Cobb-Douglas labor demand functions for each crop are

$$L_{iX} = \left( \frac{p_X A_{iX} \beta^{1-\alpha} \alpha^{\alpha}}{w_i^{1-\alpha} \phi_{i2}^{\alpha}} \right)^{\frac{1}{1-\alpha-\beta}} \tag{5}$$

$$L_{iC} = \left( \frac{\beta^{1-\alpha} \alpha^{\alpha}}{w_i^{1-\alpha} \phi_1^{\alpha}} \right)^{\frac{1}{1-\alpha-\beta}} . \tag{6}$$

If migration causes the wage to equalize across countries, then each country demands the same

amount of labor for $C$ ($L_{HC} = L_{DC}$), and the country with lower $\phi_{i2}$ or higher $A_{ix}$ demands more labor for $X$. Therefore, labor migrates to the country with a comparative advantage in producing $X$, the one with lower transaction costs or better technology. Migration costs mitigate these flows and may even stop migration, but they cannot change the direction.

When $p_x$ increases, the returns to plantation agriculture increase. Thus, plantation labor demand will increase in both countries. But on net the country with lower transaction costs or higher $A_x$ will receive migrants. These elements give the country a comparative advantage that will increase the return to labor.

This result tells us that migration can come from two sources. The obvious source of migration is if Dominican plantations are more productive than their Haitian counterparts. But the non-obvious source is if assembling plantations in the Dominican Republic is less costly. Even if productivity is the same in both countries, labor will move to the one with lower transaction costs. The increase in prices from the export boom strengthens the migration flows, but migration itself does not reveal whether the country is more productive or has lower transaction costs. To discern the difference, we must stop migration.

*Implication 5: If* $p_X A_X \geq 1$ *and if* $\phi_2 = 0$*, then if migration between countries stopped, the ratio of* $\Delta T_X$ *to* $\Delta T_C$ *would be greater than or equal to one. However, if* $\phi_2 > \tilde{\phi_2} = \left((p_X A_{HX})^{\frac{1}{\alpha}} - 1\right)\phi_1$*, then* $\Delta T_X / \Delta T_C < 1$*.*

Figure 4 demonstrates this implication. When migration opportunity disappears, the marginal product of land increases for both $X$ and $C$ because each can hire more labor at the same wage. This shift will lead the country to include more land in the $C$ sector, moving from $HO_C$ to $GO_C$, such that $\Delta T_C = GH$. The $C$ sector's change is independent of how high $\phi_2$ is, but the change in the $X$ sector depends on $\phi_2$'s magnitude. If $\phi_2 = 0$, then $T_X$ would expand from $O_X D$ to $O_X E$, and $\Delta T_X = DE > \Delta T_C$. However, with high $\phi_2$, $T_X$ goes from $O_X A$ to $O_X B$, $\Delta T_X = AG < BH$. This is a significant increase over the previous level of $T_X$, but the change is not as large as what occurs in the $C$ sector.

Another way to think about how transaction costs affect the land market's response to a change in migration costs is to think about how transaction costs affect the equilibrium marginal rate of technical substitution. When transaction costs are high, the marginal product of land is high relative to the marginal product of labor. An increase in migration costs lowers the cost of labor in country $H$, which will lead farms to hire more labor. However, the marginal product of labor is already relatively low, so hiring more labor does little to improve plantation productivity. With high transaction costs, the marginal productivity of land is high, but the economy cannot afford to adopt more plantation land.

This can also be demonstrated in the Cobb-Douglas demand. Moving to autarky, the wage will

go from $w_1$ to $w_2 < w_1$, and the change in $T_{HX}$ is

$$\begin{aligned}\Delta T_{HX} &= \left(\frac{p_X A_{iX} \beta^{\beta} \alpha^{1-\beta}}{(\phi_1 + \phi_{H2})^{\alpha}}\right)^{\frac{1}{1-\alpha-\beta}} \left(\frac{1}{w_2^{1-\alpha}} - \frac{1}{w_1^{1-\alpha}}\right)^{\frac{1}{1-\alpha-\beta}} \\ &= \left(\frac{p_X A_{iX} \phi_1^{\alpha}}{(\phi_1 + \phi_{H2})^{\alpha}}\right)^{\frac{1}{1-\alpha-\beta}} \Delta T_{HC}.\end{aligned}$$

If there are no transaction costs to assembling plantations ($\phi_{H2} = 0$), then

$$\frac{\Delta T_{HX}}{\Delta T_{HC}} = (p_X A_{HX})^{\frac{1}{1-\alpha-\beta}}. \tag{7}$$

Thus if $p_X A_{HX} \geq 1$, then $\Delta T_{HX}/\Delta T_{HC} \geq 1$. As $\phi_2$ increases, $\Delta T_{HX}/\Delta T_{HC}$ decreases, and if $\phi_2 > \left((p_X A_{HX})^{\frac{1}{\alpha}} - 1\right)\phi_1$, then the ratio will be less than one. Note that $\tilde{\phi_2} > \bar{\phi_2}$ from Implication 3, so if this implication holds then that one does too.

