

Universidad de Puerto Rico  
Recinto de Río Piedras  
Facultad de Ciencias Sociales  
Departamento de Economía

**Regional Growth Effects of Early 20th Century Agricultural Expansion in Puerto Rico: An Instrumental Variable Approach**

Tesis presentada como requisito para el grado de Maestría en Economía

Fabián Rivera Reyes  
Abril, 2022



Derechos Reservados

## Table of Contents

<b>Introduction</b>	<b>3</b>
<b>Literature Review</b>	<b>13</b>
Institutions in Global Development Conversations . . . . .	15
<b>A Brief Historical Overview</b>	<b>21</b>
Modern Colonies and the Study of Extractive Industries on Development .	21
The Geography of Puerto Rico as Key to Understanding its Institutions . .	22
Vague Institutions in a Modernizing Colony . . . . .	23
The case for the Extractiveness Descriptor: Sugar Industry Expansion in Puerto Rico . . . . .	24
<b>Data</b>	<b>28</b>
<b>Methodology</b>	<b>34</b>
Identification of Industry . . . . .	35
The IV Strategy . . . . .	36
A Closer Look at the Instrument . . . . .	39
<b>Results</b>	<b>41</b>
<b>Conclusion</b>	<b>50</b>
<b>References</b>	<b>54</b>
<b>Appendix</b>	<b>59</b>

## Figures

1	Population Change from 1899 to 1930 . . . . .	31
2	Changes in County Subdivisions from 1899 to 1930 . . . . .	32
3	Good Soil for Sugar Production? . . . . .	33
4	Population Change as a Proxy for Sugar Production . . . . .	34
5	Fertility Data Overview . . . . .	38
6	Sugar Industry and Lower House Values . . . . .	43
7	Interaction Specification Marginal Effects from Sugar Value Production	43
8	Sugar Industry and Lower House Values . . . . .	46
9	Sugar Industry and Lower House Values, including FE's . . . . .	47
10	Sugar Industry and Lower House Values, Extended . . . . .	60
11	Sugar Industry and Upper House Values, Extended . . . . .	61

Tables

1	Municipalities by Sugar Value Production and Good Soil for Sugar . .	29
2	Predicting Population Changes from 1899 to 1930 using Soil Fertility	40
3	Interaction Regression Results: House Values . . . . .	42
4	IV Results: House Values . . . . .	45
5	Municipalities with most acres dedicated to sugar and sugar value pro- duction per acre . . . . .	59

## DEFENSA DE TESIS

Certificamos que el estudiante **Fabián Rivera Reyes** aprobó su Defensa de Tesis. Con la defensa de la tesis, el estudiante cumple con los requisitos del grado de Maestría con concentración en Economía. El título de la tesis es:

***“Regional Growth Effects of Early 20th Century Agricultural Expansion in Puerto Rico: An Instrumental Variable Approach”***

Certificado hoy viernes, 1 de abril de 2022; en Río Piedras, Puerto Rico.

---

Carlos Rodríguez Ramos, Ph.D.  
Consejero

---

Argeo T. Quiñones Pérez, M.A.  
Lector

---

Juan A. Lara Fontáñez, Ph.D.  
Lector

## Abstract

This thesis provides an empirical exploration of regional path divergence within Puerto Rico as related to the expansion of sugar-related economic activity from 1899 to 1930, the period of highest volume of sugar production at highest intensity. By using contemporary soil data, I am able to relate soil suitability for sugar production to population changes taking place early 20th century in each County Subdivision. I interpret soil suitability to be a valid instrument at a time of a critical institutional juncture and find that sugar industry expansion from 1899 to 1930 reduces County Subdivision house values in the present. Specifically, I estimate that for every sugar related population percentage increase from 1899 to 1930, the median house value for a County Subdivision decreased by \$384. This can prove quite significant for the 83 County Subdivisions that experienced population percent change increases of 100% or more from 1899 to 1930. In addition, I include an interaction term analysis that provides further evidence of this statistical relationship between municipality sugar production value in 1929, County Subdivision demographic change, and future house values in County Subdivisions. Using the available historiography to interpret the empirical results, this thesis provides a significant amount of evidence to support the hypothesis that sugar industry expansion in Puerto Rico had long term negative effects on local asset markets, increasing wealth inequality in Puerto Rico.



Regional Growth Effects of Early 20th Century Agricultural  
Expansion in Puerto Rico: An Instrumental Variable  
Approach



## Acknowledgements

I would like to thank my advisor Carlos Rodríguez for his unwavering support and meaningful recommendations throughout this project. I would also like to thank professors Juan Lara and Argeo Quiñones whose comments and questions as members of the thesis committee undoubtedly improved the thesis from its initial proposal stages. This is, in many ways, a family project. I must express deep gratitude for all family members who have supported me in a wide variety of ways including but not limited to supporting healthy study breaks, listening to my ideas, and encouraging my academic trajectory. I feel deeply indebted to you all. I hope you find our endeavor worthwhile.

## Introduction

The American Community Survey 5 year sample taken from 2014 to 2018 places Puerto Rico's persons in poverty rate at 44.5% (U.S. Census Bureau (2014–2018)). The highest percentage of U.S. citizens in poverty for any state of the United States during the same time period is Mississippi with a rate of 20.8%. For context, Puerto Rico had a population then of 3,386,941. Mississippi had a population of 2,988,762.

Amidst a prolonged recession, Puerto Rico's economic difficulties are currently exacerbated by its government debt crisis. Attempts by the Puerto Rican government to facilitate a bankruptcy procedure were declared unconstitutional by the U.S. Supreme Court<sup>1</sup>. Shortly thereafter, the United States Congress passed the PROMESA Act, which established a federally appointed Oversight Board that would mediate discussions between the Puerto Rican government and its debt-holders while maintaining full plenary powers over Puerto Rico's budget. Since the establishment of the Oversight Board, an austerity regime with considerably less democratic characteristics has ensued<sup>2</sup>. School closures and budget reductions to public services and the University of Puerto Rico have exponentially augmented the economic crisis on the island. Yet, Puerto Rico is no stranger to discussions that highlight unsustainable growth and high poverty rates. Field Marshall Alejandro O'Reilly conducted one of the first economic overviews on the island in 1765 and claimed that the people of Puerto Rico were among the "poorest that there are in

---

<sup>1</sup> In June 28, 2014, the Puerto Rican government passed a regional government law, known colloquially as "La Quiebra Criolla", that would allow public corporations to restructure their debt through a bankruptcy process. Puerto Rico is specifically excluded from Chapter 9 of the Federal bankruptcy code, which addresses local government insolvency.

<sup>2</sup> The Center for a New Economy, Puerto Rico's leading economics think tank, refers to PROMESA as a failed colonial experiment and details the ways in which authoritarian tendencies made their way into the legislation and voting seats in the Board. In addition, the report concludes that PROMESA has failed to deliver stability, fiscal responsibility, or economic development. (Deepal Lamba-Nieves and Torres (2021))

America” (Dietz (1985), O’Reilly (1765)). Even then, the Puerto Rican government’s lack of tax revenues for sustainable operation forced it to rely on a periodical payment from Mexico known as the Situado (Dietz (1985); O’Reilly (1765)).

The current historical moment of transformative institutional overhaul requires an acknowledgement of the persistence of unfavorable economic characteristics throughout Puerto Rico’s history. This thesis explores the degrees to which material resources have affected the geographical distribution of development on the main island of the Puerto Rican archipelago. To do so, I tie the case of Puerto Rico to a discussion that touches upon the economic research on institutions and the impact on geographic disparities at an international scale. Regional disparities could shed significant light on the role institutions have played in Puerto Rico’s development and enable a much needed discussion on the different patterns of development within Puerto Rico. I find evidence that there exists institutional persistence related to the sugar industry that depresses property values, a notion that is well in step with the literature of institutions but had received no particular attention in examining the geographic distribution of wealth in Puerto Rico.

A quick overview of Puerto Rico’s economic characteristics suggests that resources, particularly land and human capital, are inefficiently employed. A New York Federal Reserve Report on Puerto Rico’s Competitiveness (2012) and its subsequent Update (2014) highlight low labor force participation, especially among young adults, a large informal economy, and out-migration caused by poor labor market opportunities as three of the main obstacles for sustained growth. High costs for businesses in the form of energy costs, transportation costs, and regulatory burdens are cited as key factors that depress growth. Such high costs for firm establishment in a region where the median household income is \$20,166 (in 2018 dollars) (U.S. Census Bureau (2014–2018)) could explain the apparent mismatch

between labor supply and existing employment opportunities. Growth can hardly be sustained by local firms and preferences under such an environment, especially given Puerto Rico's low savings rates. Low income levels are not offset by lower regional costs of living or higher wealth levels. Although different methodologies for calculating Consumer Price Indices between the Puerto Rican government and the Bureau of Labor Statistics complicate comparisons, the differences in residential electricity rates could shed light on the matter. According to the U.S. Energy Information Administration, Puerto Rico's residential electricity rates were 23.24 cents/kWh in May 2020 (Administration (n.d.-b)) while Mississippi's residential electricity rate was 11.21 cents/kWh in June 2020 (Administration (n.d.-a)).

The net outmigration that dominated the start of the 20th century, and strengthened after Hurricane María's arrival on the island, evidences the tension between unemployed, young human capital and high living costs. This dynamic poses a significant structural trend that will impose long term costs on Puerto Rico's economy. The increasing integration of Puerto Rico's economy with that of the United States has witnessed the opposite of convergence and, at the turn of the 20th century, Puerto Rico fell into a deep recession, where it is still today. The Federal Reserve's Competitiveness Report (2012) emphasizes that austerity measures have the potential to further undercut Puerto Rican economic growth if budget reductions take place at the expense of human capital, a sentiment echoed frequently by Nobel prize winner Joseph Stiglitz (Stiglitz and Guzman (2017)).

Throughout the history of Puerto Rico, administrative attempts to assuage its trajectory of economic poverty and inequality have repeatedly turned towards planned economic development as the preferred antidote (Perloff (1950)). These arguably well-intentioned but paternalistic policies have ignored the ways colonial institutions have hampered the possibility of a free, autonomous, and fair exchange of goods and services. Furthermore, the link between institutionally imposed firm

costs and the historical role of government in promoting specific industries, as was the case with the sugar industry expansion from 1899 to 1930's and Operation Bootstrap<sup>3</sup>, points towards a link that centers market distortions on behalf of institutions in Puerto Rico that has systemically produced a mismatch in key factor markets.

Economists refer to dependent growth as a phenomenon in which governments assume the active posture of subsidizing and legislating in favor of industry through foreign investment as the main development strategy while relying on key foreign transfers and outmigration to alleviate growing poverty and inequality (Villamil (1979)). In such cases, periods of high economic growth as measured by output can shadow the susceptibility of economies tied to highly specialized industries at a particular point in time and reliant on a set of foreign investors. Puerto Rican economists such as Villamil (1979) have long argued that current levels of outmigration, inequality, and low output have been a result of the planned economic development Puerto Rico has undergone. Drawing from an institutionalist perspective, Villamil (1979) compiles a bibliography of authors, namely Tavares (1972), Cardoso and Magnani (1974), Furtado (1969), Furtado and Girvan (1973), and Sunkel and Girvan (1973), who observe that Puerto Rico's strategy for growth in the XXth century was not the neoclassical success story that had originally been portrayed. A key observation arose. The capitalist sector needed to be distinguished from national economic growth, as the former could grow independently, perhaps to the detriment, of the latter. Hidden by general figures of output in a region, this disparity between national growth and specific companies using the land but incentivized to expatriate profits elsewhere could overstate the

---

<sup>3</sup> Operation Bootstrap was an official government policy by which the Puerto Rican government sought to develop a manufacturing industry by bolstering Puerto Rico's international competitiveness. A notable policy was government financing of land and capital that was rented long-term to foreign manufacturers as incentive. This project initially also conceived of land redistribution, but in practice the redistribution that took place was very limited.

welfare benefits of a rising Gross Domestic Product measure.

Recent economic research emphasizes the persistent effects of extractive or colonial institutions on contemporary economic outcomes (Dell (2010), Acemoglu, Johnson, and Robinson (2001)). The rise of the sugar industry that took place in XXth century Puerto Rico, which is documented to have largely monopolized land-use, could continue to have a persistent effect on modern day economic development. Nunn (2008), Glaeser and Shleifer (2002), Acemoglu et al. (2001), Acemoglu, Johnson, and Robinson (2002), and Hall and Jones (1999) are among those who have explained contemporary economic outcomes using regional historical characteristics.

Acemoglu et al. (2001) have used surveys that assess risk of government expropriation as a proxy for the extractiveness of local institutions. Yet, addressing this question appropriately requires acknowledging both private and public institutions as extractive or inclusive. In the transition towards a legal framework that acknowledged private property, private and public agents alike conspired to take ownership over land that had been occupied by others throughout the history of Puerto Rico. A significant hallmark of Puerto Rico's political extractive institutions wrested in the vagueness of the protections offered to its population. For example, in its transition from a feudal land-use system to a more modern social order, where private property was recognized and protected as separate from that of the Spanish Crown, the elites from Puerto Rico and other colonies took advantage of the Royal Decree of 1778 and the Cédula de Gracias in 1815 to systematically dispossess small farmers that had been living on their land for generations (Dietz, 1986; Scarano, 1984). The historical evidence shows that the vagueness in institutional protections of civil rights played a large role in the expansion of the sugar industry in its initial large expansion period from 1800 to 1850 and the largest expansion period from 1900 to 1930. Undue influence and corrupt relationships

between the sugar industry and the colonial government in Puerto Rico characterized the colonial status under the control of both Spain and the United States for a majority of these periods in time (Scarano (1984); Ayala and Bernabe (2016)). Companies and private investors can also have tendencies of expropriation. The case of Puerto Rico emphasizes how a political framework of a colonial regime allowed political agents and dominant industries of the time to extract rent from the Puerto Rican people. In circumstances of vague public protections for individuals and their rights, I interpret industry technology and production processes as the most credible lower boundary for worker exploitation. Industrial organization therefore emerges as a source for institutional extractivism just as relevant as the protection against government expropriation of the individual sphere, frequently conceptualized within the scope of private property.

The totality of geographic space on Puerto Rico has been shaped by colonial institutions. There is no real counterfactual to the central question of Puerto Rican development in a colonial regime compared to the condition of autonomous exchange. This is especially true given the dependent relationship of development patterns when strongly tied by geographic closeness. Puerto Rico is an island with a relatively high population density of 1,088.2 per square mile in an area 3,423.8 square miles (U.S. Census Bureau (2010)). Divergent paths should be conceptualized along the lines of dual economies, where the paths themselves are not independent of each other and require the other to exist. As transportation across the island became more affordable, the proximity between the far ends of Puerto Rico shrank. People were more readily able to travel to different regions of the island to work. I believe we can safely hold the research prior that as transportation across the island became more commonplace, demands for local public goods across the board was lessened by the possibility of substitution through travel. If the schools in the mountains of Puerto Rico were of a lesser

quality, parents could choose to take their children to private schools in the Metropolitan area. Similarly, if medical services in small towns of the West were lacking, individuals could visit larger hospitals in locations such as Mayaguez.