Implication 5 provides a testable hypothesis: differences in productivity and transaction costs have different implications for the response to migration barriers. It is like developing plantations using protectionism in the input market: if the Dominican Republic ($D$) produces more of the export good $X$ because it has higher productivity, then a protectionist policy that eliminates migration would stimulate the plantation industry in Haiti ($H$). On the other hand, if workers migrate because assembling plantations in Haiti is too costly, then moving to autarky will have almost no effect on plantation land there. Instead, workers will go to subsistence farms. This implication is tested in the next section.

# 5 Using the Trujillo Massacre to Test the Model

The patterns in Section 4 confirm that in the early 20th century there was little activity in the Haitian land market. New farms were small and land was sitting idle. But such patterns have not established whether this equilibrium came from productivity differences or high transaction costs. Failing to understand the mechanism will result in improper policy recommendations. To discern the mechanism, I test the model's fifth implication using an exogenous shock to the Haitian labor market, and I find empirical results consistent with high transaction costs in the land market.

The model's Implication 5 predicts that when Haitian workers lose the chance to migrate to the Dominican Republic, farmers will adopt the idle land in Haiti. To test this implication, I use the 1937 Trujillo massacre's effect on migration. In October 1937, without warning, the Dominican Republic's President Rafael Trujillo sanctioned the slaughter of Haitians living in the Dominican Republic.[21] The exact number of deaths is unknown, and estimates vary widely; however, the most reasonable estimates count 12,000 deaths (Vega 1988).

[21]The Dominican Republic and Haiti frequently contested their border, but they usually settled the disputes diplomatically (Roorda 1996). They achieved such a peaceful settlement in 1936 that the two presidents received 14 nominations for a joint Nobel Peace Prize. See http://www.nobelprize.org/nomination/archive/show_people.php?id=9662 accessed 22 Aug 2016

Table 4: Distribution of Haitians in Dominican Republic by Province, 1935 and 1950

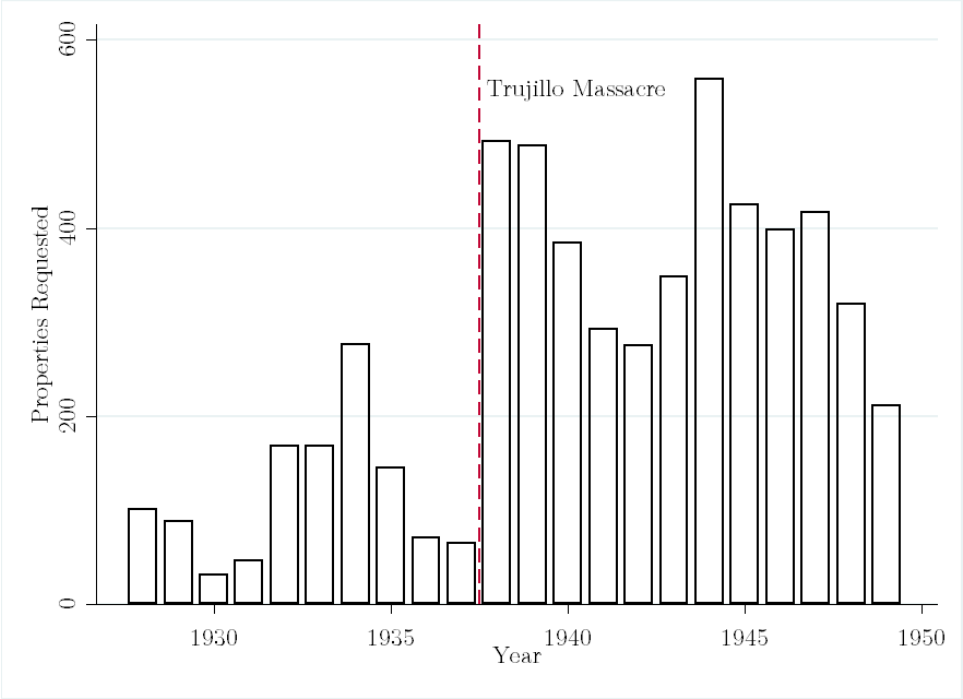
| Relative to Haiti | Province | 1935 | 1950 | Change | % Change |
|---|---|---|---|---|---|
| Border | Barahona | 7,327 | 1,658 | -5,669 | -77% |
| | Independencia | 1,491 | 648 | -843 | -57% |
| | Libertador | 2,444 | 1 | -2,443 | -100% |
| | Montecristi | 1,372 | 2 | -1,370 | -100% |
| | San Rafael | 3,442 | 4 | -3,438 | -100% |
| Near Border | Bahoruco | 9,647 | 2,989 | -6,658 | -69% |
| | Benefactor | 1,785 | 20 | -1,765 | -99% |
| | Puerto Plata | 2,313 | 226 | -2,087 | -90% |
| | Santiago | 1,255 | 14 | -1241 | -99% |
| East | All Interior Provinces | 21,584 | 13,210 | -8,374 | -39% |
| **Total** | | **52,660** | **18,772** | **-33,888** | **-64%** |

Source: Anuario Estadistico de la Republica Dominicana 1938 V 1; Republica Dominicana Tercer Censo Nacional de Poblacion 1950

Although some have attributed the massacre to economic and racial causes, the consensus is best expressed by Turits (2003), "What caused Trujillo to order the 1937 massacre will probably remain forever obscure" (p. 179). No explanation has convinced historians (Heinl 1996 p. 482). The economy was benefiting from rising sugar prices (Anuario Estadistico 1938 vol 2, p. 205), and the government filled the vacant jobs by recruiting Puerto Ricans, not Dominicans (Roorda 1996). While racial animus certainly contributed, anti-Haitianism was not substantially a problem in the Dominican Republic until after the massacre (Turits 2003, Derby 1994). Whatever the cause, the massacre was exogenous to conditions in Haiti's land and labor markets.

The massacre shocked the Haitian labor market by increasing the cost of being Haitian in the Dominican Republic and by pushing refugees into Haiti, disproportionately so in certain regions. After the massacre, ethnic Haitians choosing to stay in the Dominican Republic were risking their lives, and survivors fled to Haiti abandoning high wages (Vega 1988) and personal property (Turits 2003, Palmer 1976). Within 15 years, the Dominican Republic lost 64% of its Haitian population. The 1935 Dominican census counted almost 53,000 Haitians, but the 1950 Census found fewer than 19,000. Table 4 shows in the north-western provinces where the massacres occurred (Libertador, Monte Cristi, and San Rafael) the 1935 count included more than 7,000 Haitians, but the 1950 count was only 7. Even in the southern province of Barahona, where no mass killings were reported, almost 6,000 Haitians disappeared. The extreme drop could reflect people lying about their ethnicity (though their skin color would make it difficult), but even so lying confirms the danger of being Haitian in the Dominican Republic. Furthermore, the census numbers underestimate the massacre's

Figure 4: Annual land rental requests before and after the Trujillo Massacre, 1928-1949




Notes: The pre-massacre average was 116 requests per year; the post-massacre average was 357. The difference is statistically significant with a t-score of 4.96.

effect on Haitian workers because they do not reflect the change in seasonal migration or migration generally. Because the Dominican Republic employed so many Haitians, the massacre was a massive disruption to the labor market.

The massacre further influenced the Haitian labor market by disproportionately increasing labor supply in certain regions. Naturally, for refugees fleeing the Dominican Republic the border districts were the first stop, and it is likely such districts originally supplied many of the workers. But such ties are not the only reason some districts received so many workers. To accommodate the refugees, the sanctioned five refugee camps (called "agricultural colonies") in the border where it could better coordinate aid and public goods.[22] Although the government's investment in the refugee camps did not last long (Lundahl 1979), the refugees stayed in the border districts and could be found there decades later (Derby and Turits 1993). The size of the influx is unknown, but documents in Vega (1988) show that in the weeks immediately following the massacre thousands of refugees crossed the border.

According to the model, these labor market changes should affect the land market. Once workers cannot get higher wages in the Dominican Republic, farmers in Haiti can employ them. More labor increases the marginal product of land, and of course a higher marginal product will cause farmers

[22]The five villages that hosted camps were Dosmont, Grand Bassin, and Terrier Rouge in the North-East, and Thiotte and Savane Zombi in the South-East ( Derby 1994 p. 101). The government regularly received updates on the agricultural colonies, but the short reports focused mostly on activities at the schools. For an example, see Republic of Haiti (1939).

to cultivate more land. The model ignores variation within Haiti, but the labor supply mechanism means the disproportionate shock to the border districts should increase land adoption in the border more than the interior. Furthermore, the model implies that if land market transaction costs are low, farmers should employ the refugees on plantations. Indeed, although the model treats all labor the same, farmers would value the refugees just as much or more than average Haitians because of their plantation experience. However, if transaction costs create barriers, then the model predicts a disproportionate increase in subsistence farming.

The massacre's causal effect is clearly seen in the time series of requests. Figure 4 shows the number of requests for each year from 1928 to 1949. There is a clear difference between the pre and post massacre periods: 1928 to 1937 averaged 116 requests per year; but from 1938 to 1949 the average number of requests was 357. The difference between the pre- and post-massacre means is statistically significant with a t-score of 4.96.