Yet, if there is a difference in institutional quality caused by the inheritance of certain historical characteristics, this pattern would be most apparent in the value of property. While decreasing transportation costs may make new resources available for people, the local dimension of house values reminds us that asset markets are valuable descriptors of development in different regions. This thesis's central finding sustains the notion that there is no long term human capital relationship geographically tied to historical characteristics, but there exists a wealth related inheritance, which confirms the idea that wealth can be interpreted as the best marker of historical circumstance. This idea of wealth as a good current estimator of historical effects has been mentioned by Darity Jr. and Darrick Hamilton in the stratification economics literature (Darity Jr, Hamilton, and Stewart (2015)).

To buttress my instrumental variable approach, I adopt a theoretical framework that incorporates aspects from structuralist and institutionalist schools of thought, both of which have been particularly prevalent in research into Latin America's economic development. Wedded from the seminal works of Veblen in North American institutionalist thought and Raúl Prebisch's assessment of Latin American economic differences with the rest of the world, this paper interprets regional economic development in Puerto Rico to be an evolutionary process, as opposed to an equilibrating mechanism of stable economic relations (Street and James (1982)). By emphasizing the expansion of the sugar industry in Puerto Rico, sugar industry technology and its material incentives incorporate surrounding land, as evidenced by the historiography, assume a primary role in potentially explaining disparate regional development dynamics.



Using an instrumental variable approach, I capture sugar industry expansion from the XXth century and conclude that institutions embedded in industry had long term effects on regional development levels in Puerto Rico. My instrument is the proportion of soils to general area that were characterized in the 1942 Puerto Rico Soil Survey as good for sugar production. The National Soil Survey from the United States Department of Agriculture National Resources Conservation Service has maintained a consistent naming system and I am therefore able to identify the soils most suitable for sugar production. Demographic changes from 1899 to 1930 proxy for economic development in a given region. Given that this period in time hosted the exponential rise of the sugar industry, as well as the decay of the coffee industry, I interpret soil-driven population changes as evidence of the sugar industry's increasing presence in the County Subdivision. Further evidence for this assumption is provided in the Data section. Since the demographic shifts take place during a critical juncture, namely the beginning of the United States occupation of Puerto Rico, the industry-induced demographic shifts that took place can be plausibly perceived as exogenous when controlling for previous colonial institutions. I control for previous methods of social organization by using the population levels at 1899.

When the sugar industry expansion of the XXth century took place, it did so in the context of an outdated production process. Puerto Rican sugar at the time was primarily processed in small sugar mills across the island, fertilizer use was rare, and land was cultivated at low levels of intensity compared to Cuba (Ayala and Bergad (2020)). The introduction of Puerto Rican sugar industry into new U.S. markets and the near immediate U.S. investment in sugar industry capital on the island, led to a rapid process of capital renewal that had marked effects on output, land cultivation, and industrial organization. Thus, this process of expansion was associated with a wave of capital endowment that very well could have spurred

growth and have been repurposed after the decline of the Puerto Rican agrarian economy. This would be a result similar to that of Dell and Olken (2020), who find that the Dutch Java cultivation system had a positive effect on education and infrastructure levels. These regions in Java do not just have higher levels of educated individuals but they also have more schools, yielding the possibility that the initial endowment of capital increased the availability of opportunities linked to education and industry. Yet, Dell (2010) also finds that when colonial industry coincided with ill-defined property rights, there is a negative effect on public goods and human capital, as exemplified by the mining mitas in Peru.

Throughout the course of this investigation, I find that there are negative effects on house values in an environment of poorly protected property rights. Specifically, there is a systematic devaluation of home value associated with the historical inheritance of sugar-related economic activity. I also investigated the possibility of human capital effects in the realm of education and poverty. I have found none to date. This lack of a finding, I believe, is also a finding in and of itself, as decreasing transportation costs across such a small but densely populated island would make additional resources increasingly available to those that travel.

This investigation provides significant evidence in favor of the hypothesis that extractive institutions have persistent legacies of depressing wealth in the geographies their economic activity was concentrated. This would imply a serious geographical tradeoff between short term growth and long term asset building practices. Given the historical context of migration and demographic change in favor of coastal plains, hypotheses that associate a positive effect with sugar industry success in the early XXth century have been frequently mentioned in economic circles pertaining to Puerto Rico. I note that the methodology does not directly measure sugar industry activity, although I do provide evidence that population changes do reflect the desired empirical pattern as to be representative

of sugar activity.

The second chapter reviews the literature on measuring institutional effects on economic growth. Chapter 3 articulates a brief historical background with special emphasis on the case for the description of Puerto Rico's sugar industry as extractive. Chapter 4 presents the data and Chapter 5 outlines in detail the methodology, arguing for the internal validity of the chosen instrument. Chapter 6 presents the results and Chapter 7 concludes with a discussion of recent policy and how current conversations surrounding home values, tax incentives, and development interact with my findings.

## Literature Review

Institutionalism has left a profound mark in the tradition of academic research on Puerto Rico. Perhaps this is due to the impact Tugwell's set of institutional reforms had on the way government relates to the economy. In particular, economists have highlighted the creation of the Puerto Rico Industrial Development Company, the Puerto Rico Planning, Urbanization, and Zoning Board, and the Puerto Rico Government Development Bank. These offices continue to exist and exert considerable influence on the economy, a dynamic that is particularly notable in a region where the government is the largest employer. As Catalá (1998) illustrates, it is also noteworthy that poor employment from economic planning coincides with a period of rapid government growth in Puerto Rico.

Catalá and Francisco (1996) emphasize contributions from institutionalist approaches most directly tied to Veblen's tradition. In so doing, he characterizes institutionalism as a fundamental challenge to the idea that objective market forces allocate resources in economies. Instead, this allocation takes place as a function of institutions, "habits of thought" intertwined with the way individuals interact with communities. Institutional constraints could be formal laws or government regulations as well as regional habits or cultural restrictions to market behavior. This theoretical approach regards the maximizing interactions that take place in the market as complementary to the evolutionary process of knowledge, technology, values, and methods of organization that define the environment upon which said market interactions take place. When Villamil (1979) identifies the need to track the economic development of the capitalist class as separate of national economic development, he refers to the importance of public institutions mediating the exchange of resources in Puerto Rico. In the academic literature that looks at Puerto Rico's development through an institutionalist lens, this constitutes one of the first articulations that relate class processes and economic development

inequalities to the colonial institutions that have historically characterized Puerto Rico.

Oliveras (2007) echoes the importance of an institutionalist lens in understanding Puerto Rico's economic development. He refers to "path dependence" as the stagnant economic development policy sponsored by political institutions and "ceremonial encapsulation" as the institutional rigidities that have enforced this stagnation in the way policymakers view economic progress on the island. Unable to adapt to changing technological and organizational realities both in Puerto Rico and abroad, Puerto Rican institutions have not changed the development strategy away from fiscal incentives that have lost their effectiveness. Yet, what is perhaps a subtle but significant observation, Oliveras and Francisco (1998) tie institutional rigidities to the fact that institutions are not formed through socially efficient processes and instead are established by those powerful enough to do so. For a region that has seen colonial rule for the past 500 years, this observation directly relates Puerto Rico's foregone economic potential to the colonial condition that is and has historically been imposed.

While Aponte (2002) highlights how bureaucratic and other types of institutional constraints have hindered local firm growth in Puerto Rico, recent research, such as that conducted by Colón (2019) centers the colonial condition as the key feature characterizing an institutional approach towards Puerto Rican development. In so doing, Colón (2019) ties together language and observations stretching all the way back to Villamil (1979) to the more modern language of extractive institutions articulated by Acemoglu, Johnson, and Robinson (2001). Using descriptive data and relevant cross-country comparisons, Colón (2019) presents Puerto Rico's economic plight as that of an extractive institution that experiences unproductive destruction processes amidst social and economic stagnation. While the underlying set of observations worded by Colón have already

been identified by other notable Puerto Rican economists, this work ties Puerto Rican economic development directly to the conversation surrounding inclusive and extractive institutions. Furthermore, the insistence of such studies predicated on observational data analysis, emphasizes the need for studies that look to disentangle the value of these extractive institutions in Puerto Rico and empirically quantify the degree to which they may have altered Puerto Rican economic development. The broader literature on empirical investigations of extractive institutions provides insight on different methods of measurement, approaches to identification, and interpreting meaning through an institutionalist lens.

### **Institutions in Global Development Conversations**

The notion that institutional aspects have a profound effect on economic development has received special attention in recent economic discussions. Acemoglu, Johnson, and Robinson's (2001) seminal paper highlights the persistence of extractive institutions European powers created in their imperial expansions. They argue that a considerable portion of cross-country inequality can be explained through the type of institution, extractive or inclusive, Europeans fomented in their occupations. Extractive institutions are primarily theorized to depress economic growth through lack of adequate property rights protections for broad swathes of the population. In order to estimate the impact of the development of extractive institutions Acemoglu, Johnson, and Robinson use an instrumental variable approach. They interpret the European death rate at the time of colonization as a powerful incentive for Europeans to establish more extractive institutions. In opposition to this case, regions that were less hostile to European expansion were more likely to invite European migration, incentivizing the colonial creation of more inclusive institutions so as to benefit the large amount of European migrants. This instrument is used to directly relate countries that used to be colonies to current

measures of individual protection, such as the risk of expropriation for foreign investment as constructed by Political and Risk Services. The first-stage is then used to explain modern levels of economic development.

Acemoglu, Johnson, and Robinson's (2001) approach to institutions emphasizes material aspects pertaining to different regions of the world, such as their degree of hostility towards European populations, and structurally relates it to coevolutionary processes embedded in institutions. This theoretical approach lends itself directly to an instrumental variable approach where specific geographic features at times of critical junctures can serve to trace the path of institutional persistence.

Acemoglu, Johnson, and Robinson's (2002) Reversal of Fortune hypothesis articulates how European empire expansion in the 15th century seems to have inverted prosperity across the colonized regions. Initially, the results challenge the "geography hypothesis" by which scholars such as Alfred Marshall and Gunnar Myrdal have argued that climactic, geographical, and ecological differences across regions are strong explanations for economic prosperity. If that were the case, development up to the 15th century would be strongly correlated with economic growth now. Given this evidence, an assumption that prosperity up until the 15th century was driven by geographical resources would imply that colonial extractive institutions impose costs on communities that far outweigh the benefits of resource endowment. Most importantly perhaps, this understanding clarifies that initial resource endowments necessarily interact with historical institutions to provide varying levels of economic development. Acemoglu, Johnson, and Robinson (2002) use population levels as an adequate proxy for economic development that relies on the notion that regions with higher economic development have more capacity to sustain larger populations. In so doing, they extend meaning to population levels related to economic development in ways that inform econometric approaches for

regions and time periods where data may be very scarce, as is the case in Puerto Rico.

The important role of population dynamics in this context is enforced by Chanda, Cook, and Putterman (2014), who use ancestry-adjusted population data to provide evidence for a people-based persistence of Pre-Colombian prosperity. They also show some evidence that territory-based prosperity reversal coexisted with this persistence of people-based prosperity. These results point towards the long term persistence of human capital. The striking nature of the simultaneous but inverted relationships between institution-induced territory reversal and region-of-origin persistence provides an interesting addition to the evidence that colonies where more European migrants settled developed less extractive institutions (Acemoglu, Johnson, and Robinson (2001)).

While much of the conversation begun by Acemoglu, Johnson, and Robinson (2001, 2002) has focused on institutions as a source of cross-country inequality, Dell (2010) and Dell and Olken (2018) research the effects of extractive institutions within Peru, in the former paper, and Java, the latter. A Regression Discontinuity Design is employed to facilitate the comparison between regions that were under the control of the colonial industry and those that were not but maintained similar geographical characteristics. By placing emphasis on the geographical demarcations of colonial extractive industries, the researchers are able to identify persistence of effects on economic development within the nation-state. This identification strategy and subsequent robustness of results underpin the fundamental premise that industrial organization is a separate but impactful component of extractive institutions in the colonial experience.

Dell (2010) investigates the mining Mita's labor conscription system, taking advantage of a boundary that intersects the Andean mountain range in Southern Perú. The results show that the Mita mining system had a significant negative



effect on public goods and human capital development, increasing the prevalence of stunted growth in children and lowering household consumption significantly. These results are particularly striking because the geographical counterfactual to the Mita labor system was the prevalence of haciendas, which have been regarded as a source of land inequality and a potential cause for growth depression in Latin America (Engerman, Sokoloff, and Haber (1997)). Similarly striking results are found in Dell and Olken (2018), where areas within Dutch sugar factory catchments now have more schools and higher education levels. This relationship was also previously observed in the historical characteristics and therefore may perhaps be associated with a larger investment of public goods that helped maximize economic returns in the colonies. These results show that colonial industry structures have been repurposed and can continue to promote economic activity in the long run.

This dynamic, whereby colonial industries invest in structures that are repurposed for economic development in the future, is of special importance for the sugar industry in Puerto Rico, which demonstrated a vested interest in facilitating cargo transportation from the hacienda to the sugar manufacturing factory and then to ports. This led to the systematic improvement of accessibility to rural, coastal regions across the island. Nevertheless, Asher and Novosad (2020) find that rural road development appeared to have no sizeable effect on incomes, agricultural output, or assets. Dell, Lane, and Querubin (2017) show evidence that the inheritance of a strong centralized state had positive effects on citizen organization for public goods and redistribution in Vietnam. The effects persisted even after the original state disappeared. Yet, most of the land tenure in the favored region was informally organized, a reality that highlights ways in which favorable informal institutions can be overlooked by modern metrics for state institutional quality.

The literature on economic development under extractive institutions poses an understandably complicated picture where political context interacts with

colonial industries to create varied incentive structures for and against the investment of durable public goods. The type of public good seems to matter. An analysis on the effect of extractive industrial institutions must take into consideration differences in endowments, public goods, protections and violations perpetrated by political institutions, and the historical trajectory of the region. The examples cited all present the circumstance where previously colonial institutions were transformed into national structures whereby aspects of the previous extractive institutions persist alongside its effects. The case of Puerto Rico presents a singularly interesting example. Puerto Rico continues experience a colonial institutional framework that although ever-changing in its representative peculiarities, continues to derive its political mandate from the United States federal government. Oliveras's (2007) warning against the rigidities of institutions that correspond to the needs of those powerful enough to establish them gains particular force in the context of Puerto Rico.