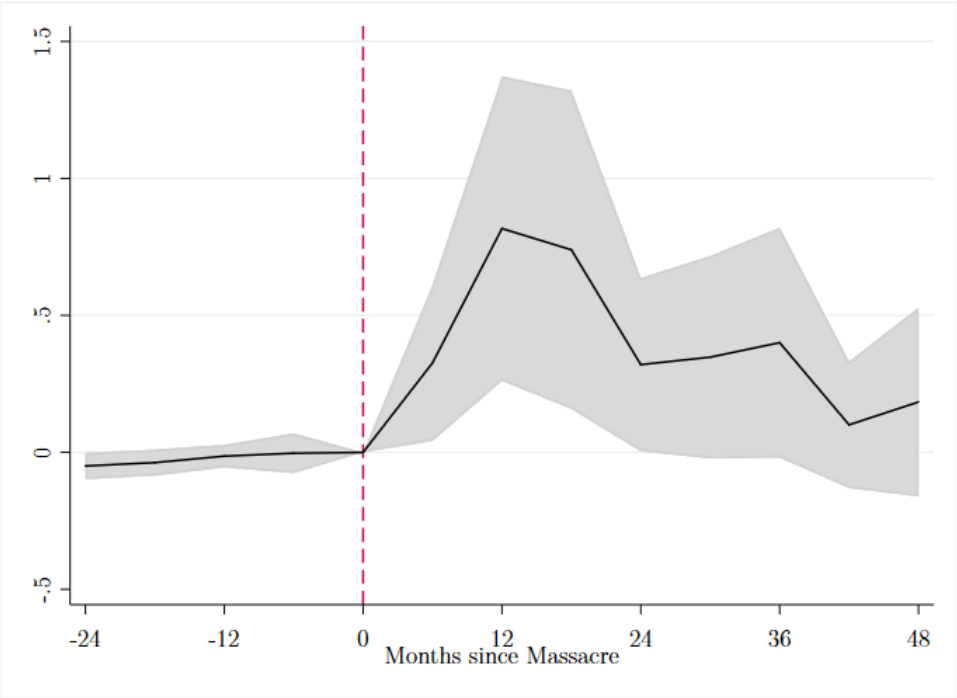
Beyond the time series, a difference-in-differences analysis confirms the refugees caused the increase in requests. The best indicator of where refugees settled are the camps the government established. The treatment group in the difference-in-differences analysis is districts that are close to a refugee camp (i.e., within 20 km; see the appendix for a sensitivity check). The data are condensed into six-month periods, and the following regression estimated:

$$\sinh^{-1}(Req_{it}) = \delta_i + \beta_t D_{it} + \varepsilon_{it} \tag{8}$$

where $Req_{it}$ is the number of requests per 1,000 inhabitants in commune $i$ in the six-month period $t$, $\delta_i$ is a commune fixed effect, and $\delta_t$ is a period fixed effect. The $D_{it}$ is an interaction between treatment status (district is within 20 km of a refugee camp) and the six-month period $t$; hence, the $\beta_t$ are the difference in requests between treatment and control districts in period $t$. The coefficients are estimated for each period before and after the massacre to test for pre-treatment trends. Because in many years $Req_{it}$ equals 0, the dependent variable is transformed using the inverse hyperbolic sine, which is similar to the logarithmic transformation but evaluated at zero (Burbidge et al. 1988). To eliminate concerns about the confounding effects of World War II and its related policy changes (which are explored in Palsson (2019)) , the data are limited to requests made between 1935 and 1942.To account for serial correlation, standard errors are clustered at the commune level.

Figure 5 plots the $\beta_t$ and their confidence intervals (coefficients and standard errors are reported in column 2 of Table A2, along with a check on how sensitive results are to the 20 km radius). During the two years before the massacre, treatment districts (i.e. districts within 20 km of a refugee camp) showed no difference in land requests relative to the control districts. But in the six months immediately following the massacre, land requests in treatment districts increased sharply. In every six month period after the massacre, treatment districts had more land requests than the control districts. The pattern follows what we would expect. The first six months saw an increase in requests, but the commotion of the massacre actually stopped all requests throughout the country in the first three months, so all of the measured effect is coming from just three months

Figure 5: The Trujillo Massacre's effect on land requests for districts within 20 km of a refugee camp




Notes: Point estimates are the $\beta_t$ from the Equation 1. The omitted group is districts greater than 20 km from a refugee camp. Standard errors are clustered at the district level. Coefficients and standard errors are reported in column 2 of Table A2.

Table 5: Total hectares adopted under each farm type after the massacre, 1938-1942

| Land Category | Hectares |
|---|---|
| Land adopted after the massacre from 1938-1942: | 3,841 |
| Land adopted under small-scale farms (<5ha) $\Delta T_C$ | 2,888 |
| Land adopted under large-scale farms (>50ha)$\Delta T_X$ | 953 |
| Ratio of large-scale to small-scale $\Delta T_X/\Delta T_C$ | 0.33 |

Notes: Large-scale is defined as greater than or equal to 50 hectares; small-scale is less than or equal to 5 hectares.

(January–March 1938). The gap peaked during the next six months (April–October 1938) when the government gained more control over the situation. The evidence in Figure 5 clearly shows the refugees' effect on land requests.

Having established that the refugees increased land adoption, we can now examine Implication 5, which says in response to the massacre, absent transaction costs, farmers should adopt at least as much plantation land as subsistence. In the terms defined in the model, $\Delta T_X/\Delta T_C > 1$. But if farmers face large transaction costs to adopting plantation land, they will adopt more *small* plots. Table 5 shows how much land farmers adopted under large-scale plots (50 ha or more, $\Delta T_X$) and small-scale plots (5 ha or less, $\Delta T_C$) after the massacre until 1942. Throughout the country, farmers adopted 3,800 hectares, but only one quarter of that land went to farms larger than 50 hectares ($\Delta T_X/\Delta T_C = 0.33$). The figures are significantly below what we expect given the differences in productivity between the two farm sizes and suggest significant transaction costs to creating large plantations.

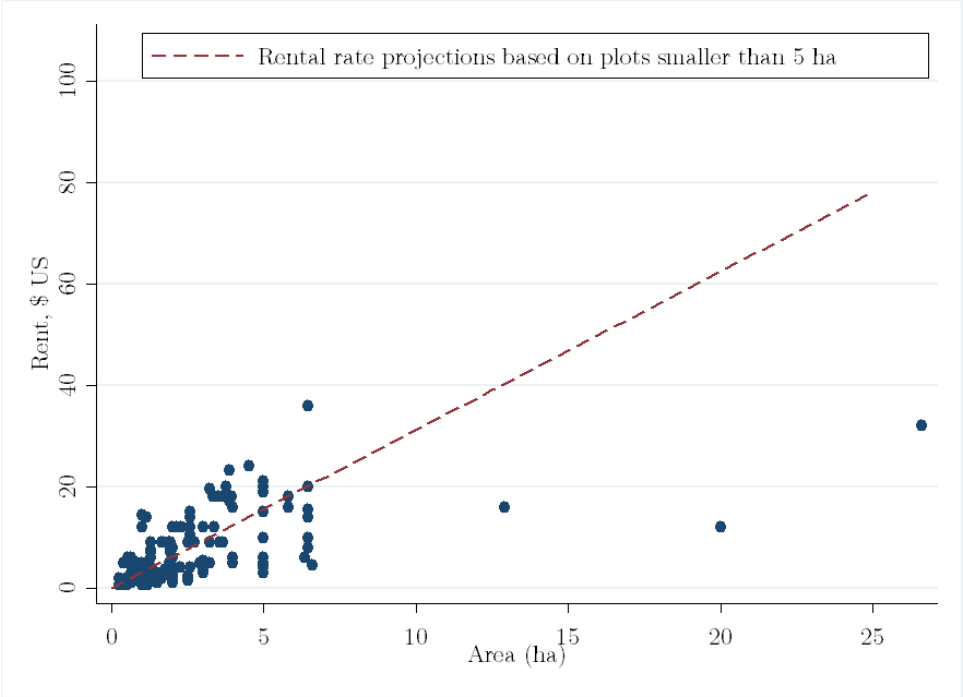
# 6 Addressing Alternative Explanations

The evidence presented throughout the paper disputes common explanations for Haiti's small farms and strengthens the case for transaction costs. In this section, I address three other explanations: market power, land quality, and capital constraints.

## 6.1 Market Power

An alternative explanation for this farmer behavior is the government's market power. In the small-farm market, the government does not have market power because everyone has at least some land. For large farms, however, the government owns so much land that it could have a monopoly over plantation-sized tracts. In that case, it might exercise its monopoly power and restrict the supply of plantation land to extract rents.

Figure 6: Prices and plot sizes from a sample of land appraisals, 1928-1950




Notes: The data come from rent payment accounts from local archives in Acul du Nord, Grande Riviere, and Dondon. To be included in the sample, the account had to list the property's original appraisal value and year, and the appraisal had to occur between 1928 and 1950 (N=346). The dashed line takes the per-hectare rental rates for properties 5 hectares or less and extrapolates them to the rest of the sample.

Testing the market power hypothesis requires data on the rental rates for these plots. For 346 plots adopted from 1928 to 1950, I know the original rental rate and size.[23] Figure 6 plots rent against plot size with a line showing predicted rents for large plots (greater than 10 hectares) based on the rates for small plots (5 hectares or smaller). Applying the small plot rental rates (US$3.12 per hectare)[24] to the plots over 10 hectares significantly overestimates rental rates on large plots. The government could not have received any rents from these large plots. In fact, if the law had not forbidden it, the rents would go to the tenant who rented the large plot from the state then leased sections of it to other tenants. The rental rates do not support the market power hypothesis.

### 6.2 Land Quality

The rental rates do raise another explanation: low rates on large plots might reflect low quality land. Though data on soil quality in the early 1900s are unavailable, evidence from witnesses, history, and smallholder choices shows the land was good. Contemporaries struggled to understand why so much "fertile" land sat idle (HBRF, 1932, p 28 ), even in areas sending workers abroad (Casey 2012 p. 86). Historically, the land proved its quality by supplying half of the world's coffee and sugar. During the Haitian Revolution at the end of the 18th century, the government acquired the plantation lands (Trouillot 1990, Millspaugh 1929), and by the 20th century any depletion from colonial overproduction had been remedied by 100 years of sitting fallow (HBRF, 1927, p 137; see also Millspaugh 1929). The land was so good that small farmers chose to cultivate it when they could. In the early 1920s the government allowed farmers to exchange their privately-owned land for state-owned land, and the program was so popular that the government had to end it because of the adverse selection problems (Renaud 1934 p. 228; HBRF, 1940, p 121).