For this reason, this paper uses historical evidence as a driving force in assumptions, a key interpretive tool for results, and as a compass for econometric identification. The literature discussed indicates that there could be competing mechanisms and directions of effects associated with institutions. Despite the adverse economic consequences that arise from inequitable market structures, capital investments, population concentration, and regional access to formal institutions of any kind could spur growth in the long term relative to those regions nearby that were not able to compete with the aforementioned characteristics of extractive industry. The very notion of population growth in regions dominated by extractive industries highlights a framework where exploitation coexists with the concentration of resources and comparatively higher employment opportunities.

By using an instrumental variable approach to measure the impact of the sugar industry's expansion in Puerto Rico on regional disparities, I examine within

country differences associated with institutions for a particularly revealing example of modern colonialism. My approach contributes an interesting empirical example of long run effects while adding a theoretical caveat to the conversation comparing extractive and inclusive institutions as separate from private organizations and investors.

## **A Brief Historical Overview**

Puerto Rico is an archipelago containing approximately 140 insular geostructures in the Caribbean. There are three inhabited islands in Puerto Rico: a main island also named Puerto Rico, Culebra, and Vieques. The island Puerto Rico contains the vast majority of inhabitants in the jurisdiction and is by far the largest of the three, measuring approximately 8,870 square kilometers. The main island is the focus of this paper's study and the name Puerto Rico will hereafter refer to the main island solely. Despite the integral role these neighboring islands have played in the expression of political and economic interests, it is most appropriate to exclude the neighboring islands because their geography has historically implied an institutionally separate trajectory as well as significantly different transportation costs.

### **Modern Colonies and the Study of Extractive Industries on Development**

The United States legally differentiates Puerto Rico from states by describing Puerto Rico as a non-incorporated U.S. territory, a status that rests upon the determinations of the insular cases. These Supreme Court decisions paved the way for differential treatment of United States citizens in its territories and the systematic limitation of constitutional rights to citizens under its jurisdiction to a subset of constitutional rights they arbitrarily determined to be “fundamental”. *Balzac v. Porto Rico*, a subsequent case, relies on the insular cases to conclude that a trial by jury is not among these fundamental constitutional rights conferred to Puerto Ricans. Torruella (2007), who also functioned as a judge for the First Circuit Court of Appeals, argues that the insular cases have used racially motivated justifications related to the argumentative structure that enforced *Plessy v. Ferguson*. These rulings established a de facto legal structure of “political apartheid” whereby Puerto Ricans have no effective political voice to challenge the

institutions that established the political ghetto upon which they were located (Torruella, 2007). Torruella's (2007) argument is echoed by a growing literature of Puerto Rican and U.S. history that recognizes the imperialistic nature of federal-territory relationships and appropriately refers to these territories as colonies. This typification allows me to draw from a growing developmental economics literature that addresses and quantifies the effect of persistent colonial institutions, as demonstrated in the literature review.<sup>4</sup>

### **The Geography of Puerto Rico as Key to Understanding its Institutions**

Puerto Rico has experienced two distinct colonial powers. From the XVIth century to 1898, Puerto Rico was owned and controlled by Spain. In 1898, the United States acquired Puerto Rico as part of the culmination of the Hispanic-American war and has owned and administered the territory ever since. In line with Acemoglu, Johnson, Robinson's (2001) theoretical approach, Puerto Rico's topographical features and variations in climate systematically shaped both the intensity and scope of Puerto Rico's colonial institutions. Repeated attacks by French ships, British expeditions, and pirates forced the construction of military fortresses in San Juan and the relocation of colonial settlements<sup>5</sup>. Defying Spanish colonialism, perhaps as many as a third of indigenous people on the island formed settlements on the mountainous region on the island that the Spanish could not easily find (Dietz (1985)). Contraband played a large role in the development of

---

<sup>4</sup> The insular cases were a set of legal challenges that arose after the U.S. Congress established the first civilian government of Puerto Rico under U.S. occupation through the Foraker Act of 1900. The six cases that are widely considered to be a part of these foundational decisions are: *De Lima v. Bidwell* in 1901, *Goetze v. United States* in 1901, *Dooley v. United States* in 1901, *Armstrong v. United States* in 1901, *Armstrong v. United States* in 1901, *Downes v. Bidwell* in 1901, and *Huus v. New York and Porto Rico Steamship Co.* These insular cases, which were largely debated on the matter of differential treatment of import tariffs with respect to the U.S. mainland, established that Puerto Rico belongs to but is not a part of the United States.

<sup>5</sup> This was the case with San Germán, which was originally located at the mouth of the river Añasco but was relocated further upriver and joined with a neighboring town population to facilitate its defense.

Puerto Rico and the sustainability of its tenuously growing population well into the 19th century. During this period in time, geographical barriers and distance separating settlements from the main colonial town of San Juan often influenced whether the Spanish monopoly on trade would be respected and the degree to which colonial policies dictated everyday life in Puerto Rico (Dietz (1985)). In distinct parts of the island, disease forced the relinquishment of colonial settlements, as was the case in Guánica, a regional characteristic that Carroll (Carroll (1899)) describes as the “unhealthiness” of the place. The historical evidence for these settlement patterns in Puerto Rico are similar to these described by Acemoglu et al. (2001) suggesting that their framework could be a useful explanation for regional inequality within nation-states or modern colonies.

### **Vague Institutions in a Modernizing Colony**

Under colonial direction in the 19th century, Puerto Rico acquired a secondary functionality in addition to its role as a military outpost. Scholars of Puerto Rican economic development point towards a series of reforms dictated by the Spanish Crown after the first official census report conducted by Marshall Alejandro O'Reilly (1765) as the juncture in which Puerto Rico begins developing an agrarian, export-oriented economy. For the first time in Puerto Rico's history, a royal decree in 1778 formalized the notion of land tenure as property in a colony that had largely preserved feudal production processes and where the Crown was the primary landholder (Dietz (1986)). The system of communal *hatos*<sup>6</sup> and subsistence agriculture that existed throughout Puerto Rico for the majority of Spanish colonial rule was gradually subverted for the recognition of private property claims (Ayala and Bergad, 2020). The process of land arbitration, which was then

---

<sup>6</sup> *Hatos* refers to the territorial demarcations related to the budding pastoral industry that was taking place in Puerto Rico.

sped up by the Cédula de Gracias,<sup>7</sup> frequently oversaw conflicting land claims and favored wealthy hacendados and immigrants in these disputes. Both of these decrees set the stage for the systematic dispossession of small farmers who were quickly run off their land by hacendados who had the money and power to claim land successfully to the Spanish colonial authorities in Puerto Rico (Dietz, 1986, Scarano, 1984, Figueroa, 2005). The introduction of private property laws marked the beginning of the systemic dispossession of small peasant farmers and the expansion of plantations into previously uncultivated land. There is evidence that as the century progressed, land arbitration became increasingly regulated and the amount of land easily accessible to the wealthier members of society through illegal occupation or unfounded claims decreased. By the time the U.S. empire landed on the shores of Puerto Rico, land-use in Puerto Rico was already largely integrated in both the mountainous region, characterized by the coffee industry, and the coastal plains, characterized by the presence of the sugar industry (Ayala and Bergad, 2020), a testament to the high rates of latifundism that embodied colonies of the Spanish empire throughout the world.

The institutional vagueness that coexisted with Puerto Rican agrarian development would consistently serve as a buttress to inequality, exploitation, and poverty in the following centuries.

### **The case for the Extractiveness Descriptor: Sugar Industry Expansion in Puerto Rico**

The first significant period of sugar production took place from 1800 to 1850 and was propelled by plantation slavery and horizontal land integration. Although

---

<sup>7</sup> The Cédula de Gracias was declared in 1815 and designed to stimulate economic activity in Puerto Rico by providing an attractive haven for plantation owners and Spanish loyalists that had been forced out of other colonies by revolutionaries. White immigrants were awarded acres for moving to Puerto Rico. Additional acres were awarded for each slave brought by the immigrant. This royal decree helped cement a pattern that began with the arrival of plantation owners from Haiti during and after the Haitian Revolution. (Ayala and Bergad (2020), Dietz (1986))

George Flinter's study (1832) has misled a strand of historical literature to portray slavery in Puerto Rico as insignificant, Scarano (1984) emphasizes the essential statistical relationship between human trafficking and plantation growth at the turn of the century. From 1815 to 1828, the slave population in Puerto Rico increased at a rate of 4.2% per year (Scarano (1984)). A correlation matrix relating demographics to production by land use for municipalities in 1828 finds that the correlation between slaves and sugar lands was 0.92. The primary sugar municipalities of Mayagüez, Ponce, and Guayama saw an approximate four-fold increase of slave labor from 1812 to 1828 (Scarano (1984)). The exploitative conditions of the sugar plantations disincentivized the rural peasantry from participating in the sugar industry labor force (Scarano (1984);Dietz (1985)). Even when political convulsions in the Europes managed to advance protections for individuals through decrees that sought to limit abuse of power on the island, they were often distorted or outright defied by the Spanish elites. The increase of plantation slavery from 1800 to 1850 frequently engaged with illegal trade with colonial officials' tacit consent, and the conditions under which the enslaved lived was frequently in direct violation of the Spanish slave codes, touted by Flinter as supposedly humane. The sugar industry developed a dependence on slave labor for the majority of the expansion despite a large, free, and unemployed population because plantation owners insisted that slave labor was key to profitability given their technological productive conditions (Scarano, (1984)). The slave plantation system was most directly threatened by the Reglamento de Jornaleros of 1849 <sup>8</sup> (Scarano, 1984).

After 1898, when the United States acquired Puerto Rico, the class structure

---

<sup>8</sup> The Reglamento de Jornaleros established a system of labor in Puerto Rico by which the free population was forced to work a preestablished set of hours and have them authorized by plantation owners in their notebooks or face conscripted labor in public works. Originally articulated as a statute against vagrancy, this law accorded vast arbitrary bargaining power to legal authorities and large landholders (Scarano(1984)).



and inequality that had already been established by the Spanish colonial regime was further exacerbated. Despite exponential increases in sugar production and profitability from 1899 to 1930, the vast majority of Puerto Ricans continued to live in poverty. Historians have even gone as far to suggest that Puerto Rican livelihoods decreased during this period of sugar industry expansion. Ayala and Bergad (2020) go to great lengths to challenge the common historical generalization that the arrival of U.S. rule in Puerto Rico radically dispossesses a legion of small Puerto Rican farmers and sets the stage for the concentration of land in control of U.S. capital. The argument rests on the fine reading of the 1930 census by which they notice that other historians had interpreted the loss of small farms when, in reality, the census had stopped officially recording such farms. When correcting for mistakes such as these, Ayala and Bergad (2020) argue that intense land concentration had already taken place under Spanish colonial rule and while U.S. corporations manage to acquire a large share of land ownership that did not exist before, the land inequality and class exploitation that existed in 1930 also existed under the Spanish Crown. Recognizing this poignant criticism of the historiography of the sugar industry in Puerto Rico, I will proceed to outline institutional changes that could have yielded the ambiguity possible for exploitation increase. The fact of the matter remains that land cultivation exponentially increased in intensity and that this second wave of sugar industry expansion presents the moment in time in which Puerto Rico's agrarian economy was largest in its history.

U.S. rule coincides with the systematic arrival of capital investment that serves to improve technology across Puerto Rico and establish centrales that would go on to replace the old sugar mills that were frequently used. The sheer demand for sugar cane that needed to be quickly satisfied in order to make these large sugar manufacturing factories profitable consist of a large incentive for an increase in exploitation of both resources key in the production process: land and human

capital. This increasing rate of cultivation was further exacerbated by the following major political institutional changes that took place after 1898. Puerto Rico was effectively included within the U.S. tariff wall such that Puerto Rican sugar producers gained a noticeable advantage over other major sugar-producers from the Caribbean. The 500 Acre Law, lobbied for by competing beet sugar producers, was passed. Thirdly, the Hollander Tax, initially a 2% property tax valued by a federal government appointee, was imposed on land-owners in Puerto Rico. These three major institutional changes present the largest points of discussion in the historiography of the sugar industry.

The 500 Acre Law, which established a legal maximum ownership of 500 Acres, was openly and frequently disregarded by wealthy local landowners and U.S. corporations alike for a good majority of the first half of the 20th century. The banking sector was dominated by U.S. and Canadian interests: the American Colonial Bank, the Royal Bank of Canada, Bank of Nova Scotia, and the First National City Bank (Ayala and Bernabe (2011)). By the early 1930's four U.S. sugar corporations were vertically integrated with the five largest centrales in Puerto Rico, which processed nearly one half of all sugar produced on the island. The first civil appointed governor of Puerto Rico, Charles Herbert Allen, would later on become the president of the American Sugar Refining Co., a part of one of the previously mentioned corporations. Conflicts of interest would continue to abound in Puerto Rico's institutions that associated the political colonial state with the expanding sugar sector.<sup>9</sup>

---

<sup>9</sup> A Note On Vague and Compromised Institutions in Contemporary Puerto Rico: There exists in contemporary Puerto Rico a noticeable tension between Spanish institutions and U.S. institutions that yield outcomes that are extractive, contradictory, and vague. After Hurricane Maria in 2017, FEMA officials and first-responders documented being unable to find residences and businesses in Puerto Rico due to a lack of 911 compliant addresses. This is perceived to be the inheritance of the extension of two colonial institutions: a Spanish naming convention address system and the poor protection and documentation of land for everyone. The Center for Investigative Journalism highlighted in a February 2018 article how the lack of appropriate property rights documentation, which often requires several costly legal proceedings, led to a large amount of FEMA aid

## Data

The lack of a complete longitudinal dataset that accurately describes the production of sugar by “barrio”<sup>10</sup> presents one of the most challenging confounding variables in this analysis. The closest data to a comprehensive survey of geographical sugar industry activity in Puerto Rico can be found in a project conducted by the Universidad Metropolitana in conjunction with the Fundación Puertorriqueña por las Humanidades, which maps centrales and ingenios while providing a brief description of each individual structure including date of closure, and a thorough survey of Haciendas in Puerto Rico in 1902 by Pagán. While Ferreras Pagán (1902)’s survey details concerning agrarian production by municipality, the survey does not present accurate and sufficiently granular spatial information that is able to locate sugar farms within the relevant municipalities.

In order to relate the geographical suitability of the County Subdivision to

---

application rejections (Rebecca Banuchi (2018)). In light of these institutional ambiguities that have historically favored the wealthier citizens of Puerto Rico and absentee capital, the geographical importance of inaccessibility in rural areas once again arises as an important factor in the scope and force of colonial institutions on the island. In practice, there exist institutional boundaries that pave the way for a large informal economy and for the conceptual dichotomy between that which is official and extractive and that which is informal but free. The limitations of complete and official economic interactions for a large population of Puerto Ricans could explain in part many of Puerto Rico’s contemporary economic woes.