Furthermore, quality is endogenous, and farmers on larger plots have greater incentives to improve the land (Libecap and Hansen 2004). Even if there was an immutable quality gap, this argument strengthens the transaction cost hypothesis because it means households occupied the best land, making forming a plantation on good land even more costly.

### 6.3 Capital constraints

The final alternative explanation for the farmer behavior is capital constraints. Large farms require more capital, which could especially cause problems after the massacre in the late 1930s because the Depression made capital harder to obtain. But capital constraints alone is an insufficient explanation. First, Haiti's agricultural machinery imports had recovered to their pre-Depression levels by 1934. Second, even if a Haitian farmer would struggle to acquire capital, in the 1930s the capital-rich Standard Fruit and Steamship Company sought land for a banana plantation but failed because of the abundance of small-holders (Lundahl 1979 p. 286). Finally, if capital constraints were the only problem, then we would have observed more investors establishing plantations during

[23] These prices come from local tax archives in three districts in the *Departement du Nord*: Acul du Nord, Grande Riviere, and Dondon.

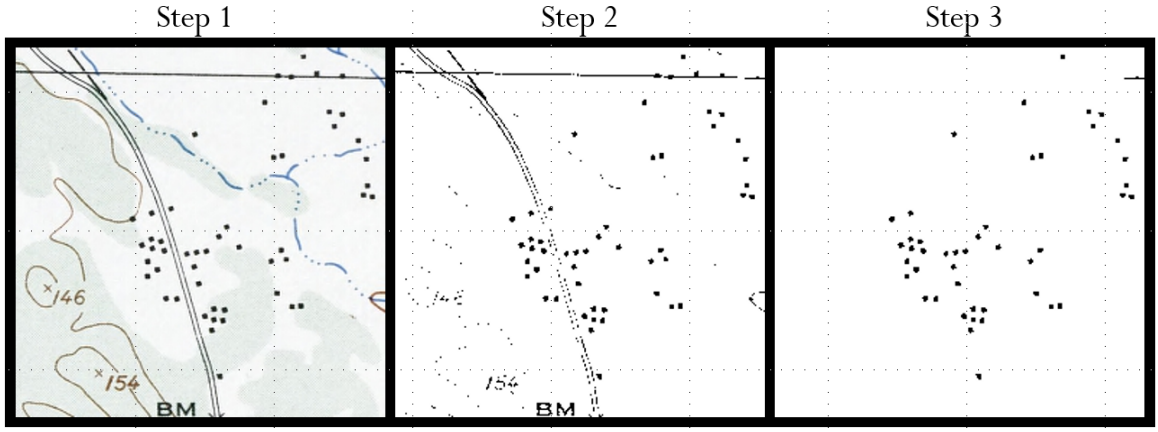
[24] The exchange rate was 1 US$ for 5 Haitain gourdes.

the 1920s. Even with the capital available then, farmers could not setup large farms because of the smallholders. Capital constraints complement the transaction cost story but cannot replace it.

# 7 Conclusion

Haiti teaches that property rights policy in developing countries best assists development when it balances the security of property rights with making them elastic to changes in economic conditions. A large part of Haiti's poverty comes from its agricultural structure, a result of institutions implemented after independence in 1804. Haitian farmers could not transition to large-scale agriculture themselves because property rights were too secure: no one abrogated their rights, but they also could not easily sell their property because family members could veto the transfer. Comparing Haiti's history to other Caribbean countries shows that the land institutions indeed played a large role in Haiti's underdevelopment. A titling program that gives all rightsholders a legal title to the land would not resolve this problem because too many people would still hold legal claim. The government would have to consolidate rights under single holders who possess all usufructuary and alienation rights, but doing so would entail expropriating rights from whole lineages and redistributing wealth to an extent beyond the capacity of most developing countries. A government with greater power to reallocate land to more productive uses could have helped the country capture profits from the sugar industry.

Figure A1: Example of a simulated plantation going through the image processing algorithm




Notes: Step 1 shows a simulated plantation in the Artibonite department extracted from 1956 U.S. Army Inter-American Geodetic Survey. The simulated plantation is 256x256 pixels, or roughly 100 hectares. Each dot on the plantation represents a building, usually huts. In Step 2, the algorithm converts the image to black and white to remove extraneous details, such as the water. In Step 3, the algorithm finds all groups of black pixels that match the criteria for a house, as described in the text. The algorithm counts all groups black pixels in the Step 3 image and concludes there are 45 buildings on this simulated plantation.