One of the many implications of such a large informal economic sector and the poor documentation of private property rights across the island is the lack of reliable data. In an effort to to circumvent this obstacle, this paper looks at the possibility of identifying institutional effects on modern institutions by using two key historical data structures: the location of different sets of colonial extractive institutions on the island and regional migration patterns that take place immediately after the U.S. invasion of Puerto Rico. This approach emphasizes the importance of geography in historical colonial practice and attempts to gain insight upon the geographical boundaries of the effect of these institutions in contemporary Puerto Rico. Although this statistical problem complicates the interpretation of the counterfactual to sugar industry geographic hegemony, the historical background is a testament to the resilience of markets in the face of repressive structures. Assuming that the incentive to conceal informal markets was positively correlated with the geographical proximity to sugar industry extractive institutions, regression estimates may capture a self-selection effect into more formal conditions of economic exchange that provided necessary protection from informal economic threats. Crime and low investment in public goods, such as roads which are particularly important in Puerto Rico’s mountainous region, are two examples.

<sup>10</sup> Barrios refers to the County Subdivisions in Puerto Rico. Counties are referred to as municipalities and County Subdivisions is interchangeable with the term barrios

population change and sugar production I constructed the sugar suitability measure by combining contemporary National Soil Survey Data with a 1942 description from the National Soil Survey for Puerto Rico that details the suitability of different soil types with respect to sugar production. The soil types described in the 1942 soil survey have largely remained constant throughout the years. Using this qualitative description, I identify the soils most appropriate for the cultivation of sugar and calculate the geographic proportion of the soil to the total area of the County Subdivision. The ranking of the top municipalities according to this proportion can be found alongside the proportion of sugar crop value relative to total crop value produced in Table 5.

**Table 1**

*Municipalities by Sugar Value Production and Good Soil for Sugar*

Municipio	% Sugar of Total Crop \$	Municipio	Good Soil +
Santa Isabel	99.57	Santa Isabel	18.14
Salinas	96.47	Lajas	14.52
Fajardo	93.53	Arroyo	9.414
Arroyo	92.35	Guayama	9.303
Humacao	88.83	Salinas	8.947
Juncos	78.12	Manati	8.177
Guayama	77.80	Naguabo	6.382
Loiza	76.55	Mayaguez	6.264
Yabucoa	75.38	Yabucoa	6.023
Guayanilla	75.16	Toa Baja	5.838
Lajas	74.70	Anasco	5.790
Toa Baja	70.88	Juana Diaz	5.631
Naguabo	68.36	Aguada	5.621
Vega Alta	66.76	Dorado	5.404
Cabo Rojo	65.80	Humacao	4.667
Ponce	65.70	Cabo Rojo	4.464
Sabana Grande	60.67	Morovis	4.203
Carolina	60.03	Barceloneta	4.050
Rincon	59.91	Arecibo	3.818
Aguadilla	59.22	San German	3.784

(a) % Sugar of Total Crop \$, 1929

(b) Soil Suitability for Sugar

I transcribed data from the US censuses of Puerto Rico from 1899 to 1930 in

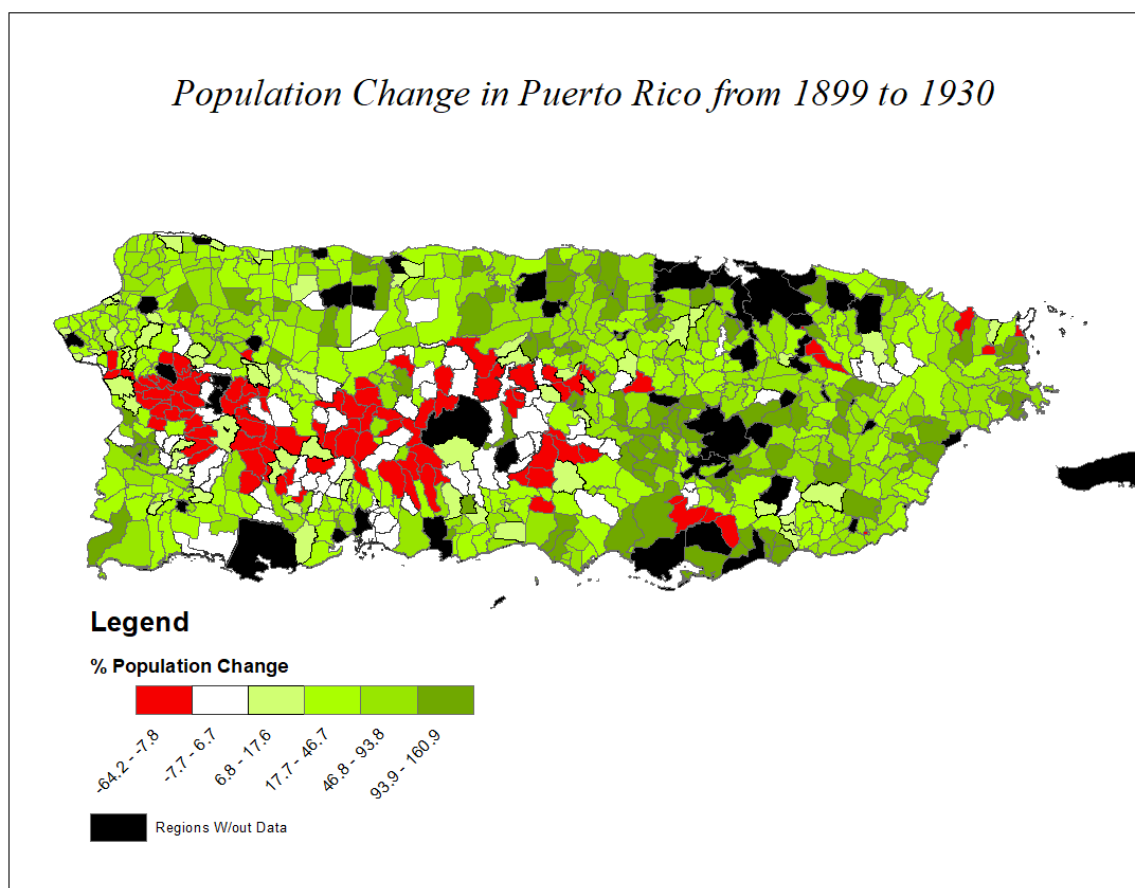
order to compile information on agricultural productivity at the municipality level and population levels at the County Subdivision level. This data is used to calculate the population percentage change from 1899 to 1930. Figure 4.1 shows a map of the population change from 1899 to 1930. It is noteworthy that significant County and County Subdivision reorganization takes place from 1899 to 1930. I have excluded those County Subdivisions for which names change. A significant number of County Subdivisions do not change but merely change the municipality they belong to. These County Subdivisions remain in the sample. When clustering for standard errors, I take into account their new municipality as opposed to the one they belonged to in 1899. Some municipalities that change during this time period are Barros, which existed in 1899, but largely becomes Orocovi, and Fajardo, which loses some of its barrios to create Ceiba.<sup>11</sup> I include the County Subdivision units that were subdivided or changed names between 1899 to 1930 by merging the 1930 values into their 1899 demarcations.

The regions that have been merged in this manner to bring robustness to the analysis are shown in Figure 2. Notice that the vast majority of Puerto Rico is represented in the sample included for this analysis. In Figure 4, you can observe the population percent change from 1899 to 1930 for our sample.

In order to verify the validity of the sugar suitability measure, I map a weighted average of the sugar suitability index at the municipality level (weighted by the geographic area of each subcounty unit) to a measure of the proportion of sugar value produced in 1929 relative to total crop value produced in 1929. The relationship between the two variables can be seen in Figure 3. The figure confirms the qualitative description of the 1942 Soil Survey and provides further evidence that the measure for soil suitability is related to sugar production in a significant

---

<sup>11</sup> While some additional municipality modifications take place after this time period, for example, the creation of the Florida municipality from Barceloneta's barrios, the bulk of the changes take place from 1899 to 1930.

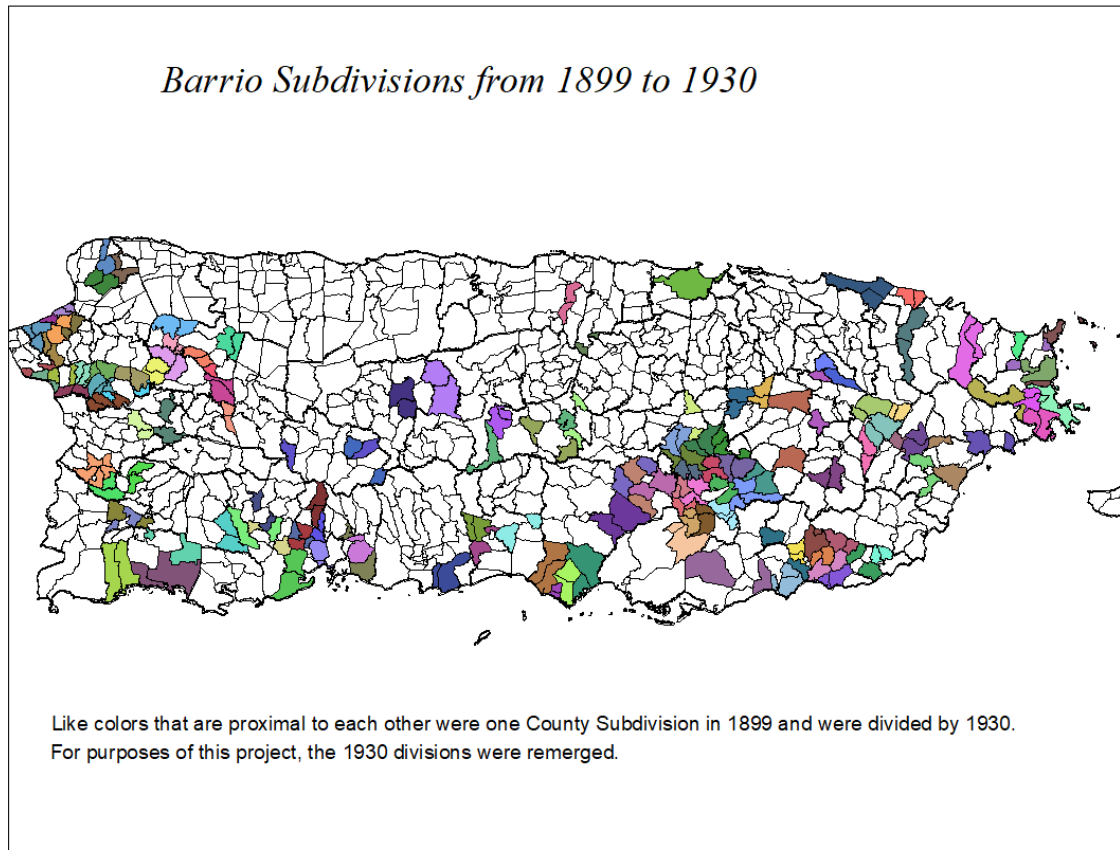


**Figure 1**  
*Population Change from 1899 to 1930*

way at the municipality level.

Tables that rank the top municipalities by the acres dedicated to sugar production and the sugar value in dollars associated with each acre can be found in the appendix.

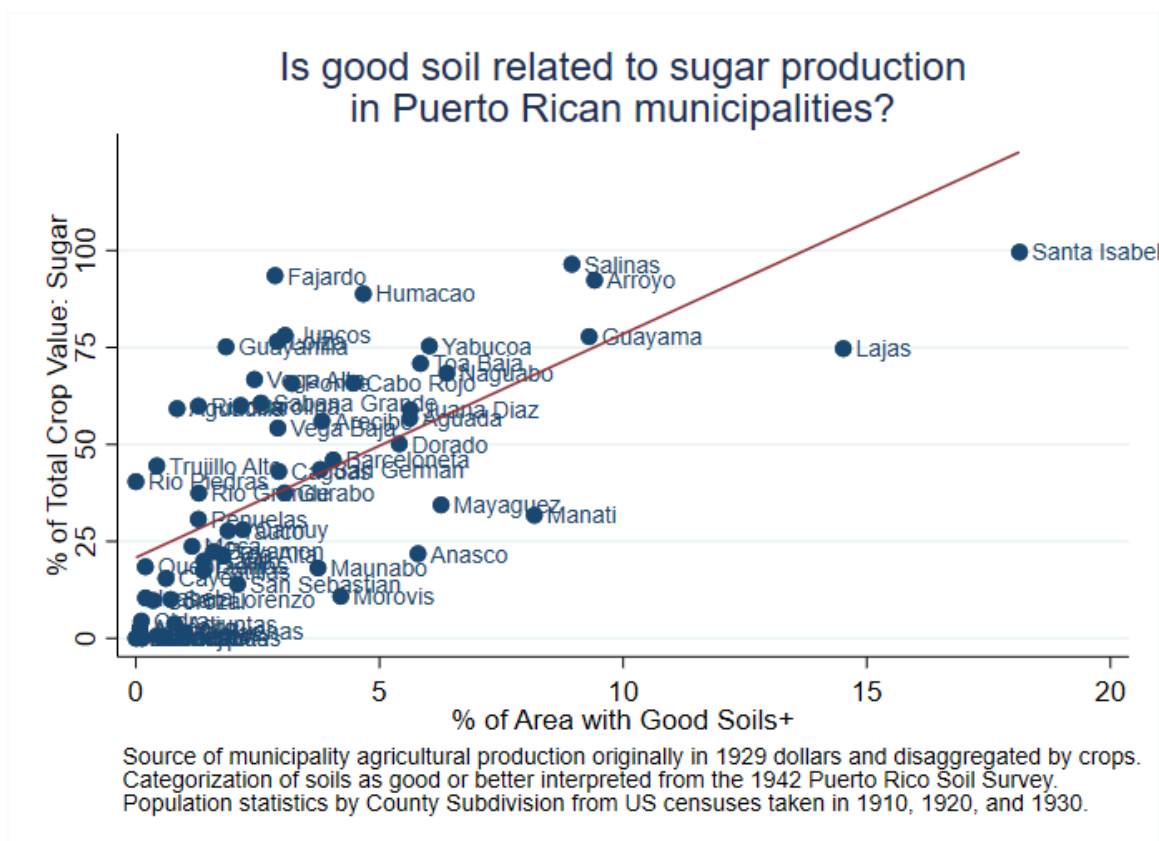
As documented in Ayala and Bergad (2020), demographic shifts during this time period encompassed regional migration patterns towards coastal districts that presented employment opportunities tied to the sugar industry. Sugar production reached a peak in 1934 with approximately 2,300 tons (Ayala and Bergad (2020)). This historiography, further expanded upon in Ayala and Bernabe (2011), the History Task Force (1979) and Dietz (1986), allows me to interpret soil-driven population changes from 1899 to 1930 as a measure of the impact of industry. I find



**Figure 2**

*Changes in County Subdivisions from 1899 to 1930*

further evidence of the statistical relationship of population change as a proxy for sugar industry activity in the municipality in Figure 4. Figure 4 clearly shows that the relevance of soil suitability for sugar and population changes increases as the production of sugar in the relevant municipality increases. While Figure 4.2 demonstrates that the soil suitability measure is appropriate in predicting sugar production at the municipality level, Figure 4 shows that the relationship between soil suitability and population change from 1899 to 1930 is contingent upon high sugar production value. Figure 4 provides evidence that, given the lack of agricultural production data at the County Subdivision level, the relationship between suitable soil for sugar production and the population change from 1899 to 1930 is an appropriate proxy. If we remove sugar producing municipalities from the



**Figure 3**

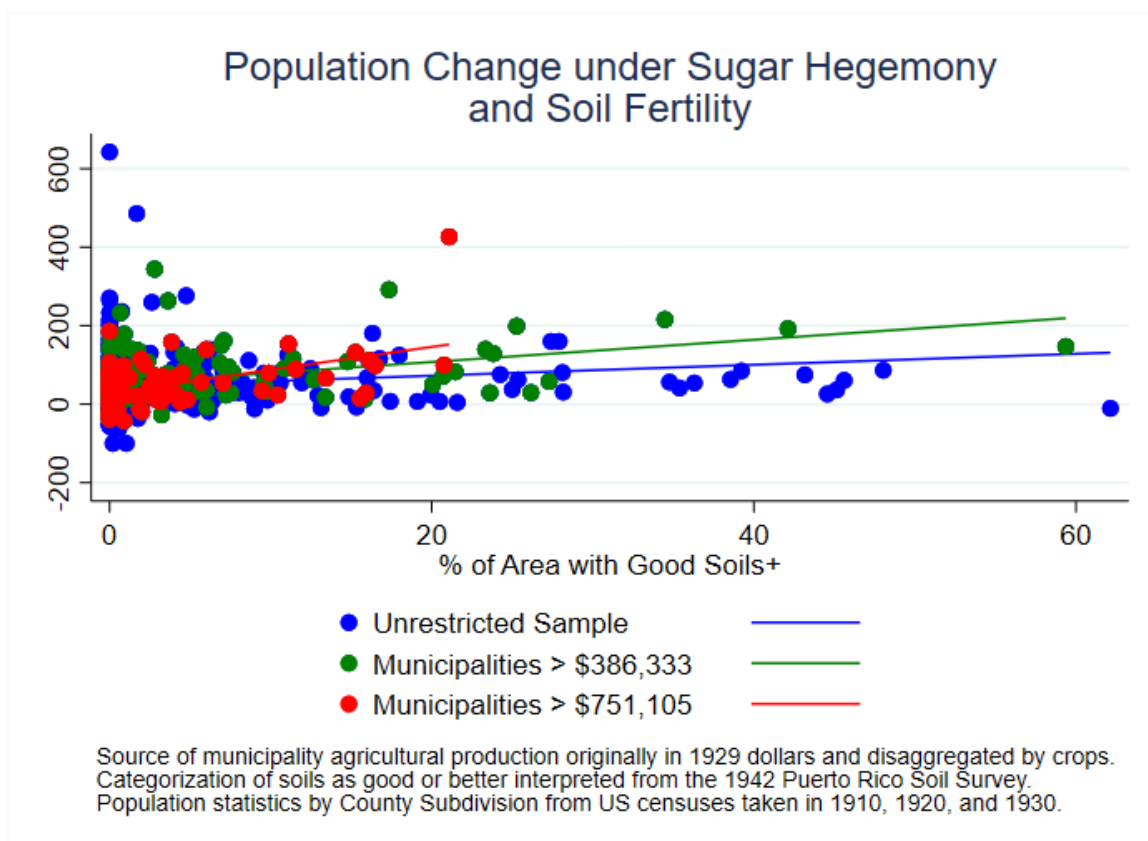
*Good Soil for Sugar Production?*

sample, there is no statistically significant relationship between population change and the proportion of good soil per County Subdivision.

Notice that agricultural data is only available at the municipality level while the population percent change data from 1899 to 1929 is available at the County Subdivision level. In order to make use of both types of data available, I interpret the value of sugar production as an environment defining quantity that can be assigned to each of the smaller units. Therefore, for the regression analysis, barrios are assigned the value of the sugar production belonging to their municipality in 1910.

Contemporary outcomes such as median, lower quartile, and upper quartile house values are obtained from the 2015-2019 American Community Survey Sample.





**Figure 4**

*Population Change as a Proxy for Sugar Production*

## Methodology

The last functioning “central”<sup>12</sup>, the Central Coloso, closed in 2002. The sugar industry’s activity in Puerto Rico is far from uni-dimensional. Sugar was consistently cultivated in the region for 200 years, albeit at different rates of intensity. Given these constraints, the best way of identifying an effect associated with the sugar industry requires identifying a period in time of highest relative intensity and sugar industry spatial expansion that the analysis relates to long run measures of economic development. Based on the historiography and the macrodata available, the period characterized by the highest intensity of sugar production in

<sup>12</sup> Large-scale sugar manufacturing centers that presented a significant capital improvement from the older and less efficient sugar mills that dominated Puerto Rico’s sugar production in the XIXth century.

the history of Puerto Rico is an expansion from 1899 to 1929.

This structuralist theoretical framework is supported by an instrumental variable approach that directly relates soil particularly favorable to sugar production to its predictive power of population changes from 1899 to 1930. In addition to the instrumental variable approach, I included an interaction term regression analysis to further understand the statistical relationships between the variables included. Constrained with lack of data that measures economic activity, historical approaches have often sought to interpret population changes as markers for economic development (Acemoglu, Johnson, and Robinson (2002)). The methodological decision to emphasize population change by barrios as the primary proxy for Sugar Industry presence is internally valid if the set of chosen controls facilitates the distinction between soil-driven population changes that could be associated to another agrarian industry in Puerto Rico that was also expanding during the same time period.

### ***Identification of Industry***

Three major agrarian industries played especially relevant roles in the historical period from 1899 to 1930: the sugar industry, the coffee industry, and the tobacco industry. All three saw a period of expansion in the beginning of the 20th century. Yet, Puerto Rico's inclusion within the U.S. tariff wall gave sugar producers an increased benefit while coffee producers suddenly faced import tariffs entering their main markets in Europe. Puerto Rican coffee producers could not compete with the Brazilian coffee producers that had captured a large share of the U.S. market (Ayala and Bergad (2020); Dietz (1985)). A series of devastating hurricanes, San Ciriaco in 1899, San Vicente in 1901, and San Felipe in 1928, had a large impact on the coffee crop and the complementary plants that often provided shade to growing coffee plants. As such, the coffee industry contracted and, as the

sugar industry grew, many previous coffee growers operating as “agregados”<sup>13</sup>, moved to employment in the coastal sugar districts.

The sugar industry quickly overtook the position of the largest share of export crop and only exponentially grew. Its impact of U.S. capital investment directly incentivized by the presence of the sugar industry, as seen in the form financial institutions, railroads, and schools, had a large impact on the sugar districts they managed to control. The sugar industry was the dominant agrarian industry in Puerto Rico during this period in time both in crop export share and spatial distribution across the island (Dietz (1985)).

Yet, Ayala and Bergad (2020) caution against discounting the tobacco industry and its effect on social organization. Tobacco farms frequently had the opposite impact of capital integration and small farms increased alongside population levels across majority tobacco districts. For this reason, I include categorical controls to account for primary crop production in the relevant district. Different forms of this restriction are exercised in the initial regressions to enable a consistent and internally valid interpretation of soil-induced population changes.

### ***The IV Strategy***

Instrumental variable strategies aim to circumvent confounding variables that are unobservable, enabling a causal interpretation. An instrument approach enables a causal interpretation if it only has an effect on the endogenous treatment variable and not on confounding variables. This exclusion restriction holds if the sugar industry reached a maximum of expansion near the discrete time period utilized, past institutions are controlled for, and we can interpret soil-induced population changes as pertaining to the sugar industry exclusively. If all but the last assumption hold, then the methodology measures the average effect of the

---

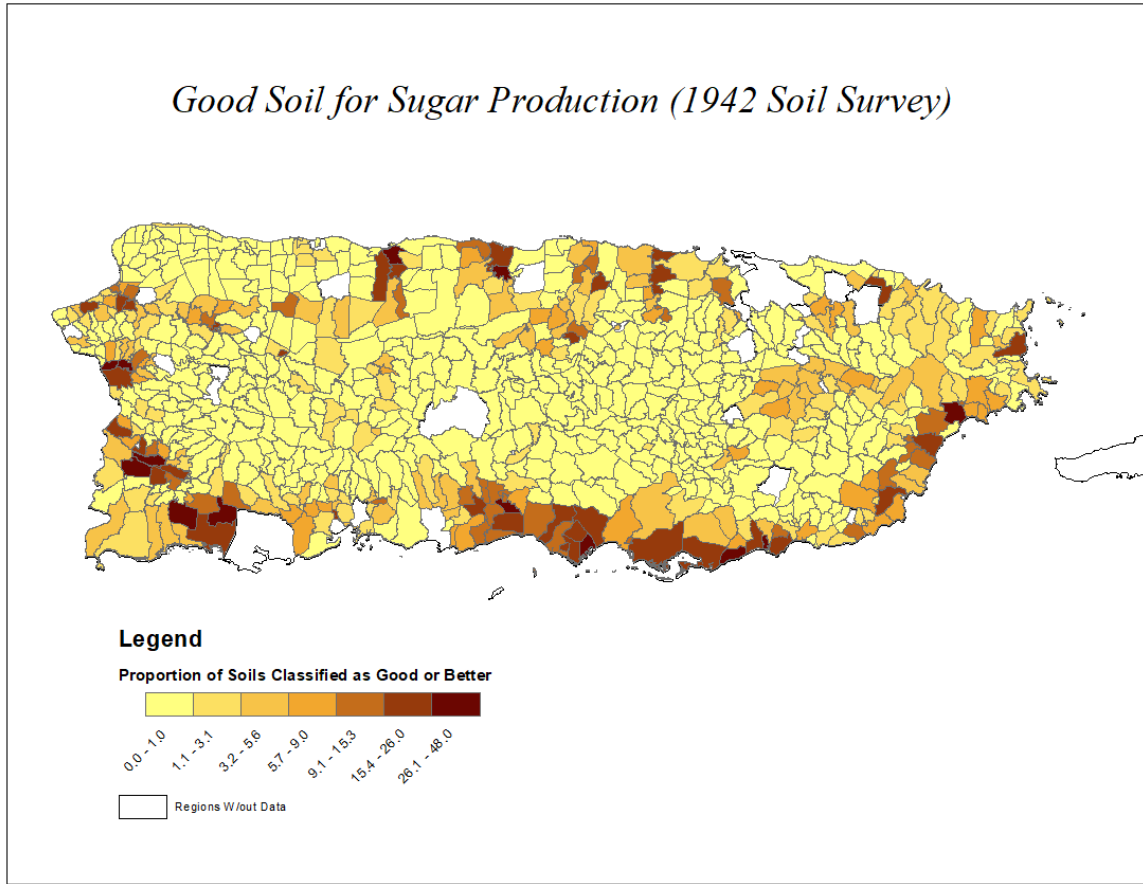
<sup>13</sup> Plantation workers that lived on tenant land and retained rights of usufruct, often cultivating subsistence and complementary crops in addition to the coffee they picked

expansion of all agrarian industries.

Population changes that took place in Puerto Rico from 1899 to 1930 were a function of several institutional shifts that coincide with U.S. acquisition, such as decreasing death rates resulting from medical interventions on the island related to tuberculosis and uncinariasis. Generally speaking, the arrival of U.S. rule coincides with a general and marked population increase in Puerto Rico. Urbanization rates increased, especially in primarily coastal sugar districts and in the outskirts of already densely populated areas, such as San Juan. In order to isolate the institutional shifts that arise from sugar industry expansion, I adopt a spatial approach that interprets material geographic resources as the primary determinants of sugar industry location.

There are two primary geographic characteristics that largely determine agrarian industry location. Soil fertility has been repeatedly named in the historiography of Puerto Rico as a key geographic structure for the development of sugar haciendas. Extractive institutions and industry had already been established in Puerto Rico with respect to these geographic characteristics as well. My claim that the shift in demographic changes from 1899 to 1930 is representative of exogenous sugar industry expansion rests in the ability to control for the levels of development that existed before the period in question. Given the evidence provided in the Data chapter of this thesis, I proceed with the first stage with the assumption that population changes from 1899 to 1930 are exclusively related to soil suitability for sugar production. Further evidence of this statistical relationship is provided by Table 1, which provides the first stage at different levels of sample restrictions subject to sugar production levels at the median or above. In addition, I also include an interaction term regression that demonstrates that positive population changes from 1899 to 1930 associated with good soil for sugar production disappear when we include as a control and an interaction term sugar

value produced by the municipality.



**Figure 5**  
*Fertility Data Overview*

The functional form for the methodological approach is as follows:

$$Population\Delta_{1899-1930} = \alpha_1 FertileSoil + \alpha_2 \mathbf{X} + \mu \quad (1)$$

$$Y = \beta_1 Population\Delta_{1899-1930} + \beta_2 \mathbf{X} + \beta_3 CurrentPopLevel + \varepsilon \quad (2)$$

, where the first stage regresses the percentage change of population levels by County Subdivision from 1899 to 1930 on the percentage of good soils pertaining to each County Subdivision and a stochastic error term  $\mu$ . The second stage regress current median house values (as well as upper quartile house values and lower

quartile house values)  $Y$  by County Subdivision, on the instrumented change in population levels by County Subdivision from 1899 to 1930. This stage also includes a vector of control variables  $\mathbf{X}$ , which includes the population level at 1899 and the contemporary population level, and a stochastic error term  $\varepsilon$ . The second stage includes the additional control for the current population level, intended to enable a comparison between County Subdivisions that achieved a similar level of development after the fact and in light of future industrialization that took place in XXth century Puerto Rico. It is notable that the variable by which we measure industry expansion, the treatment variable, is measured by a percentage change because it takes into consideration the preceding level of development in 1899 as portrayed by the population level in 1899. Although the chosen IV approach is unrelated to current levels of population sustainment, controlling for both levels of development in 1899 and 2014-2019, gives a more appropriate anchoring in the counterfactual comparison. We want to compare County Subdivision Units that have the same amount of people in 1899 and in 2014-2019. The operative question remains, how did the process of getting there dictate current economic development levels? The second level can be used to analyze effects of said industry on long-run levels of economic development; 86 years separate the two stages.

### ***A Closer Look at the Instrument***

The exclusion restriction for the instrument requires that fertile soil percentage only affect population changes as a result of the expansion of the sugar industry. Table 2 demonstrates a strong and significant relationship between the percentage of potential farmland and the population change percentage that takes place within the proper time period. Model 1 is the unrestricted version of the regression, Model 2 restricts at the median of the sugar value production in 1929 and Model 3 restricts the sample at the 75th percentile of the sugar production

value. The chosen model, which hones in on the most appropriate counterfactual looks at Model 1 as shown in 2. This ensures that we capture the first stage effect as it pertains to a relationship with sugar industry activity. Including Model 4 provides additional evidence that good soil only affects population change through sugar industry activity at an increasing rate. The estimate also loses significance for good soil, loading all of the significance onto the interaction term.