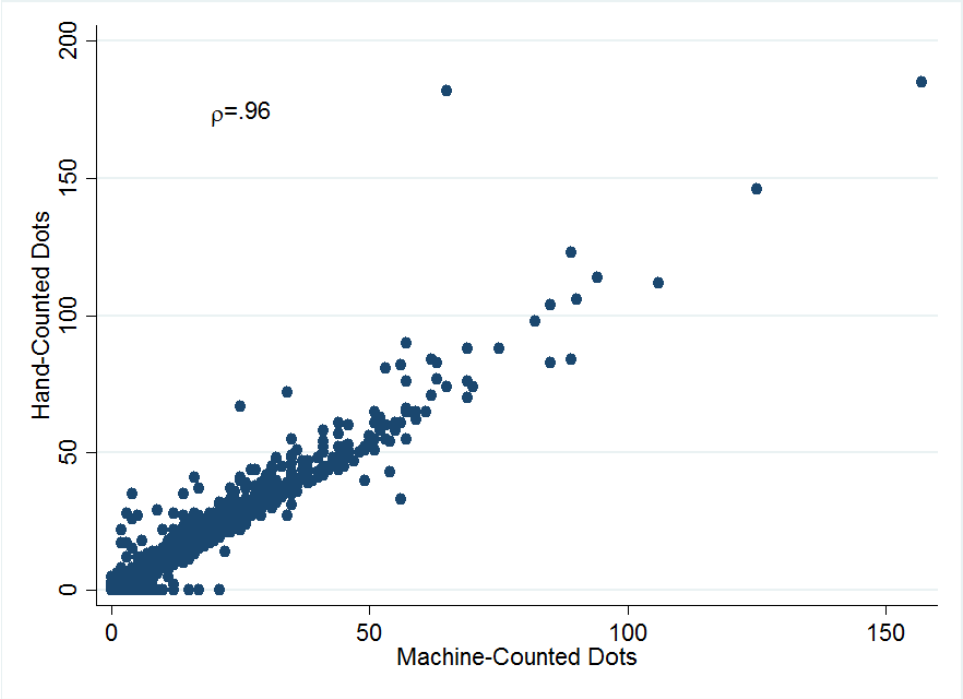
# 8 Appendix

## 8.1 Image Processing Algorithm

The image processing algorithm takes three steps, represented in Figure A1. First, the algorithm extracts the simulated plantation from the map created by the 1956 U.S. Army Inter-American Geodetic Survey. Next, the algorithm converts the colored image to black and white, which erases many of the irrelevant features such as contour lines or shading. Finally, the algorithm tags all groups of connected black pixels. The algorithm locates a black pixel, then checks each neighbor to the north, east, south, and west to see if it is also black. Adjacent black pixels are labeled connected, and a group is a set of pixels such that every pixel is connected to at least one other pixel in the set. The algorithm identifies all groups, then it classifies a group as a house (i.e. an agricultural plot) if it meets two criteria: (1) the group contains between 8 and 24 pixels inclusive and (2) the farthest distance between any two pixels in the group is less than or equal to 5 pixels. The first criterion comes from the observation that the house markers were typically 3x3 to 5x5 pixels. The second eliminates groups that fit the first criterion but are too diffuse to be a house marker; i.e. a road that is 20 pixels long.

The algorithm does not perfectly identify dots in every image. Comparing Step 1 and Step 3 in Figure A1, we can see in the north-east corner of the plantation the algorithm missed four dots where the pixels touched the latitude line. On the other hand, in the same region of the image, the algorithm counted the intersection of the same line with the river as a dot. To check

Figure A2: Comparing machine-counted dots to hand-counted dots




Notes: Each dot represents a simulated plantation (N=1,629). The x-axis represents the number of dots that the image processing algorithm counted on the simulated plantation. The y-axis represents the number of households that a research assistant counted. The Pearson correlation coefficient between the two counts is 0.96.

the algorithm's accuracy, 1,629 images were selected for both hand-counting and the algorithm. Figure A2 shows the relationship between the hand-counted and machine-counted tallies, and the correlation coefficient between the two counts is 0.96.

### 8.2 Proof of Implication 3

If $\phi_2 > \bar{\phi}_2 = (p_X A_{iX} - 1)\phi_1$, then

$$\begin{aligned} p_X A_X f_T(T_{iX}, L_{iX}) &= \phi_1 + \phi_{i2} \\ &> \phi_1 + (p_X A_{iX} - 1)\phi_1 \\ &= p_X A_{iX} \phi_1 \\ &= p_X A_{iX} f_T(T_{iC}, L_{iC}) \\ \implies f_T(T_{iX}, L_{iX}) &> f_T(T_{iC}, L_{iC}). \end{aligned}$$

From the profit maximizing condition for labor (2) we know that

$$f_L(T_{iX}, L_{iX}) < f_L(T_{iC}, L_{iC}). \tag{9}$$

For both of these conditions to hold, it must be that $T_{iX} < T_{iC}$ and $L_{iX} \leq L_{iC}$.

### 8.3 Land Rental Data - Sources

Table 8.3 lists the issues of *Le Moniteur* from which the land rental data were collected.

### 8.4 Refugee Settlement Radius

The difference-in-differences analysis in Section 5 assigns treatment status to all districts within 20 km of a refugee camp. Unfortunately, there are no records on where the refugees ultimately settled, but research by Derby and Turits (1993) shows that many of the refugees' descendants can still be found near the original refugee camps. Because the 20 km radius can seem arbitrary, in this section I test the sensitivity of the results to different radius specifications.