**Table 2**

*Predicting Population Changes from 1899 to 1930 using Soil Fertility*

VARIABLES	(1) Pop % $\Delta$ Unrestricted	(2) Pop % $\Delta$ $\geq$ p75	(3) Pop % $\Delta$ $\geq$ p90	(4) Pop % $\Delta$ Unrestricted
Sample				
Good Soil+	1.393*** (0.438)	2.879*** (0.794)	5.825 (2.934)	-0.879 (0.759)
Population 1899	0.000 (0.004)	0.003 (0.006)	0.003 (0.005)	-0.001 (0.004)
Value Sugar 1929				0.018 (0.017)
Val Sugar 1929 * Good Soil+				0.006*** (0.002)
Constant	44.539*** (7.789)	46.260*** (11.871)	25.925* (10.726)	41.587*** (9.393)
Observations	677	182	80	664
R-squared	0.028	0.128	0.241	0.081

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Sample restrictions were made based on County Subdivision values of Sugar Value Production in \$ in 1929 as pertaining to total Municipality production.

## Results

A preliminary look at the data available suggests there exists a statistically significant relationship between sugar production and future house values. Furthermore, an interaction term analysis suggests that there also exists a statistical relationship between the population percent change at the County Subdivision level from 1899 to 1929. There only exists a relationship between sugar production value in 1929 in the municipality and future house values through the population change variable. Evidence to this end is presented by Table 3 which contains two interaction term regressions. The first constructs a categorical description by assigning a value of one to County Subdivision units that belonged to a municipality that was in the upper 75th percentile of sugar production. Given that the distribution of sugar production in 1929 dollars was heavily skewed to the right, this seems like an appropriate way of capturing a heterogenous effect conditional upon a different environment. In order to further verify these results, specification 2 includes sugar value production in 1929 as a continuous variable. I report the marginal effects associated with sugar for both of these specifications in Figure 7a and 7b. Notice that the marginal effects associated with Figure 7a directly correspond to the divergent linear relationships in the data visually presented by the scatterplot in Figure 6. A priori, this is further evidence in favor of the validity of the first stage chosen for the instrumental variable analysis. The population percent change is positively associated with future house values, consistent with reading the population percent change as a sign of regional development. Neither of the sugar production value variables are significant in predicting future median house values for County Subdivisions but for both specifications, the interaction terms are. This relationship suggests that the negative association between sugar value production in the municipality and future median house values is related to the economic expansion taking place in the chosen time period.



**Table 3**  
*Interaction Regression Results: House Values*

VARIABLES	(1) Median House Value	(2) Median House Value
1.Majority Sugar	4.4462 (5.3692)	
% Pop $\Delta$	0.1193*** (0.0223)	0.1426*** (0.0234)
0b.Majority Sugar * % Pop $\Delta$	0.0000 (0.0000)	
1.Majority Sugar * % Pop $\Delta$	-0.1062** (0.0418)	
County Sugar \$ 1929		0.0128 (0.0079)
% Pop $\Delta$ * County Sugar \$ 1929		-0.0002*** (0.0000)
Constant	93.5753*** (2.4009)	91.2229*** (2.3814)
Observations	650	639
R-squared	0.0604	0.0645

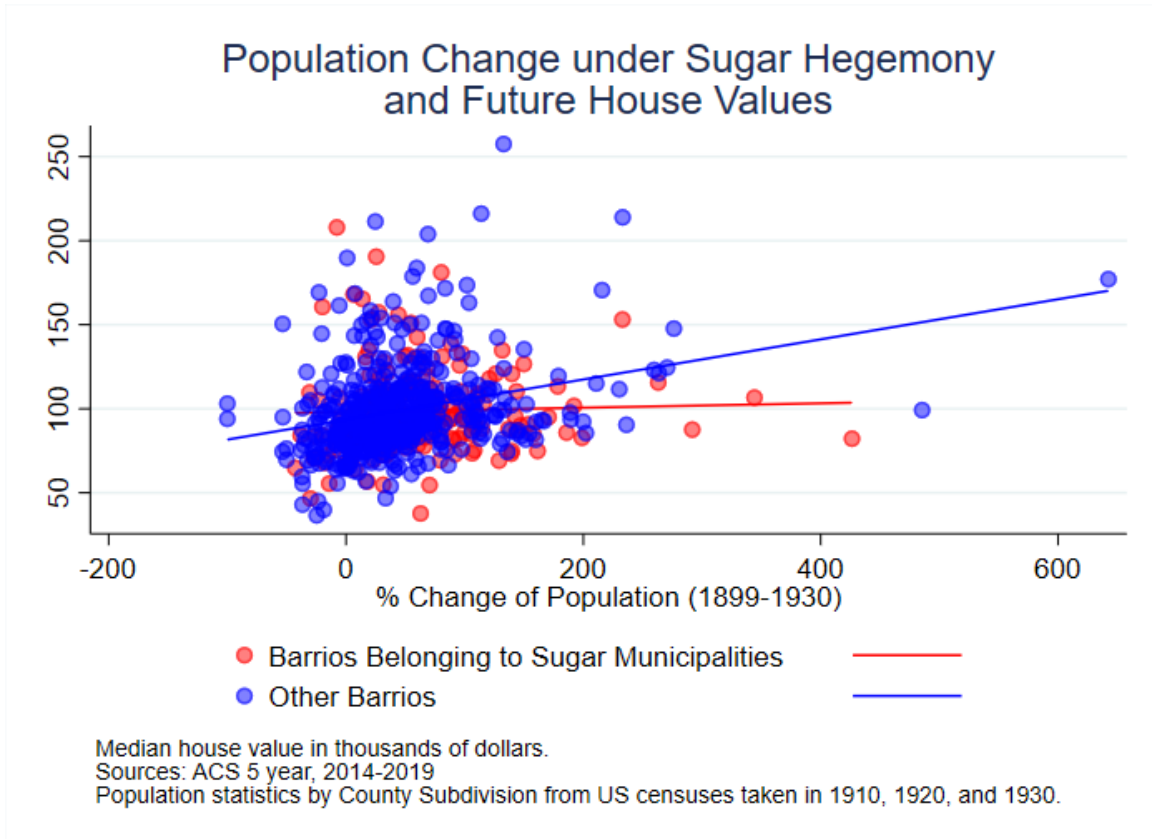
Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

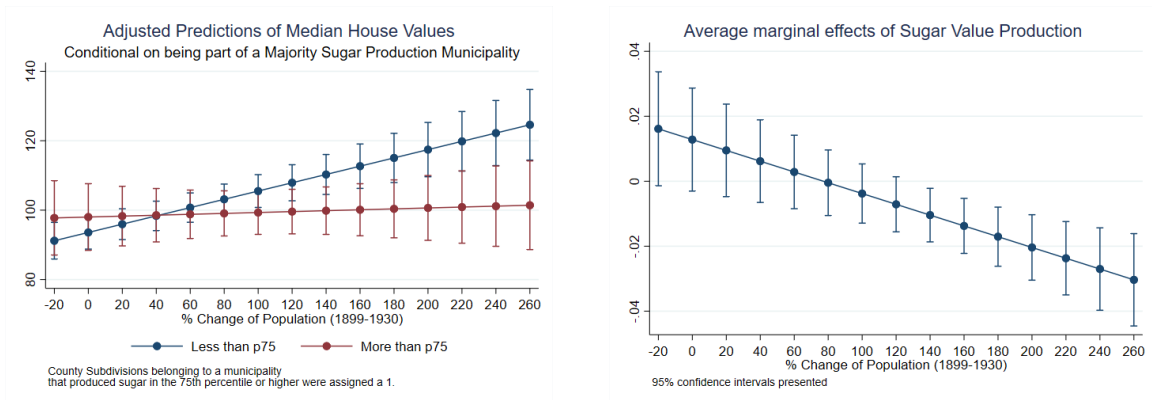
Sugar production values in 1929 are available at the municipality level. Every county subdivision received the value of the municipality it belonged to in 1910. High Sugar Production is a categorical variable constructed by assigning a one to the County Subdivisions in the 75th percentile of sugar production value in 1929. Sugar value production in 1929 and contemporary home values measured in 1000s.

While there is no relationship between the proportion of good soil and future house values, there does exist a significant relationship between population percent changes from 1899 to 1930 and future median house values conditional upon sugar production in 1929, as evidenced by Figure 6. In particular, the direction of the difference provides preliminary evidence that supports the idea that historical sugar production has depressed contemporary house values. Recall that \$386,333 is the median of the municipality distribution of sugar production in 1929 dollars.

Figure 6 shows a clear positive relationship between house values and County Subdivision population percent change from 1899 to 1930. We can reasonably



**Figure 6**  
*Sugar Industry and Lower House Values*



(a) *Specification 1*

(b) *Specification 2*

**Figure 7**  
*Interaction Specification Marginal Effects from Sugar Value Production*

expect that, all else equal, a previous epoch of prosperity associated with any industry would boost levels of wealth in the future. For County Subdivisions that

belonged to municipalities that produced below the median of the distribution of municipality level sugar production value, we see this positive relationship is present and striking. Estimating an association of an additional \$120 in median house values per percentage change in population from 1899 to 1930. Noticeably, this positive association disappears for sugar producing municipalities. The quantity of data points available for this comparison is enough for us to perceive significant resistance to outliers.

The marginal effects Figure 7 for both interaction term specifications help illustrate the qualitative effects captured by the interaction term. Notice that the effect associated with sugar value production in 1929 varies as a function of the population percent change that took place under sugar hegemony. This would imply that the marginal effect associated with Sugar Value Production in 1929 for a County Subdivision that experienced a 150% population percent change would be a decrease in future home value of \$17 per every thousand dollars dedicated to producing sugar in that municipality 1929. A County Subdivision belonging to a municipality that produced \$300,000 dollars in sugar would have a negative impact of \$5,100 in the median contemporary home value. Meanwhile, the associated effect of an additional percent population change for a County Subdivision that produced \$20,000 in sugar value would be \$100. For a County Subdivision, experiencing a 150% percent change in population during the critical juncture this implies an increase in future median home value of \$15,000. This comparison allows us to estimate a stark opportunity cost in producing sugar in 1929. Quite simply, production of sugar in 1929 implies that relative to other productive regions of Puerto Rico, as measured by positive population changes, assets would not appreciate and others would.

The idea that sugar associated development has a negative effect on contemporary wealth relative to other types of development that have taken place in

Puerto Rico is further evidenced by the instrumental variable approach.

The results of the instrumental variable investigation as reported in Table 4 provide further evidence that there exists a negative effect on wealth associated with sugar production in multiple regions of the distribution of contemporary house values. There is a moderate negative impact on median house values, one which becomes very materially significant for houses belonging to County Subdivisions that experienced particularly large population percentage changes from 1899 to 1930. County Subdivisions that experienced a 50% population increase saw contemporary median house values decrease by about \$19,200, controlling for modern population levels in the region. For County Subdivisions with edge cases of population changes of %50 or more in either direction, all the way up to the most extreme data point of a 400% increase, we may interpret that there could be life altering results for homeowners belonging to these County Subdivisions.

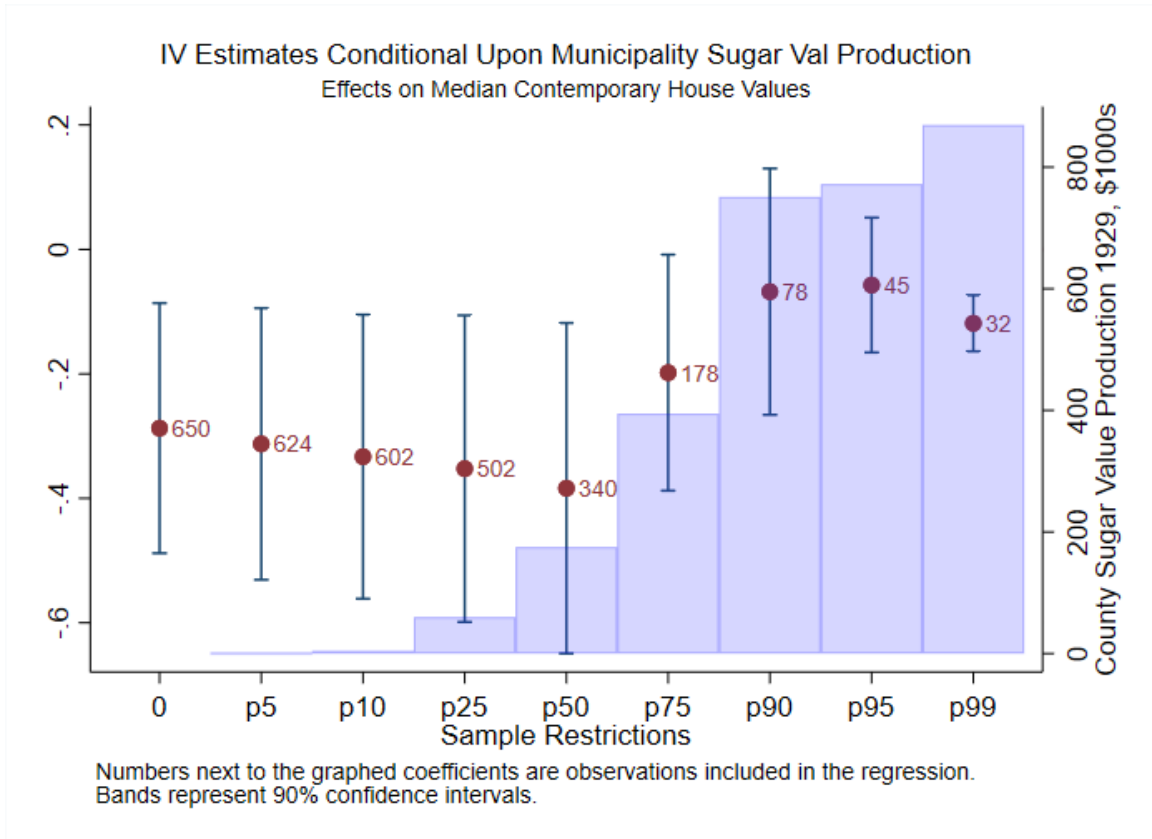
**Table 4**  
*IV Results: House Values*

VARIABLES	(1) Median val	(2) Upper qtil val	(3) Lower qtil val	(4) Built by 1939
% Pop $\Delta$	-0.384** (0.161)	-0.599** (0.271)	-0.182** (0.088)	0.256* (0.133)
Pop. 2014-2019	0.003*** (0.001)	0.005*** (0.001)	0.002*** (0.000)	0.002*** (0.001)
Pop 1899	-0.006*** (0.002)	-0.008*** (0.003)	-0.005*** (0.001)	0.038*** (0.008)
Constant	114.697*** (10.145)	162.322*** (15.731)	79.144*** (6.108)	-46.397*** (12.051)
Observations	340	337	339	182
R-squared				0.559

Robust standard errors in parentheses

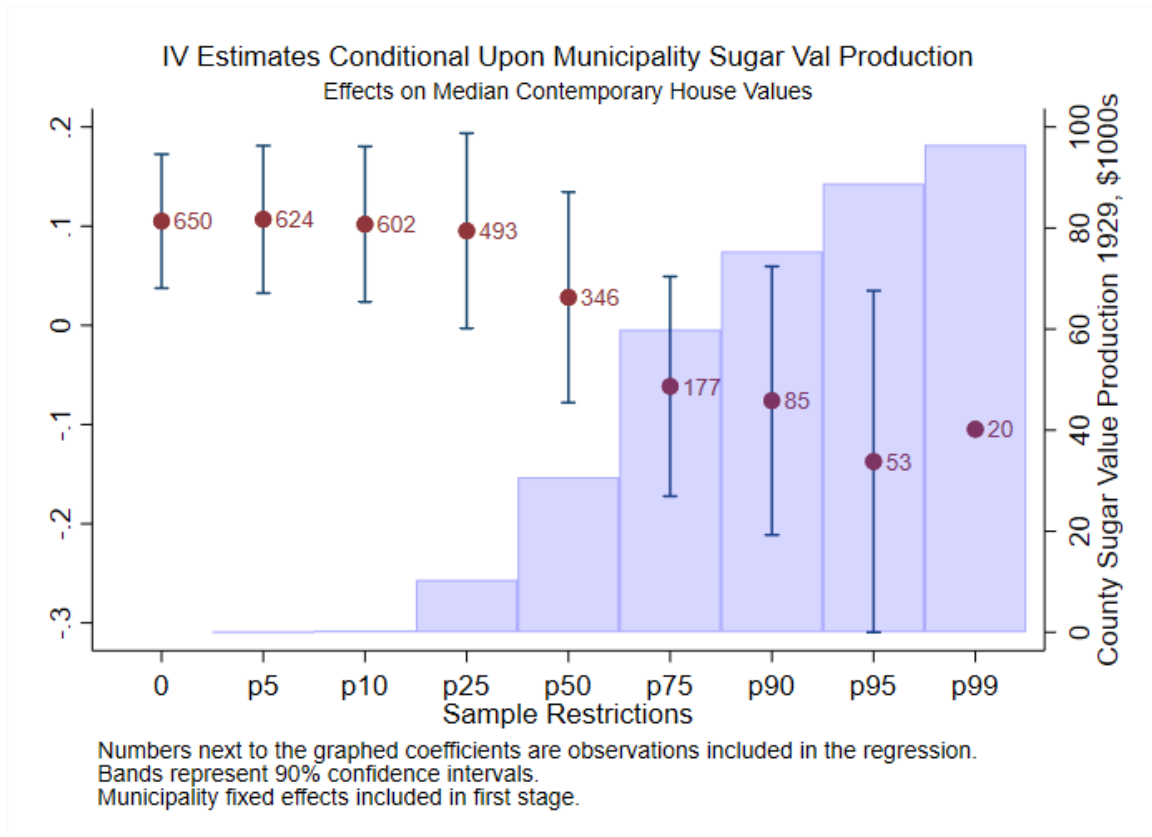
\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Specifications 1 through 3 are restricted from the 50th percentile onwards in sugar value produced. Specification 4 is sample restricted from the 75th percentile and above in sugar value produced.



**Figure 8**  
*Sugar Industry and Lower House Values*

Figure 8 shows what the estimates look like conditional upon sample restrictions based on sugar value production in 1929. Notice that as I restrict the sample to just include sugar producing regions, the magnitude of the estimate decreases, making the results insignificant. In contrast, Figure 9 shows the same coefficient estimate with similar restrictions but including municipality level fixed effects in the first stage. This estimate should inform us about the possibility of a negative or positive effect given population changes and holding constant the municipality we are estimating. Soil induced population changes that occurred at an intra municipality level have a *positive* effect on future house values, *until* we restrict the sample to just include sugar producing municipalities (although these estimates are not significant). This exercise informs the variation that is driving our results. The negative results estimated in the baseline instrumental variable



**Figure 9**

*Sugar Industry and Lower House Values, including FE's*

specification largely capture inter regional effects, possibly realized through differences in institutions or public goods. The remaining negative association with municipality fixed effects in the first stage further sustains the notion that sugar production was not beneficial for property values in the long run. That said, municipalities that were not majority sugar producers and managed to expand outwards in association with soil suitable for sugar production did benefit from the gains realized in higher future housing values.

Notice that these results hold for a threshold of statistical significance of 5%. Given that the results are clustered by municipality and such caution has been employed to demonstrate consistency in direction of the estimates, I believe this threshold is sufficient to provide appropriate evidence for the interpretations I have proposed. The direction and general magnitude of the estimates are robust to

varying specifications, teetering between significance at 5% and 20%. The insistence of estimate direction despite varying functional approaches and given the descriptive evidence leads me to believe there is a significant negative relationship between sugar industry production and future property values. Recall, in addition, that the sample included covers the vast majority of Puerto Rico. Specification four in Table 4, provides further evidence at the 10% significance level of a persistent relationship between the construction date of housing structures and the sugar suitability soil related population percent change from 1899 to 1930. This specification is restricted at the 75th percentile of sugar value production in 1929, further emphasizing the notion that there is a relationship between structures pertaining to the period of sugar hegemony (and before) and soil induced population change as long as we take into account varying levels of sugar production at the municipality level.

### **Limits and Contributions**

This study is limited in several significant ways that are worth discussing now. First and foremost, the statistical power of the empirical analysis is strongly limited by the relative weakness of the instrument. The t-statistic for the first stage referring to the coefficient relating the percentage of sugar-appropriate soil and the population percentage change from 1899 to 1930 is halved by clustering standard errors around municipalities. While the relationship remains significant at the 1% confidence level, the literature associates ideal identification with higher t-statistics. Secondly, due to small sample concerns related to the first point, I would hesitate to associate this effect with any and all expansions of the sugar industry throughout different periods in time. I believe that, fundamentally, the industry in question is incidental and that similar effects would take place with any combination of poor private property protections and industries with market power and profit motive to exploit them. Therefore, these results can only be appropriately interpreted in

conjunction with the history of Puerto Rico, other studies on extractive institutions, and their interactions with different industries.

Recognizing those limitations, these results when appropriately interpreted help us understand Puerto Rico's modern economic woes as they are related to previous institutions and industries. Given the supporting evidence, the selection of a sample for internal validity, and the robustness of the direction of results (despite varying levels of significance) this study does significantly support the hypothesis that the expansion of the sugar industry in the early XXth century lowered property values in the most affected geographic regions of modern day Puerto Rico. For more information on how the sample restriction based on sugar value production in 1929 affects the instrumental variable estimates please refer to appendix figures 10 and 11 for the results measuring effects on the upper and lower quartiles of the housing value distribution. In addition, the relative strength of the first stage is also evaluated (Figure A4) at different sample restrictions to contextualize the estimates on the future housing distribution at the County Subdivision level. More research should be done to tie the geographic link between the sugar industry and property rights with the household level welfare effects we would expect. I further discuss this future avenue for research and its relationship with this thesis in the conclusion.



## Conclusion

The results provide evidence in favor of the notion that the hegemony of sugar industry from 1899 to 1930 took place at the expense of future property values. The County Subdivision affected in the highest order had a population percentage change of more than 400%, which according to the instrumental variable estimation, would cause a decrease in median house value of more than \$150,000, all else equal. This statistical relationship poses a significant challenge for current policy makers.

### **Policy Response to a Persistent Problem and a Research Path Forward**

This thesis emphasizes the need to acknowledge persistent geographical disparities that are discussed throughout Puerto Rico and tie their formation to colonial institutions. Under the guise of attracting foreign investment, recent government policies could be exacerbating the welfare consequences of lower property house values in different areas across Puerto Rico. Of note, Acts 20 and 22, now organized under Law 60, ratified in 2019, covers an umbrella of new and old tax incentives geared towards foreigners (including people from the U.S. mainland not born or part of the Puerto Rican community). Social media messages of people from the United States raving about investment opportunities in Puerto Rico due to lower home prices, investors buying land dedicated for conservation and farming as reported by Graulau (2021) and the Center for Investigative Journalism (Valentín Ortiz et al. (2021)), and increasing home prices throughout Puerto Rico (Vázquez Colón (2021)) all seem to be intricately related to the colonial history of Puerto Rico. Many have been quick to hypothesize that Law 60, and previously Acts 20 and 22, has been successful in bringing foreigners to Puerto Rico and outpricing middle class Puerto Ricans from their homes in the past years (Murphy Marcos and Mazzei (2022)). Yet, employment numbers on the island and growth have all but

recovered. This presents a troubling panorama for the Puerto Rican government.

Regions historically affected by colonial institutions could be especially vulnerable to the gentrification brought forth by Law 60. Notice that the estimated effect on the house value distribution has a much higher magnitude on the lower quartile than it did on the median. Families that rent within that region could be once again displaced by developments catering to the tourism industry or second homes for U.S. mainlanders. It is worth noting that due to the geographic discrepancy between home values means that home prices do not appreciate uniformly across all urbanization complexes in Puerto Rico. Largely unlike the U.S. mainland, fenced urbanization complexes are common in Puerto Rico. Anecdotally, this means that municipalities like Dorado have two residential markets: one of them for the Puerto Rican elite and U.S. mainlanders, fenced off and protected by private security forces, and other neighborhoods occupied by middle and lower class households, which includes a mix of renters, indebted homeowners, and homeowners. It is imperative that the Puerto Rican government and research agencies investigate the effects brought forth by these laws and their interaction with a colonial history. The economic geography of Puerto Rico must become a central part of the way policy makers perceive development.

Given the persistent relationship between colonial industries and wealth in Puerto Rico in the environment of a particularly weak job market, the Puerto Rican government and the United States Federal government should look for alternative ways of boosting economic development. The current incentive-based approach simply is not one that most Puerto Ricans can have access to and, in part, this is due to the colonial history of Puerto Rico's persistent effects on its population. The currently favored approach towards public policy produces serious ethical questions for those who have opted for this path in government.

In addition to eliminating the current incentives due to the risk they pose for

local communities, a favorable public policy approach necessarily would incorporate facilitating the natural progression of research projects that could provide evidence for a better development strategy. Further research should look to further understand inter-group and intra-group wealth based disparities in Puerto Rico and how they interact with economic geography. Reliable household level survey data could shed significant light on the individual impact of institutions and policies on individuals, as opposed to geographic units. This research path follows the pioneering work from Stratification Economists in the United States such as Darity Jr et al. (2015).

Similarly, in the field of development, notable figures such as Banerjee and Duflo (2020), have recommended policy makers focus more on distribution in development as opposed to GDP growth. These trends in modern research find a telling intersection in Puerto Rico as a case study. This thesis provides some evidence relating past institutions to current levels of wealth using geographical variation at the County Subdivision level. To better understand the experience of Puerto Ricans in these places, it would be imperative to conduct surveys that look to ascertain levels of wealth across Puerto Rico at the individual level, and taking into consideration other sources of wealth (and debt) not captured by house values.

Studying the distribution of wealth in Puerto Rico is of pressing concern, especially when we take into consideration how low levels of wealth across a population can pose a high risk to future human capital development and native business growth Fairlie and Krashinsky (2012).

Once an informative picture of wealth disparity in Puerto Rico is constructed, government officials should explore a variety of options to reduce wealth inequality urgently on the island, as a matter of historic reconciliation with a colonial past and a support for economic development. Some of these options include baby bonds proposals (Cassidy, Heydemann, Price, Unah, and Darity Jr

(2019)), estate taxes on the island (De Nardi and Yang (2016)), and additional taxes on unused or misused land redistributed to entrepreneurs with proposals from locals that correspond to the land's use appropriate use.<sup>14</sup>

Popular discourse in Puerto Rico often differentiates between "la isla", which translates to "the island", and the Puerto Rican Metropolitan Area. The popular distinction between urban and city life, characterizes different consumption bundles as well as access and quality of public resources throughout Puerto Rico. There is a large geographic disparity between different areas of Puerto Rico. By defining the institutional environment in Puerto Rico at a critical juncture, I am able to come up with an identification strategy that finds a meaningful negative future effect associated with the expansion of the sugar industry. I confirm the instrumental variable results with robustness checks and an interaction term analysis. The days where economists can solely focus on GDP measures without worrying about the production process and sustainability therein are, I believe, over. As has been suggested by newer development research throughout, production is not the metric of well-being we should be focusing on in the road towards development. Perhaps, distribution of wealth will better point the way towards development.

---

<sup>14</sup> The Junta de Planificación or, loosely translated, Puerto Rico Planning Board creates and updates a map that categorizes land across Puerto Rico and designates a according to zones different areas that have to be used for specific purposes, such as farming or habitat conservation.

## References

- Acemoglu, D., Johnson, S., & Robinson, J. A. (2001). The colonial origins of comparative development: An empirical investigation. *American economic review*, 91(5), 1369–1401.
- Acemoglu, D., Johnson, S., & Robinson, J. A. (2002). Reversal of fortune: Geography and institutions in the making of the modern world income distribution. *The Quarterly journal of economics*, 117(4), 1231–1294.
- Administration, U. E. I. (n.d.-a). *Electric power monthly*. Retrieved from [https://www.eia.gov/electricity/monthly/epm\\_table\\_grapher.php?t=epmt\\_5\\_6\\_a](https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a)
- Administration, U. E. I. (n.d.-b). *Puerto rico territory energy profile*. Retrieved from <https://www.eia.gov/state/print.php?sid=RQ>
- Aponte, M. (2002). Factores condicionantes de la creación de empresas en puerto rico un enfoque institucional.
- Asher, S., & Novosad, P. (2020). Rural roads and local economic development. *American economic review*, 110(3), 797–823.
- Ayala, C. J., & Bergad, L. W. (2020). *Agrarian puerto rico: Reconsidering rural economy and society, 1899–1940*. Cambridge University Press.
- Ayala, C. J., & Bernabe, R. (2016). *Puerto rico en el siglo americano: su historia desde 1898*. Ediciones Callejón.
- Banerjee, A. V., & Duflo, E. (2020). How poverty ends: the many paths to progress-and why they might not continue. *Foreign Aff.*, 99, 22.
- Cardoso, F. H., & Magnani, J. G. C. (1974). Las contradicciones del desarrollo asociado. *Desarrollo económico*, 3–32.
- Carroll, H. K. (1899). *Report on the island of porto rico: Its population, civil government, commerce, industries, productions, roads, tariff, and currency, with recommendations* (No. 2118). US Government Printing Office.