Table A2 reports the coefficients under the sensitivity tests. Each column indicates the radius used for assigning treatment. Under all radius specifications, there are no pre-treatment trends that confound the analysis. The general pattern across specifications is that as the radius expands, the magnitude of the coefficients decreases. This is as expected since expanding the radius assigns treatment status to districts that were unlikely to have refugees. The results for the 10 km radius and 20 km radius are similar, but there is a large drop in magnitude from 20 km to 30 km.

Table A1: Year and issue numbers of *Le Moniteur* that provided data on rental plots

| Year | Issue Numbers |
|---|---|
| 1929 | 24; 55; 82 |
| 1930 | 55; 105 |
| 1931 | 3; 38; 64; 84; 105 |
| 1932 | 30; 59; 88; 104 |
| 1933 | 27; 62; 64; 100 |
| 1934 | N/A |
| 1935 | 2; 18; 38; 73; 102 |
| 1936 | 19; 56; 84 |
| 1937 | 14; 45; 73; 102 |
| 1938 | 9; 51; 68; 90; 104 |
| 1939 | 9; 30; 50; 81 |
| 1940 | 10; 50; 76; 79 |
| 1941 | 3; 41; 70; 94; 108 |
| 1942 | 10; 30; 40; 70; 100 |
| 1943 | 26; 60; 85; 97 |
| 1944 | 12; 53; 72; 90; 95; 103 |
| 1945 | 28; 29; 41; 49; 55; 72; 80; 84; 106 |
| 1946 | 13; 17; 46; 62; 64; 65; 99; 124; 125 |
| 1947 | 10; 11; 12; 56; 63; 103; 115 |
| 1948 | 23; 43; 100 |
| 1949 | 23; 43; 71; 103 |
| 1950 | 1; 7; 32; 79; 83; 106; 148 |

Notes: The 1934 Moniteur was presented in a single volume without issue numbers.

Table A2: Refugee effect on district land requests under different treatment specifications

| | 10 km | 20 km | 30 km | 40 km | 50 km |
|---|---|---|---|---|---|
| **Pre-Treatment** | | | | | |
| April 1935–Sep 1935 | -0.0693** | -0.0497** | -0.0529** | -0.0308 | -0.0164 |
| | [0.0329] | [0.0246] | [0.0236] | [0.0218] | [0.0211] |
| Oct 1935–Mar 1936 | -0.0521 | -0.0375 | -0.0354 | -0.0062 | -0.00274 |
| | [0.0335] | [0.0244] | [0.0254] | [0.0262] | [0.0229] |
| April 1936–Sep 1936 | -0.0258 | -0.0138 | -0.0238 | -0.0143 | -0.00766 |
| | [0.0318] | [0.0212] | [0.0173] | [0.0137] | [0.0115] |
| Oct 1936–Mar 1937 | -0.00266 | -0.00323 | -0.0103 | -0.00484 | -0.00449 |
| | [0.0578] | [0.0371] | [0.0270] | [0.0210] | [0.0171] |
| **Post-Treatment** | | | | | |
| Oct 1937–Mar 1938 | 0.476** | 0.327** | 0.193* | 0.141* | 0.111* |
| | [0.201] | [0.145] | [0.105] | [0.0805] | [0.0632] |
| April 1938–Sep 1938 | 0.902** | 0.817*** | 0.515** | 0.398** | 0.343** |
| | [0.349] | [0.284] | [0.212] | [0.165] | [0.133] |
| Oct 1938–Mar 1939 | 0.801** | 0.739** | 0.570*** | 0.411** | 0.311** |
| | [0.364] | [0.297] | [0.209] | [0.166] | [0.133] |
| April 1939–Sep 1939 | 0.231*** | 0.320* | 0.191* | 0.136 | 0.0887 |
| | [0.0856] | [0.161] | [0.115] | [0.0888] | [0.0716] |
| Oct 1939–Mar 1940 | 0.257 | 0.347* | 0.245* | 0.171* | 0.127 |
| | [0.184] | [0.189] | [0.130] | [0.100] | [0.0796] |
| April 1940–Sep 1940 | 0.329 | 0.400* | 0.237 | 0.151 | 0.092 |
| | [0.204] | [0.214] | [0.152] | [0.119] | [0.0970] |
| Oct 1940–Mar 1941 | 0.00276 | 0.101 | 0.103 | 0.0569 | 0.033 |
| | [0.0634] | [0.118] | [0.0966] | [0.0771] | [0.0657] |
| April 1941–Sep 1941 | 0.00569 | 0.184 | 0.164 | 0.115 | 0.0992 |
| | [0.0559] | [0.176] | [0.123] | [0.0936] | [0.0737] |
| N | 1,170 | 1,170 | 1,170 | 1,170 | 1,170 |
| $R^2$ | 0.527 | 0.543 | 0.507 | 0.478 | 0.465 |

Notes: Requests from April 1937 to September 1937 are omitted as the control group.

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