- Cassidy, C., Heydemann, R., Price, A., Unah, N., & Darity Jr, W. (2019). Baby bonds: A universal path to ensure the next generation has the capital to thrive. *Available from Samuel Dubois Cook Center on Social Equity at Duke University and the Insight Center for Community Economic Development website at [https://insightcced.org/wp-content/uploads/2019/12/ICCED-Duke\\_BabyBonds\\_December2019-Linked.pdf](https://insightcced.org/wp-content/uploads/2019/12/ICCED-Duke_BabyBonds_December2019-Linked.pdf).*
- Catalá, F. (1998). La economía de puerto rico, 1898-1998. *Ensayos y monografías*, 93.
- Catalá, F., & Francisco, A. (1996). Economía heterodoxa: Aportes recientes del institucionalismo. *Serie de Ensayos y Monografías*, 77.
- Chanda, A., Cook, C. J., & Putterman, L. (2014). Persistence of fortune: Accounting for population movements, there was no post-columbian reversal. *American Economic Journal: Macroeconomics*, 6(3), 1–28.
- Colón, D. (2019). Instituciones extractivas e improductivas: el caso de puerto rico.
- Darity Jr, W. A., Hamilton, D., & Stewart, J. B. (2015). A tour de force in understanding intergroup inequality: An introduction to stratification economics. *The Review of Black Political Economy*, 42(1-2), 1–6.
- Deepal Lamba-Nieves, S. M., & Torres, R. (2021). *Promesa: A failed colonial experiment?* Retrieved from <https://grupocne.org/2021/06/29/promesa-a-failed-colonial-experiment/>
- Dell, M. (2010). The persistent effects of peru’s mining mita. *Econometrica*, 78(6), 1863–1903.
- Dell, M., Lane, N., & Querubin, P. (2017). The historical state, local collective action, and economic development in vietnam. *Econometrica*.
- Dell, M., & Olken, B. A. (2020). The development effects of the extractive colonial economy: The dutch cultivation system in java. *The Review of Economic Studies*, 87(1), 164–203.

- De Nardi, M., & Yang, F. (2016). Wealth inequality, family background, and estate taxation. *Journal of Monetary Economics*, 77, 130–145.
- Dietz, J. L. (1985). *Sugar and slavery in puerto rico: The plantation economy of ponce, 1800-1850*. Duke University Press.
- Engerman, S. L., Sokoloff, K. L., & Haber, S. (1997). How latin america fell behind. *Essays on the Economic Histories of Brazil and Mexico, 1800–1914*, 1–25.
- Fairlie, R. W., & Krashinsky, H. A. (2012). Liquidity constraints, household wealth, and entrepreneurship revisited. *Review of Income and Wealth*, 58(2), 279–306.
- Ferreras Pagán, J. (1902). Biografía de las riquezas de puerto rico. *Tomo II: Riqueza Azucarera, San Juan*.
- Furtado, C. (1969). Desarrollo y estancamiento en américa latina: un enfoque estructuralista. *Investigación económica*, 29(113), 43–73.
- Furtado, C., & Girvan, C. (1973). The brazilian’model’. *Social and Economic Studies*, 122–131.
- Glaeser, E. L., & Shleifer, A. (2002). Legal origins. *The Quarterly Journal of Economics*, 117(4), 1193–1229.
- Graulau, B. (2021). *MS Windows NT puerto rico’s protected land*. Retrieved 2022-01-30, from <https://9millones.com/product/investigating-puerto-ricos-protected-land/>
- Hall, R. E., & Jones, C. I. (1999). Why do some countries produce so much more output per worker than others? *The quarterly journal of economics*, 114(1), 83–116.
- Murphy Marcos, C., & Mazzei, P. (2022). *The rush for a slice of paradise in puerto rico*. Retrieved 2022-01-31, from <https://www.nytimes.com/2022/01/31/us/puerto-rico-gentrification.html>
- Nunn, N. (2008). The long-term effects of africa’s slave trades. *The Quarterly Journal of Economics*, 123(1), 139–176.

- Oliveras, F. A. C. (2007). Desenvolvimiento económico de puerto rico: dependencia de senda y encapsulamiento ceremonial. *Revista de Ciencias Sociales*, 17, 58–77.
- Oliveras, F. A. C., & Francisco, A. (1998). *La economía de puerto rico, 1898-1998*. Unidad de Investigaciones Económicas, Departamento de Economía, Universidad . . . .
- O'Reilly, A. (1765). *Memoria sobre la isla de puerto rico*.
- Perloff, H. S. (1950). *Puerto rico's economic future: A study in planned development*. University of Chicago Press.
- Scarano, F. A. (1984). *Sugar and slavery in puerto rico: The plantation economy of ponce, 1800-1850*. University of Wisconsin Press.
- Stiglitz, J., & Guzman, M. (2017). *Promesa's dangerous premises*. Retrieved from <https://www.project-syndicate.org/commentary/puerto-rico-flawed-fiscal-plan-by-martin-guzman-and-joseph-e--stiglitz-2017-09>
- Street, J. H., & James, D. D. (1982). Institutionalism, structuralism, and dependency in latin america. *Journal of Economic Issues*, 16(3), 673–689.
- Sunkel, O., & Girvan, C. (1973). Transnational capitalism and national disintegration in latin america. *Social and Economic Studies*, 132–176.
- Tavares, y. J. S., M. C. (1972). Mas alla del estancamiento: Una discusion sobre el estilo de desarrollo reciente en brasil. *Teoria, metodologia y politica del desarrollo de la America Latina*.
- Rebecca Banucchi. (2018). *Majority of Claimants in Puerto Rico Still Await for Assistance From FEMA, Many Found 'Ineligible'*. <https://periodismoinvestigativo.com/2018/02/majority-of-claimants-in-puerto-rico-still-await-for-assistance-from-fema-many-found-ineligible/>.
- U.S. Census Bureau. (2010). *Census of Population and Housing*. <https://www.census.gov/quickfacts/fact/table/PR/PST045221>.



- U.S. Census Bureau. (2014–2018). *American Community Survey 5-year Public Use Microdata Samples*. <https://data.census.gov/cedsci>.
- Torruella, J. R. (2007). The insular cases: The establishment of a regime of political apartheid. *U. Pa. J. Int'l L.*, 29, 283.
- Valentín Ortiz et al., L. (2021). *Puerto rico act 22 tax incentive fails*. Retrieved 2022-01-30, from <https://periodismoinvestigativo.com/2021/06/puerto-rico-act-22-fails/>
- Villamil, J. J. (1979). Puerto rico 1948-1976: the limits of dependent growth. *Transnational Capitalism and National Development*, Hassocks, Harvester.
- Vázquez Colón, B. (2021). *Se disparan los precios de las propiedades residenciales*. Retrieved 2022-01-31, from [https://www.elvocero.com/economia/otros/se-disparan-los-precios-de-las-propiedades-residenciales/article\\_d010376c-40fc-11ec-8ff1-2bc24d5d8c8e.html](https://www.elvocero.com/economia/otros/se-disparan-los-precios-de-las-propiedades-residenciales/article_d010376c-40fc-11ec-8ff1-2bc24d5d8c8e.html)

## Appendix

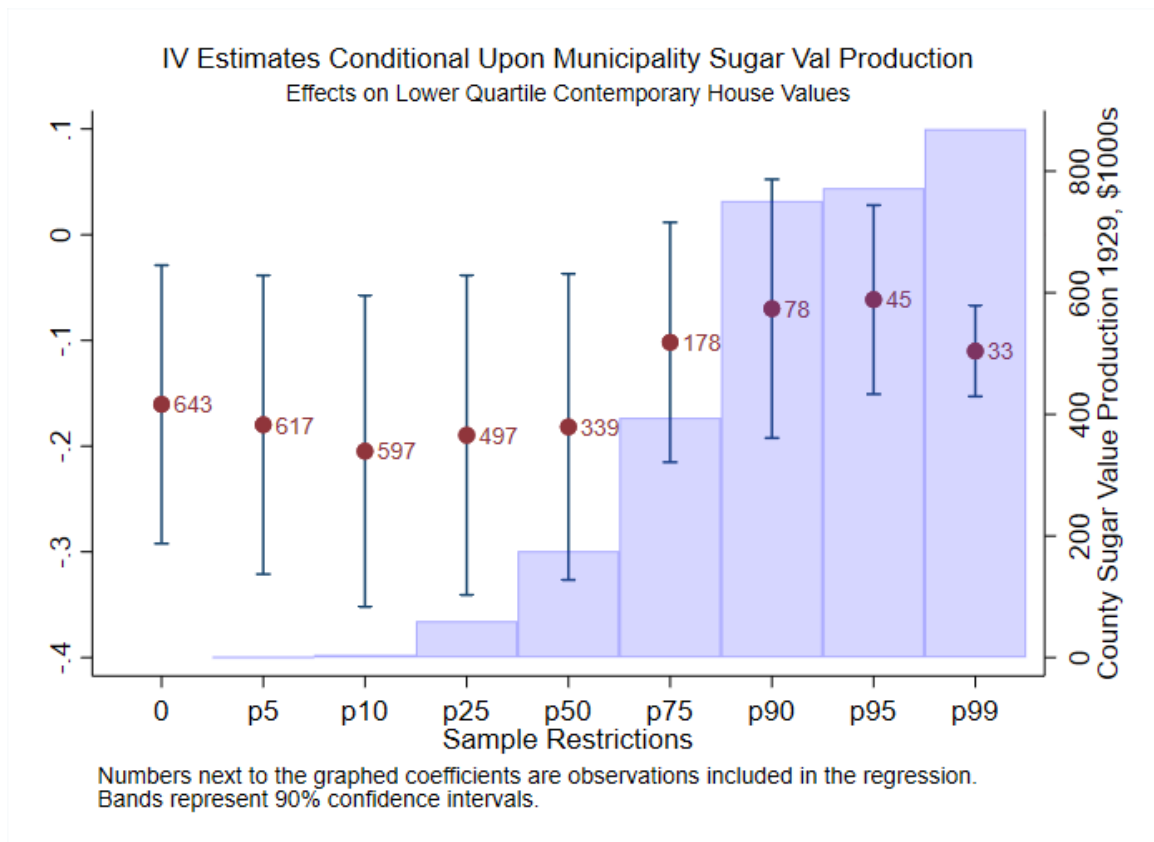
**Table 5**

*Municipalities with most acres dedicated to sugar and sugar value production per acre*

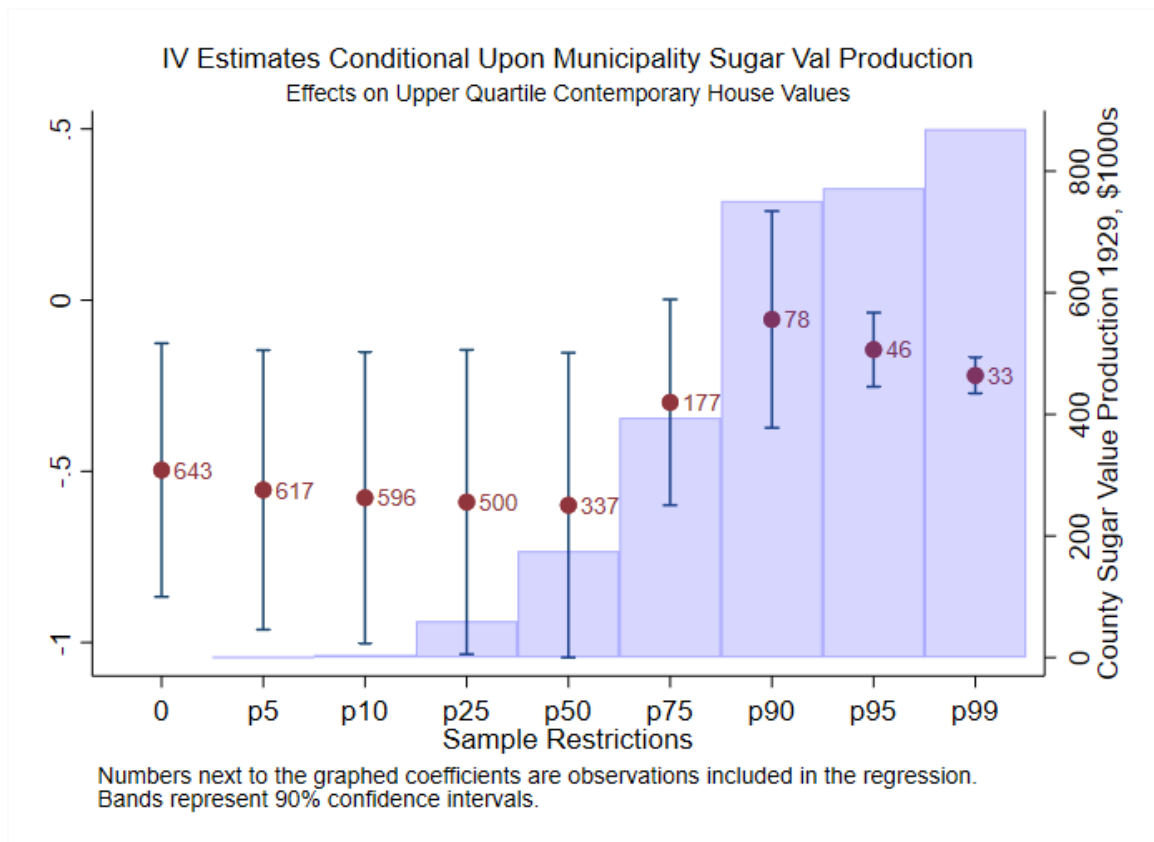
Municipio	Acres dedicated to Sugar	Municipio	Sugar Val per acre
Salinas	14415	Las Marias	3,867.2
Arecibo	12369	Maricao	1,509.6
Humacao	12367	Patillas	833.7
Fajardo	9622	Rio Grande	487.4
Cabo Rojo	8540	Yauco	449.5
Loiza	7602	Barranquitas	441.3
Toa Baja	6536	Gurabo	283.4
Arroyo	6315	Anasco	225.0
Lajas	6311	Juana Diaz	207.1
Juncos	6308	Ponce	135.0
Ponce	6272	Isabela	113.3
Yabucoa	6264	Guayama	105.4
Barceloneta	6141	Penuelas	86.8
Aguadilla	5628	Manati	78.8
Caguas	5539	Dorado	73.9
Aguada	5239	Carolina	71.7
San German	4619	Lares	69.6
Vega Baja	4427	Quebradillas	64.5
Manati	3795	Arecibo	64.0
Mayaguez	3769	Bayamon	62.9

(a) *Acres dedicated to Sugar, 1929*

(b) *Sugar Value produced per acre, 1929*



**Figure 10**  
*Sugar Industry and Lower House Values, Extended*

**Figure 11**

*Sugar Industry and Upper House Values, Extended*